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This special issue collects a selection of peer-review papers presented at the 8th International Conference INPUT 2014 titled "Smart City: planning for energy, transportation and sustainability of urban systems", held on 4-6 June in Naples, Italy. The issue includes recent developments on the theme of relationship between innovation and city management and planning.

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TeMA

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TeMA

Journal of
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This special issue of TeMA collects the papers presented at the 8th International Conference INPUT 2014 which will take place in Naples from 4th to 6th June. The Conference focuses on one of the central topics within the urban studies debate and combines, in a new perspective, researches concerning the relationship between innovation and management of city changing.

TeMA Journal of Land Use, Mobility and Environment

EIGHTH INTERNATIONAL CONFERENCE INPUT 2014

SMART CITY. PLANNING FOR ENERGY, TRANSPORTATION AND SUSTAINABILITY OF THE URBAN SYSTEM

This special issue of TeMA collects the papers presented at the Eighth International Conference INPUT, 2014, titled "Smart City. Planning for energy, transportation and sustainability of the urban system" that takes place in Naples from 4 to 6 of June 2014.

INPUT (Innovation in Urban Planning and Territorial) consists of an informal group/network of academic researchers Italians and foreigners working in several areas related to urban and territorial planning. Starting from the first conference, held in Venice in 1999, INPUT has represented an opportunity to reflect on the use of Information and Communication Technologies (ICTs) as key planning support tools. The theme of the eighth conference focuses on one of the most topical debate of urban studies that combines , in a new perspective, researches concerning the relationship between innovation (technological, methodological, of process etc..) and the management of the changes of the city. The Smart City is also currently the most investigated subject by TeMA that with this number is intended to provide a broad overview of the research activities currently in place in Italy and a number of European countries. Naples, with its tradition of studies in this particular research field, represents the best place to review progress on what is being done and try to identify some structural elements of a planning approach.

Furthermore the conference has represented the ideal space of mind comparison and ideas exchanging about a number of topics like: planning support systems, models to geo-design, qualitative cognitive models and formal ontologies, smart mobility and urban transport, Visualization and spatial perception in urban planning innovative processes for urban regeneration, smart city and smart citizen, the Smart Energy Master project, urban entropy and evaluation in urban planning, etc..

The conference INPUT Naples 2014 were sent 84 papers, through a computerized procedure using the website www.input2014.it . The papers were subjected to a series of monitoring and control operations. The first fundamental phase saw the submission of the papers to reviewers. To enable a blind procedure the papers have been checked in advance, in order to eliminate any reference to the authors. The review was carried out on a form set up by the local scientific committee. The review forms received were sent to the authors who have adapted the papers, in a more or less extensive way, on the base of the received comments. At this point (third stage), the new version of the paper was subjected to control for to standardize the content to the layout required for the publication within TeMA. In parallel, the Local Scientific Committee, along with the Editorial Board of the magazine, has provided to the technical operation on the site TeMA (insertion of data for the indexing and insertion of pdf version of the papers). In the light of the time's shortness and of the high number of contributions the Local Scientific Committee decided to publish the papers by applying some simplifies compared with the normal procedures used by TeMA. Specifically:

- Each paper was equipped with cover, TeMA Editorial Advisory Board, INPUT Scientific Committee, introductory page of INPUT 2014 and summary;
- Summary and sorting of the papers are in alphabetical order, based on the surname of the first author;
- Each paper is indexed with own DOI codex which can be found in the electronic version on TeMA website (www.tema.unina.it). The codex is not present on the pdf version of the papers.

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Contents

TeMA Journal of Land Use, Mobility and Environment

TeMA Journal of Land Use, Mobility and Environment

TeMA Journal of Land Use, Mobility and Environment

TeMA
Journal of
Land Use, Mobility and Environment

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DEFINING SMART CITY

A CONCEPTUAL FRAMEWORK BASED ON KEYWORD ANALYSIS

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ABSTRACT

"Smart city" is a concept that has been the subject of increasing attention in urban planning and governance during recent years. The first step to create Smart Cities is to understand its concept. However, a brief review of literature shows that the concept of Smart City is the subject of controversy. Thus, the main purpose of this paper is to provide a conceptual framework to define Smart City. To this aim, an extensive literature review was done. Then, a keyword analysis on literature was held against main research questions (why, what, who, when, where, how) and based on three main domains involved in the policy decision making process and Smart City plan development: Academic, Industrial and Governmental. This resulted in a conceptual framework for Smart City. The result clarifies the definition of Smart City, while providing a framework to define Smart City's each sub-system. Moreover, urban authorities can apply this framework in Smart City initiatives in order to recognize their main goals, main components, and key stakeholders.

KEYWORDS

Smart City, Definition, Academy, Industry, Government, stakeholder

1 INTRODUCTION

"Smart City" is a concept that has been the subject of increasing attention in urban planning and governance during recent years (e.g. EIP-SCC, 2013; Washburn & Sindhu, 2009). It is a response to recent urban challenges, such as rapid expansion of urban population, the 70% share of cities in global energy consumption and greenhouse gas emissions, economic competitiveness, and rising citizen's expectations (Washburn & Sindhu, 2009). Meanwhile, it exploits new opportunities such as growing information and communication technology (ICT) advancements (Lee et al., 2013). However, some experts cast doubt on some Smart City initiatives by introducing them as a celebratory label (Holland, 2008).

The first step towards creation of Smart City is to understand its concept. A brief review of literature on Smart City definition shows there are still many open questions that refer to following issues:

- The necessity of creation of Smart Cities (Why?)
- The main aspects of Smart City (What?)
- The key actors in Smart City (Who?)
- The ways to create Smart City (How?)
- The right place and time to create Smart City (Where? and When?)

To answer these questions, the first step is to clarify the definition of Smart Cities. Thus, this Paper aims to provide a conceptual framework for Smart Cities. The objectives are to understand why it is necessary to create Smart Cities. What are the main components of Smart Cities? Who are the key actors to create Smart City? Where to create Smart Cities? When to create Smart Cities? Last but not least, How to create Smart City?

2 METHODOLOGY AND PROCEDURE

In order to answer the questions related to the definition of the "Smart City" concept a conceptual framework is proposed. An extensive literature review is used as the base for the conceptual framework structure. According to Onwuegbuzie et al. (2012) the literature review and the keyword analysis have been chosen as tools for analyzing and interpreting literature sources taking into consideration both scientific and grey literature available. The sources have been divided in 3 main domains according to the structure of the main stakeholders involved in the policy decision making process and plan development related to the Smart City development: Academic, Industrial and Governmental.

A keyword analysis (Onwuegbuzie et al. 2012) was used to extract relevant information from the analyzed literature. The output of the keyword analysis was checked and revised based on interviews with experts in different aspects of Smart Cities such as policy makers, industry people and academic professors. This resulted in a conceptual framework for Smart City that identified different sub-systems of the concept.

The procedure scheme is presented in figure 1.

According to the followed method and selected procedure, the paper is structured in four sections. First, a review of the existing literature is given. Then the keyword analysis is held and a conceptual framework for Smart Cities is provided. Finally, the results are described and discussed.

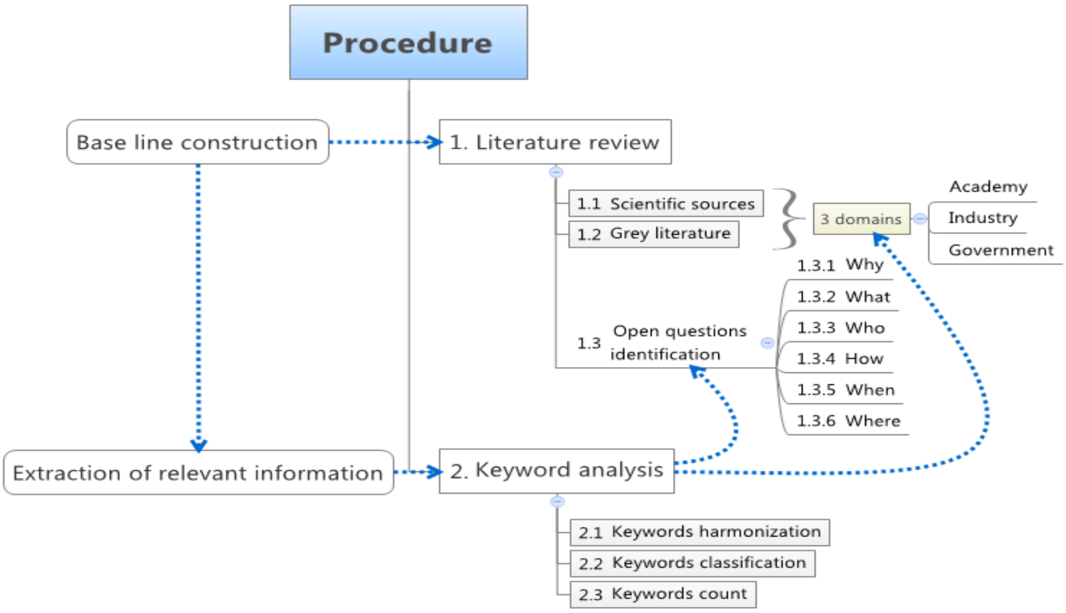

Fig. 1 Research procedure

3 STATE OF THE ART: AN OVERVIEW ON THE SMART CITY DEFINITION IN LITERATURE

There are various definitions of Smart Cities in literature and the phrase "Smart Cities" has been used in many different situations and by different stakeholders (e.g. EIP-SCC, 2013; Washburn & Sindhu, 2009). The research presented in this paper analyzed existing literature on the topic in order to provide a framework to define the Smart City concept.

Reviewing the literature shows that the concept of Smart City has been developed in three main areas: (i) Academic, (ii) Industrial, and (iii) Governmental. Reviewing these literature shows two important points: first, the meaning of Smart City is not settled yet; however, there is an agreement on the significant role of ICTs in Smart urban development. A simple keyword analysis of existing literature shows the disparity of words used in different definitions which is a sign of controversy in the concept.

Second, a difference of viewpoints exists between the three domains (Academic, Industrial, and Governmental). It derives from the different interests of each domain, as well as diverse interpretation of the word "Smart". In academic literature, with an interest in knowledge and information development, the meaning of "Smart" covers a range of technological characteristics, such as self-configuring, self-healing, self-protection, and self-optimizing (Nam & Pardo, 2011). In industrial literature with a tendency in business and industrial instruments, "smart" refers to intelligent-acting products and services, artificial intelligence, and thinking machines (Nam & Pardo, 2011). Finally, governmental documents, which aim to manage urban development, interpret "smart" with regard to an urban planning theory, "Smart Growth", which was emerged in the US in early 90s to avoid urban sprawl (Herrschel, 2013). "Smart Growth" supports compact, mixed-use and walkable cities and aims to make development decisions predictable, fair and cost effective. It encourages community and stakeholder collaboration in development decisions (EPA, 2014).

"Smart City" definition in the three domain have the same logic. In academic literature, including publications by scientific journals and Universities, Smart City concept has been applied to cover a wide range of characteristics being very detailed in some cases (Winters, 2011), and very general in some others (Canton, 2011). In spite of this variety in definitions, the use of technology and social innovation seems to be the core issue in the concept. An example is the Smart Vision illustrated by Kanter & Litow (2009): *Someday soon, leaders will combine technological capabilities and social innovation to help produce a smarter world.*

Definition	Reference
A city that monitors and integrates conditions of all of its critical infrastructures, including roads, bridges, tunnels, rail/subways, airports, seaports, communications, water, power, even major buildings, can better optimize its resources, plan its preventive maintenance activities, and monitor security aspects while maximizing services to its citizens.	Hall, 2000
A smart community initiative becomes an integrated approach to helping entire communities go on-line to connect local governments, schools, businesses, citizens, and health and social services in order to create specific services to address local objectives and to help advance collective skills and capacities. In the same spirit, the optimum use of NICT is presented rightly as an essential element of smart communities but has a tendency to become the deus ex machina from which collective intelligence and social learning stem.	Coe, et at., 2001
A Smart City or region is one that capitalizes on the opportunities presented by Information and Communication Technology (ICT) in promoting its prosperity and influence.	Odendaal, 2003
The percentage of the adult population that holds bachelor's degrees.	Glaeser and Berry, 2006
A smart environment is an environment that is able to acquire and apply knowledge about its inhabitants and their surroundings in order to adapt to the inhabitants and meet the goals of comfort and efficiency.	Marsa-Maestre et al., 2008
The Smart City provides new instrumentation that enables observation of urban systems at a micro-level.	Harrison and Donnelly, 2011
"Smart Cities" would be metropolitan areas with a large share of the adult population with a college degree.	Winters, 2011
Key conceptual components of Smart City are three core factors: technology (infrastructures of hardware and software), people (creativity, diversity, and education), and institution (governance and policy). Given the connection between the factors, a city is smart when investments in human/social capital and IT infrastructure fuel sustainable growth and enhance a quality of life, through participatory governance.	Nam and Pardo, 2011
The Smart Cities concept is connected to notions of global competiveness, sustainability, empowerment and quality of life, enabled by broadband networks and modern ICTs. Its implementation requires the development of migration paths regarding Internet infrastructures, test bed facilities, networked applications, and stakeholder partnerships	Komninos et al., 2011
The Smart City is one that will use advanced technology and sciences – computing, neuroscience, nano science, and information science – to address the challenges of the future of the city such as energy, health, safety and commerce.	Canton, 2011
Smart Cities apply the capacities that recent intelligent cities have sought to develop as the technical platform across a host of service-related domains. At this stage of development the point of emphasis and intervention begins to shift from innovation to application, from the back-office to front-line services, and in policy terms, the emphasis also shifts from the corporate to the civic, from the market to the community, and from the bureaucratic administration of the economy to a liberal democratic governance.	Allwinkle and Cruickshank, 2011
The Smart City is a new way of leaving and considering the cities. The optimization of available and new resources, as well as of possible investments is required. The achievement of Smart City objective can be reached through the support of various information and communications technologies. These can be integrated in a solution considering the electricity, the water and the gas consumptions, as well as heating and cooling systems, public safety, wastes management and mobility.	Lazaroiu and Roscia, 2012
A Smart City is a synthesis of hard infrastructure (or physical capital) with the availability and quality of knowledge communication and social infrastructure. The latter form of capital is decisive for urban competitiveness…Smart Cities are also instruments for improving competitiveness in such a way that community and quality of life are enhanced.	Batty et al., 2012
The "Smart City" concept essentially advocates the integration of the components of an urban energy system (supply, distribution and demand; thermal, electrical and gas networks; heat and electricity generation; energy providers and end-users; planners, developers, policy makers and investors) to make it more energy efficient, less carbon intensive and more robust. This applies to the planning and implementation of the system (or more precisely of its transition to-wards becoming a "smart" urban energy system) as well as to its operation. In all cases, monitoring plays an essential role.	Pol et al., 2012
The concept of the Smart City of which there are many initiatives, projects and demonstrators, is generally underpinned by one or more ambient systems parts that require a mediation process to deliver the interconnectedness required by an ambient system.	Gui and Roantree, 2012
a city that is managed by a network and which supplies its citizens with services and content via the network using both fixed and mobile Smart City infrastructure, based on high-performance ICT.	Lee et al., 2013

Tab.1 Smart City definitions by academic literature

One of the most influential definitions in academic literature is presented by Vienna University of Technology et al. (2007): "A Smart City is a city well performing in a forward-looking way in six characteristics. It is built on the 'smart' combination of endowments and activities of self-decisive, independent and aware citizens.(tab. 1)

In Industrial literature, including publications of some international corporations such as ORACLE, IBM, and CISCO, some more practical values has been added to the concept. IBM's idea of Smart City considers cities as systems of systems. It defines Smart City as one that uses technology to transform its core systems and optimize the return from largely finite resources. Smarter cities make their systems *instrumented*, *interconnected* and *intelligent* (IBM, 2009). Instrumented means to digitize systems in order to make their function measurable and to create information. Interconnected means that different parts of a core system can communicate information to each other; and Intelligent refers to the ability to use the information to create behavioral patterns and anticipate, in order to establish informed actions (IBM, 2009).

Finally, the third domain, Governmental literature, which are published by urban public Authorities and aim to transform cities to Smart Cities. This literature has more emphasize on the administrative and financial aspects of Smart City, as well as the importance of meeting global energy and environmental targets such as energy efficiency and GHG emissions.

The most effective governmental literature is published by "The Smart Cities Stakeholder Platform" (SCSP), initiated by the European Commission (European Commission, 2014a) in order to identify and spread relevant information on Smart Cities for both practitioners and policy makers (European Commission, 2014b). As stated in "10 year rolling agenda" (2013), published by the Smart Cities Stakeholder Platform's Roadmap Group, *Smart Cities are meant to increase the quality of life of city-dwellers; enhance the efficiency and competitiveness of the local and EU economy; and move towards the sustainability of cities by improving resource efficiency and meeting emission reduction targets*. This document recognizes the integration of ICTs in different urban sectors as the core of this objective, and emphasizes on the importance of highly integrated systems on various scales: from residential to national.

To summarize, Smart City definitions are various due to the diverse interests of different stakeholders. A common definition for Smart City is not yet established; however, a brief review of literature implies that Smart Cities are future urban areas that aim to help human beings overcome their problems. They use ICTs to improve urban function in its different aspects and they require collaboration of urban stakeholders. A better understanding of the concept requires detailed investigation. Thus, in the following sectors of this paper the definition of Smart City is investigated in a more detailed and systematic way.

4 KEYWORDS ANALYSIS

The keyword analysis was done in three parallel ways. First, each definition was categorized in three main domains of (i) Academic, (ii) Industrial, and (iii) Governmental. Then, each definition was analyzed against the six questions of the paper (why, what, who, where, when, and how). Then, the key words were derived and the repetition of each key word was counted divided by each category and group. It is important to acclaim that in some cases, different keywords referred to a similar meaning (e.g. the meaning of the keywords "technology", "IT", "ICT", and "artificial intelligence" is alike). Thus, in order to harmonize the definitions and make the keyword analysis meaningful, the keywords were not automatically derived by software, but they were derived and harmonized by the author. For instance, for the mentioned example, the author chose "ICT" as the main keyword.

WHY CREATING SMART CITIES IS NECESSARY?

Recent rapid growth in urban population, along with economic and technological changes caused by the globalization, has lead into many challenges as well as opportunities for cities services and infrastructure. These are one of the main drivers for Smart Cities development. "Smart Cities" aim to decrease cities' challenges including scarcity of resources such as energy, healthcare, housing, and water, inadequate and deteriorating infrastructure (like drinking water, energy, roads, schools, and transportation), energy shortage and price instability, climate change, and demand for better economic opportunities and social benefits.(Whashburn & Sindhu, 2010)

On the other hand, Smart Cities aim to exploit recent opportunities provided by recent changes in the world. *The world economy is now globally integrated and services-based, with cities as its hubs*. Cities are the locations of Physical capital as well as human capital concentration. This attracts business activities and transform cities to centers of global competitiveness. This is aligned with global political transformation from nation-state model towards more multi-level governance, which gives cities more power and freedom to act. Moreover, recent advancements in Information and Communication Technologies (ICT), aligned with technology cost reduction, such as cheap mobile aps, free social media, cloud computing, and cost effective ways to handle the high volume data, provides cities with better opportunities and tools to understand, communicate, and predict urban functions. (IBM, 2009; Berst, 2013)

Tab. 2 presents the most repeated keywords on Smart Cities' main goals and drivers divided based on literature in three main domains (academic, governmental, industry). It shows that academic literature have a holistic approach and covers a wider range of issues. It is mostly concentrated on improvement in three main aspects: governance, Community/social development, and Environment. In industrial point of view, Smart Cities are emerged mainly due to the interaction between competitiveness and sustainable urban development. In addition Efficiency and sustainable environment and Community/social development are amongst Smart Cities' main objectives. Finally, governmental literature is more concerned with international challenges including quality of life, economic growth, environment, energy, sustainability, health and safety, and mobility.

Academic	Industry	Governmental	Total
Improved Governance	economic growth	quality of life	economic growth
Community/social development	sustainability	economic growth	sustainable environment
sustainable environment	Efficiency	sustainable environment	sustainability
	sustainable environment	Sustainability	quality of life
	Community/social development	Improved Mobility	Improved Governance
		Health and Safety	Community/social development
		Energy	Efficiency
			Improved Mobility
			Health and Safety

Tab.2 Keyword analysis: Why Smart City?

WHAT ARE THE MAIN COMPONENTS OF SMART CITY?

By the components of Smart City, we mean the most important urban domains in creating Smart Cities. These are the main targets for stakeholders to put in their attention and investment. Vienna University of

Technology et al. (2007) indicates Smart Cities' different domains as economy, people, environment, governance, mobility, and building. While IBM (2009) has a more practice-oriented division. It defines Smart Cities' main components (systems) as people, business, transport, communication, water, and energy. Berst (2013) consider different Smart City domains, Universal aspects, Built environment, Energy, Telecommunication, Transportation, Water and wastewater, Health and Human Services, Public Safety, and Payments.

Academic	Industry	Governmental	Total
Economy	Transportation	Transportation	Services
Environment	Energy	Energy	Transportation
Community	Buildings	Buildings	Community
Governance	Services		Governance
Infrastructure			Energy
			Buildings

Tab.3 Keyword analysis: What?

Table 3 presents the most repeated keywords on Smart Cities' main components divided based on literature in three main domains (academic, governmental, industry). As it is seen, academic literature have a more holistic but general view about the main Smart Cities' components, while industrial and governmental literature have a more practical and short-term approach. They mainly concentrate on urban sectors that can be directly affected by urban authorities, such as transportation, energy, and buildings.

The aggregation of keywords for all three domains results in the most repeated components: Services, Transportation, People, Governance, Energy, and buildings. In addition, there are other important keywords in literature with lower repetition: health, safety, mobility, environment, education, economy, infrastructure, and water. However, further analysis is required to identify Smart Cities' main components. For example, transportation is a sub-sector of mobility, and energy could be a sub-system of natural environment. These inter-relationships lead us to choose the following sectors as the main components of Smart Cities: Government, Mobility, Services, Community, Economy, Natural Environment, and Built environment.

In this paper, Governance means administrative and organizational Part of the city. Mobility mainly includes soft and hard networks such as transportation network and internet. Services mainly include health and safety. Community means the people and neighborhoods in terms of innovation and creativity. Economy includes economic domain of the city including market of Smart Cities. Natural environment mainly includes water and energy, and finally, Built environment is mainly buildings.

WHO IS INVOLVED IN CREATION OF SMART CITY?

The main actors in creation of Smart Cities are those who has an active engagement in creation of Smart Cities. Leydesdorff and deakin (2011) introduce University, industry, and government as three main actors of Smart Cities whose functions are subsequently organized knowledge production, economic wealth creation, and reflexive control. Later, Lombardi et al. (2012) revised Triple-helix by introducing Civil Society as the fourth main actor. Aoun (2013) in a publication by "Shneider electric" states that Smart Cities involve business and local stakeholders, with city leadership. It introduces governments, private investors, industry suppliers, NGO's and associations, utilities, and planners and developers as different stakeholders of Smart Cities. These stakeholders should collaborate to achieve Smart Cities.

CONCERTO a research project in European commission, suggests that in order to create Smart Cities, policy makers should bring all actors together, including investors, local authorities, material suppliers, designers, urban planners, developers, energy utilities, contractors, engineers, tenants, and owners (Bahr, 2013).

Tab. 4 presents the keyword analysis of different ideas about main stakeholders involved in creation of Smart Cities. This table shows that academic literature presents a holistic and general point of view: the keyword analysis for academic literature shows four main groups of People, Companies/industries, Government, and University as the key actors of Smart Cities. This is while Industrial literature have a more detailed and practical approach by adding NGOs, investors, Planners and developers, contractors, etc.

Literature	References	people	companies	government	built infrastructure	university	Private investors	NGOs	planners	Industry suppliers	Utilities	contractors
Academic	Cosgrave et al., 2013	*	*									
	Yovanof & Hazapis, 2009	*	*	*								
	Leydesdorff & deakin, 2011		*	*		*						
	Lombardi et al. (2012)	*	*	*		*						
Industrial	Aoun, 2013		*	*	*		*	*	*	*	*	*

Tab.4 Keyword analysis: Who?

Governmental documents, especially those related to real practices, have the most precise and practical point of view. Smart Cities Stakeholder Platform (2013) for example, considers Mayors/politicians, City administration, Utilities, energy service companies, network operators, developers, architects, planners, construction companies, Industries, Component manufacturers, Renewable energy industry, ICT companies, Financial institutions, R&D institutes and Universities, Inhabitants.

To summarize, Literature suggests four main groups of stakeholders involved in creation of Smart Cities: People, Government, Companies/industries and Universities. In addition, some lateral groups of planners, developers, financing organizations and NGOs are also involved in Smart Cities' development. Each of these groups consist of many stakeholders. For example, Government includes Local/regional policy makers and authorities, Municipal authorities, and Other Municipal and administration authorities.

HOW TO CREATE SMART CITY?

Answering how to create Smart Cities might be the most important part of conceptualizing them. While most literature in all three domains agree on the important role of ICT in Smart Cities development (e.g. Lee et al., 2013; Odendaal, 2003), they emphasize that technology is not solely enough (Hollands, 2008); to create Smart Cities, governmental, social, economic, and environmental aspects should get Smart (Hollands, 2008; Komninos et al., 2011; Pol et al., 2012; Vienna University of Technology et al., 2007).

The key word analysis confirms the central role of ICT-based infrastructure and services in Smart Cities' creation. Different domains are briefly unanimous on the main ways to develop Smart Cities. However, Industrial literature has a more instrument-based approach (IBM, 2009) and Governmental literature emphasize on proactivity and necessity of creating metrics in order to measure the function of urban system (Kanter & Litow, 2009). (Tab. 5)

To summarize, the application of ICT in urban services and infrastructure is the core tool to achieve Smart Cities. Meanwhile, ICT is not enough; it should be combined with other strategies: investment in Social capital, Collaboration of different stakeholders, and integration of different components of the city. This requires gathering data and knowledge in all domains and of all stakeholders, and communicating this data through a comprehensive and interconnected urban network in order to have an integrated-collaborative Urban development.

Academic	Industry	Governmental	Total
Technology/ ICT (mainly in infra & services) collaboration Integration (interconnection) gather data/knowledge social capital	Technology/ ICT (mainly in infra & services) collaboration social capital	Technology/ ICT (mainly in infra & services) collaboration social capital proactivity metrics	Technology/ ICT (mainly in infra & services) collaboration Integration (interconnection) gather data/knowledge social capital

Tab.5 Keyword analysis: How?

WHEN TO CREATE SMART CITY?

The results show no serious concerns on timing of Smart Cities. The most common time reference in definitions of Smart Cities is the "future" (e.g. Canton, 2011; Komninos et al., 2011; Hall, 2000), which means there has been no time limit for creation of Smart Cities. This could be due to the continuous nature of Smart Cities (Aoun, 2013).

WHERE TO CREATE SMART CITY?

Which cities can get Smart? Is there some criteria such as size of the city, level of technological development and policy and legal framework that is required to get Smart? According to the literature, since smartness is a continuous improvement of urban situations (Aoun, 2013), each city can be Smarter (Shneider electric, 2014) Obviously, many factors can accelerate or hinder this "continuous improvement". For example, existing policy frameworks for Smart Cities, recent practices in integration of technology in urban infrastructure, and high level of technology advancement in a city can lead to better success in Smart development. However, there is no absolute limitation against implementation of Smart Cities.

4 RESULTS

With respect to the analysis, a conceptual framework for Smart City is provided. (Fig. 2) The first ring (yellow) answers why it is necessary to create Smart Cities. The second ring (blue) answers what are the main components in creation of Smart Cities. The third ring answers who are the main stakeholders involved in creation of Smart City and finally the boxes (purple) answers how to create Smart Cities. According to the analysis, each City can be Smart in the future (the answer to when and where to create Smart City).
Thus, Smart City is a sustainable and efficient City with high Quality of life that aims to address Urban challenges (improve mobility, optimize use of resources, improve Health and safety, improve social development, support economic growth and participatory governance) by application of ICT in its infrastructure and services, collaboration between its key stakeholders (Citizens, Universities, Government,

Industry), integration of its main domains (environment, mobility, governance, community, industry, and services), and investment in Social capital.

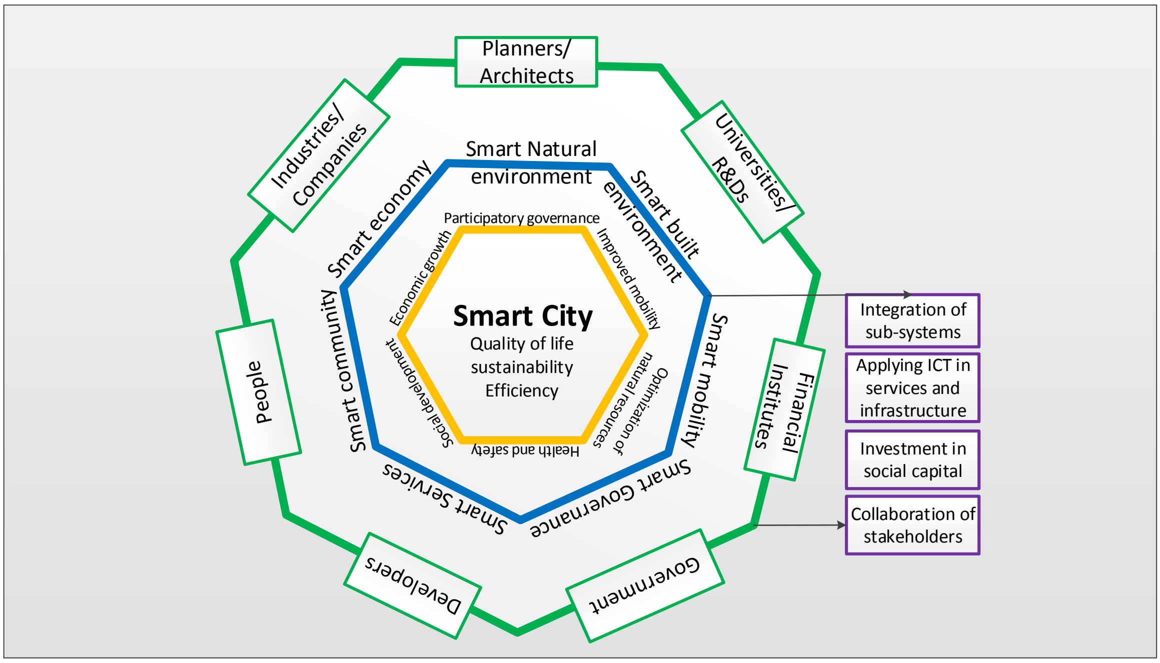

Fig. 2 A conceptual framework to define Smart City

5 CONCLUSIONS AND DISCUSSION

Smart City is a holistic approach that aims to address recent urban challenges and exploit recent opportunities provided by advancements in ICT and Urbanization. The first step to create Smart Cities is to understand the nature of the concept. This paper provided a framework to conceptualize Smart City by holding a keyword analysis to find the most used phrases in existing literature. However, it is not necessary to stick to the proposed keywords. Since each city has its unique economic, social and administrative situation, as well as different priorities, we suggest that authorities keep the main structure as the basis of the conceptualization, and then regenerate their own concept with respect to their priorities and context. However, application of ICTs in urban services and infrastructure, integration of different systems in planning and implementation, collaboration of different stakeholders in all the stages of urban development, and investment in social capital and innovation are basic alphabet of Smart City concept.

Thus, creating Smart Cities, it is necessary to identify the main goals of providing Smart Cities plans (Why), the main sub-systems and their relationships (What), and the key stakeholders involved in the plans (Who). Then, application of ICTs to enhance the functionality of urban services and infrastructure, integrated planning and implementation of sub-systems and collaborative work between stakeholders (How) should be considered to create a "Smart City".

This research is based on literature review as main source of information. Further development could include also other sources like structured interview to experts in order to confirm or discuss the results of this work.

Another development could analyze specific sub-systems of the Smart City concept that emerged from this work (i.e. Smart Energy City).

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IMAGES SOURCES

Fig. 1: Research Procedure

Fig. 2: A conceptual framework to define Smart City.

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PARAMETRIC MODELING OF URBAN LANDSCAPE:

DECODING THE BRASILIA OF LUCIO COSTA FROM MODERNISM TO PRESENT DAYS

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ABSTRACT

The paper presents the case study of the Pilot-Plan of Brasilia, important example of modernist urban design protected as human heritage. Discusses a methodological process to promote visualization of maximum envelops of urban volumes, organized in a set of rules and scripts which structures urban parameters in a logic of volume constructions. Applies City Engine - ESRI facilities to construct and visualize the urban rules. It has the goal to promote characterization, analysis, proposals and simulation of urban parameters in order to support decision making in land use transformation. The research deals with the difficulties of management urban pressure of transformation and the maintenance of urban cultural heritage. The methodology defends the change from authorial urban design to the decoding of collective values and goals. The 3D modeling and dynamic visualization promotes the composition of the whole, which means to work in a relative mode, and not in an absolute sense. Although it had been developed for a particular case study, the protected historical area of Brasilia, it presents methodological processes of how to structure rules of three-dimensional modeling to simulate the maximum constructive authorized by planning legislation (maximum envelopes), so that it can be reapplied in any other situation of definition of parameters in urban master plans and in laws for land use and occupation.

KEYWORDS

Parametric modeling of urban landscape, Visualization, Landscape simulation

1 INTRODUCTION

The parametric modeling nowadays is the new way of managing the urban occupation and to translate the urban logical to architectural scale. The establishment of urban parameters is at the origin of the urban design and in urban zoning proposed in the laws for the soil use and occupation still in modern period, but the parameterization applied today presents different motivations and goals.

The urban design emerges as authorial proposals of planners who aimed to transpose to the territory their ideals of organization of anthropic occupation of urban space. The drawings resulted in new urban projects or for reconstructions for areas already occupied. Many of these authorial projects were not translated to parameters which could represent them, as they were proposed as an absolute way, as conclusive designs.

The new way of drawing and designing the urban space puts the urban planner as a decoder of collective will, and not anymore as author of conclusive forms. As decoder of the collective will, the new urban planner must understand what composes the essence of the landscape expected by citizens and translate this essence to urban parameters. These parameters comprise maximum constructive or envelopes where the individual expression of each architectural work must fit. With this, the landscape of the city is sharpened, so as to allow the individual expressions but, at the same time, ensure the composition of the whole, which means to work in a relative mode, and not in an absolute sense.

The three-dimensional and contextualized view should be used as a principle of analysis, proposition, communication and simulation of urban parameters. It supports decisions making on projects which are the translation of the willingness of an urban region. Aware that consensus doesn't exist, the choice of defining maximum envelopes ensures the management of a collective landscape, within which the singular building performs its individual formal manifestation.

The needs of visualization, to portray the contextualized urban proposals, and not absolute and conclusive proposals, are being favored by applications of geo-technologies available nowadays. These applications transform values in volumes representing, in three-dimensional view, to favor the understanding of its significance.

In this respect, emerged the "City Zoom" in Brazil who works with the principle of visualization of the results proposed by Master Plans and to simulate the results of urban parameters to encourages the perception of the landscape (Turkienicz, et al., 2008); in Italy was developed "Invito" to promote the dialog between technicians and representatives of community to support decision making (Pensa, et al., 2013); and there is the "City Engine", proposed initially to represent cities for virtual games, adapted to ESRI systems to the employment of a basic set of geometric rules so as to encourage the construction of scripts for modeling of urban forms.

The parameterization has been the new path in architectural design, to meet a set of limits justified by the juxtaposition of isolated units that constitute the whole. The regulation plans of cities are presenting modeling parameters that requires a 3D representation for their calculations, as the example of solar envelops and axes of visualization analysis.

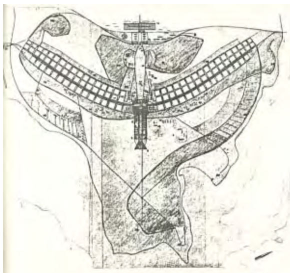
Brasilia is an emblematic case for studies of urban planning, as it is the most important example of modernist urban design. However, completed 50 years of its foundation, it has been observed that the risk of transformation of landscape and urban heritage and the loss of essence of territory due to new demands and the value of the land soil. The present study aims to use parametric modeling tools of urban occupation to promote visualization of the ideal ideas which generated the Pilot Project, and as a tool for the management of new landscape in face of current demands of transformations and new constructions.

2 BRASÍLIA – THE MODERNIST CITY, PRODUCT OF THE URBAN DESIGN

Created in 1957 and inaugurated in 1960, Brasilia is Lucio Costa's urban project and Oscar Niemeyer's architectural concept that translates all values of modernist urbanism recommended by Le Corbusier. The urban and architectural importance of the city made the core pilot be protected by IPHAN (National Institute of Historical and Artistic Heritage), receiving the title of Heritage of Humanity by UNESCO. Today, the city is inserted in a metropolitan region that has more than 3 million inhabitants and is under pressure of transformations that threaten this unique example of modernist city.

The city was built "in the heat of the "national-developmentalism", a period in which Brazil had high rates of economic growth and urban expansion. Having been designed and built by Brazilians, there has been an unprecedented effort for its realization, because "it was a project linked to the assertion of Brazil as modern nation." (Government of the Federal District, 2009).

According to Francisconi (2011), management of the historical heritage's landscape today is of great complexity, being characterized by an unsustainable urbanization, because the Pilot Plan of Brasilia does not have the legal background-normative required to promote a sustained urbanization, and there is a lack of clarity in the application of values recommended by Lucio Costa of four scales: monumental, urban residential, gregarious and bucolic. The difficulty exists, also, because two pilot plans were created by Lúcio Costa for Brasilia: the first was the original pilot plan selected by international jury as winner of the tender for the New Capital; the second was the pilot plan that guided the construction of the Pilot-Plan. (Figure 1).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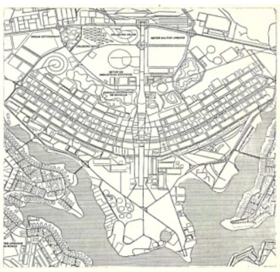
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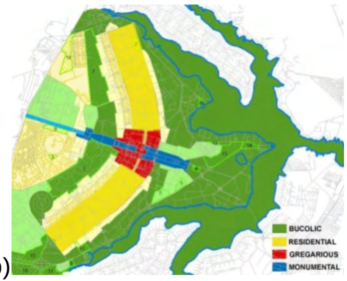

(c)

Figure 1 - Original Pilot Plan, submitted in the competition (a), and Pilot-Plan built (b). (Source: Lúcio Costa, Brasília 57-85, 1985). Scales bucolic (green), gregary (red), residential (yellow) and monumental (blue), (Adapted from SEDHAB, 2013)

The sketches of Lucio Costa present the definition of intent of landscape in residential scale modeled by maximum constructive in the region of residential blocks. But Lucio Costa did not specified in parameters these maximum constructive, committing only in carrying out the design of the patterns of the first buildings, in the expectation that the example of drawing was sufficient to establish the standard of what would be the remainder of the assembly.

Lucio Costa (1957) describes his expectations for the residential sector:

> *"As regards the residential problem, I thought the solution to create a continuous sequence of large blocks arranged in order double or simple, both sides of the strip road, and framed by a wide band densely forested, large trees, prevailing in each block certain plant species, with ground lawn and a curtain of shrubs and foliage, in order to safeguard better, whatever may be the position of the observer, the contents of the blocks, as always seen in the background and muffled in the landscape.*
>
> *Provision which has the double advantage of guaranteeing the ordination planning even when varies the density, category, standard, or quality architectural design of buildings, and offer the residents extensive shaded bands to tour and leisure activities, regardless of free areas provided within the blocks.*

Within these "super-blocks" the residential blocks may have the most varied manner, but obeying the two general principles: uniform maximum template, maybe six decks and piers, and separation of the traffic of vehicles from pedestrian traffic for the special access to primary school and the facilities existing in the interior of each block." (Figure 2).

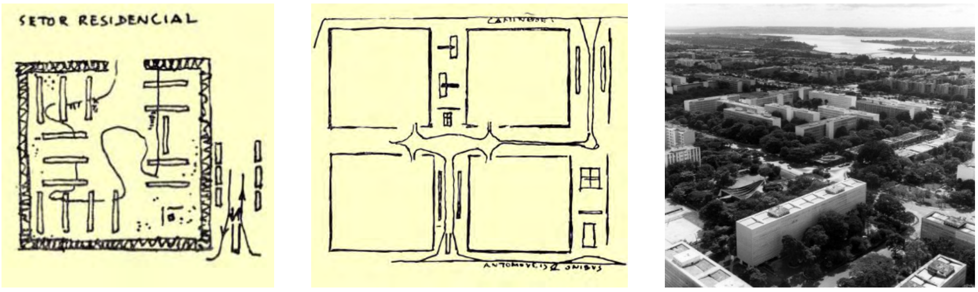

Figure 2 – (a) Lúcio Costa's sketches – the inside of the super-blocks. (b) Lúcio Costa's sketches – the articulation of super-blocks. (c) South Wing – Super-Block, Brasília, 1990. Picture from Duda Bentes (Depart. Patrimônio Histórico e Artístico do DF, Source: Paviani, Aldo, Vitruvius, 2013.)

About the essence defined for residential sectors of blocks, Lucio Costa (1987), writing about Brasilia revisited years later, thus explains:

"The residential scale, with the innovative proposal of superblock, the urban serenity assured by template uniform six floors, the free and accessible floor to all through the widespread use of piers and the predominance of green, brought with it the embryo of a new way of living, own of Brasilia and entirely different from other Brazilian cities."

The result of the planned image by Lucio Costa in residential super-blocks can be seen in the following image (Figure 2-c), in which it sees example of superblock designed by him. Many other super-blocks were not designed and occupied during the period of implementation of the plan, but there was an expectation not translated into parameterization, of which the essence if he repeated throughout the set, even with different architectural solutions. As maximum constructive were not defined, as well as other urban parameters, how to ensure homogeneity of the urban landscape assembly?

2.1. BRASÍLIA AND ITS CONTEMPORARY ISSUES

In 2011, according to the importance of Brasilia as Patrimony of Humanity and, above all, as a cultural and architectural Brazilian heritage, a study was carried out by the State Department of Housing and Urban Development to define criteria and care for the occupation of preserved areas and for ordering the growth of occupation on the edge of these areas. The report has detected the following needs and defined by the following headings:

- Currently the preserved area is all under the same level of protection;
- There is no demarcation of patrimonial interest area around the polygon of the preserved area. Therefore, it is not considered the importance of the surroundings that conforms, also, the modernist landscape.

Given the existence of significant pressure for transformation both preserved area as its edge, bearing in mind the existence of non-occupied areas in both territories, the study proposes:

- The definition of different levels of protection of this urban assembly has already been the subject of previous studies by working groups that dealt with the preservation of Brasilia. This definition is critical because not all areas that integrate the preserved polygonal must have the same level of protection, since they have different physical attributes that participate in different ways to characterize the "Urban Design";

This decision by the establishment of levels of protection for the assembly, to act in a contextualized way on the individual conditions of each portion of the territory, relies on Decree no. 299 of the National Institute of Historical and Artistic Heritage, which establishes the methods and instruments of inventory as subsidies for characterization of historic sites and the definition of differing levels of protection. (Figure 3).

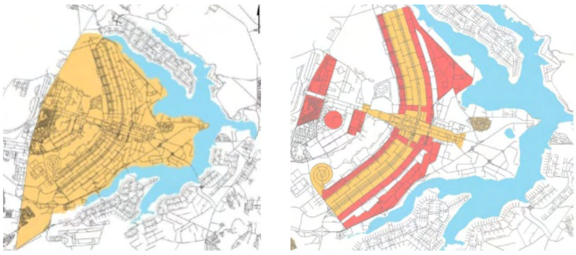

Figure 3 - Heritage area from Brasilia. Priority areas for conservation - in yellow the sectors and blocks deployed according to the pilot drawing and in red those deployed until 1967. (Source: SEDHAB, 2011)

The analysis of the criteria for preservation and for the evaluation of new uses in the preserved area should consider the landscape maintenance and urban monumental axis, with its sense of unity and of ordination, the vision of the horizon of heaven that characterizes Brasilia and the treatment of open spaces.

As a main criterion for the preservation of the preserved area, the same study indicates the identification of the design of the Pilot-Plan in its original proposal and the aspects incorporated throughout the time of its urban sedimentation, delimiting areas inside the polygonal for the maintenance of the "readability" of the landscape.

Some sectors were defined as priority areas for conservation: some camps of initial work, the sectors and blocks deployed according the Pilot-Plan, and the sectors and blocks deployed until 1967. (Figure 3). The study provides the detail of conditions of preservation in the area of the Pilot-Plan and its environs, classifying each characteristic according to their levels of need of preservation (complete, partial or no value). The characteristics proposed for evaluation in these three levels were: urban fabric (mesh, division of soil, relation of empty and full), open spaces (drawing and composition, vegetation, paving, furniture and decorations, usages) and buildings (volumetry, language and composition, historical value and uses).

In the specific evaluation of "super-blocks" and the recently practiced volumetry by buildings, the report identified the risks relating to the rupture of the initial idea of the plan through construction of volumes that promote ways that transcend the prismatic envelops provided, such as the employment of roofs with the formation of the 7th floor and the absence of leafy green belt.

The verification of setbacks also needs to be revised, because in 2007 was deployed a supplementary law that allowed the growth of buildings by advancement of projection in public areas and whose result was the increase of density built, the approximation between the buildings and the reduction of green spaces. It is also observed the constant increase on areas that should be destined for gardens or the circulations. In areas intended for houses, it was observed that they had a transformation of the landscape to respect the maximum height (7 meters at most), which would mean two floors in form of prismatic volumes.

Another risk to the preserved landscape from Brasilia is the existence of spaces still not occupied between the blocks, requiring management of typologies of occupation to avoid the rupture of language, landscape values and composition of the whole historical and cultural. In free areas, that constitute real land parcels, it is still essential to avoid conurbations of constructions and disruption of the pattern of landscape.

According to Granja (2005), the super-blocks began to be established around 1958 and, since then, this process has been occurring slowly and continuously, but with dissonance between the two wings, not being, even today, entirely constructed. According to the author, of 120 super-blocks designed, 30 are still incomplete. This means need to modeling the urban parameters for proper occupation of areas of significant value, which are under pressure of transformation, especially in the north wing.

The disregard for the protected project is denounced in blogs and manifestations by groups that have an interest in the preservation of the landscape, as is the case of the group "Planners for Planners" and "More Community", as well as other groups and professionals who has acted actively in questioning the PPCUB (Plan for the Preservation of Urban Assembly of Brasilia) and LOUS (Law of Land Use and Occupation) (Paviani, 2013), and also criticized by Ramos (2013). It is justified the need to further discussion of parameters to shape the new occupations of vacant areas, in order to preserve the genius loci of the set.

It is observed that in front of the existence of areas with conditions of crowding of the occupation, of the existence of areas still not occupied, and the significant demand and value the possibility of occupation, the proposition of instruments for the management of urban development parameters that shape the landscape is fundamental.

Another example of the manifestation of the community against the occupation of areas that are still free and whose occupation can lead to disfiguration of landscape values of the Pilot-Plan, in the light of pressures of processing and expressive value of land, is the case of the central area, in the Field of Large Areas. In this region, the district government and the urbanizing company proposed the increase of urban parameters without the prior analysis of IPHAN (Institute of National Historical ans Artistic Heritage). The complaint was published on the blog "More Community" in 2012. It stands out that for obtaining the interest of the citizens and to illustrate what would be the result of the change of landscape parameters of urban area, the blog used three-dimensional viewing, demonstrating the impact that could happen in an area of extreme interest to the assembly and still little occupied.

The State Department of Housing and Urban Development Regularization of the Federal District - SEDHAB (2013) presented in the Supplementary Law of Use and Land Cover of the Federal District document explanations to make clear the meaning of urban parameters, and argues that the use of different parameters of occupancy for each city is justified in order to maintain the local characteristics and needs, in order to respect the elements that confer uniqueness and identity to the spaces of each urban center: "By PARAMETERS OF OCCUPANCY shall mean: the maximum area that can be built; the amount of land area that can be occupied; the quantity of free permeable areas that must be kept on the land; the maximum height of the building; the mandatory setbacks and others."

The process of building a law, according to SEDHAB (op. cit.), Should be based on knowledge of the real city, knowledge of applicable laws, preparation of preliminary proposals, in the discussion of these proposals in workshops, followed by their presentation in public consultations and public hearings. The contribution of the visualization mechanisms favors all stages of proposal and decision on the urban parameters.

The establishment of zoning and urban parameters, parts of the drafting of Use and Land Cover Law of a city, must follow the principles of urban policy designated by the Federal Law No. 10,257, of July 10, 2001 - City Statute, in particular with regard to democratic management based on the participation of civil society and the population in general. This means that the preparation of the LOUS must be based on collective construction of decisions, and should provide activities and participatory events involving government agencies and the public. With the need to foster dialogue with the population for collective definition of parameters that, once charged, shape the landscape, it became fundamental the investment in the visualization of urban information, especially to view the possible results of applying the proposed urban parameters.

In this way, this paper defends the application of Parametric Modeling of Territorial Occupation, employed in the scale of the protected landscape of Brasilia, to visualize the results of the decisions on the management of the city landscape.

3 METHODOLOGY

The methodology was composed by the following work steps:

a) Construction of cartographic base adapted to geoprocessing;
b) Revision of rule-base parameters lettings composed by the ratio of returns in the currencies, occupancy rate, coefficient of utilization and maximum height of buildings;
c) Decoding of the ideas of Lucio Costa through creating rules of urban parameters that present the maximum envelope defined by him;
d) Study of the existence of areas in change for new occupations;
e) Analysis of the suitability of urban parameters proposed by the legislation for the use and occupation of the soil in face of the logic of Lucio Costa;
f) Presentation of the logic of Parametric Modeling of Territorial Occupation for the management of collective heritage and landscape.

Although it had been developed for a case study, the protected historical area of Brasilia, it presents methodological processes of how to structure rules of three-dimensional modeling to simulate the maximum constructive authorized by planning legislation (maximum envelopes), so that it can be reapplied in any other situation of definition of parameters in urban master plans and in laws for land use and occupation.

4 DEVELOPMENT AND RESULTS OBTAINED

4.1 CONSTRUCTION OF CARTOGRAPHIC BASE ADAPTED TO GEOPROCESSING:

Construction of the mosaic of CAD files, separated by layers, associated with attributes containing alphanumeric values of areas, occupancy rates practiced in each super-block, zoning proposed and its respective parameters (occupancy rate, maximum height, setbacks).

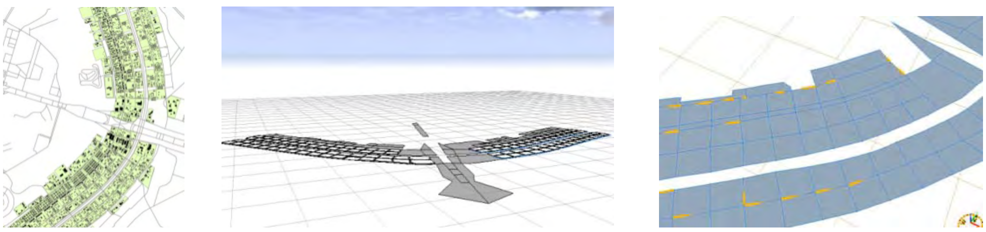

Figure 4 – Cartographic base (a) and (b). Establishment of the front of the block - in the figure the orange one represents what the system considers the front or the first line, and must be redefined (c).

Considering that the shapes at this step is not dynamic, what means to compose the territory in the form of continuous (polygonal geometry of tracks by connecting perfectly with polygonal blocks, in the form of territorial contiguous parcels), by this time it was necessary to specify the front of the lots, as some parameters differs according to the side of the block (Figure 4).

In next steps of the project it will be identified the geometric logical that structure the drawing of streets, roads and avenues of Pilot-Project, because it has a special logic, and this will allow the working with dynamic shapes, and not just static with singular layers of each variable. This means that any transformation in the geometry of a polygon is automatically reflected in the geometry of the shapes that are contiguous.

4.2. REVISION OF RULE-BASE PARAMETERS LETTINGS COMPOSED BY THE RATIO OF RETURNS IN THE CURRENCIES, OCCUPANCY RATE, COEFFICIENT OF UTILIZATION AND MAXIMUM HEIGHT OF BUILDINGS

In previous studies from the Laboratory of Geoprocessing of EA-UFMG for structuring of rules for the application of urban planning parameters for simulation of envelopes that translate the maximum constructive in Brazil, Saliba and Santana came to publish a first basic-rule (2014), but it was revised by us because of the identification of an error in geometric calculation of useful area, the maximum projection of the building.

The new basic-rule applies the following logic (Figure 5):

- Calculation of the area of the lot followed by projection of frontal, side and of back setbacks (in Brazil it´s common the specification of different values for the setbacks), for the drawing and calculation of the useful area of projection of the building;
- If the value of the usable area of projection of the building is greater than the Rate of Occupancy (R.O., in Brazil T.O.) allowed by law, it must be scaled in order to be reduced and operate as the real usable area set of deployment of the edification. In this point the error in the first basic-rule was identified, because the initial formula applied the scale factor ignoring that the reduction should occur in two axes, on "x" and "y", what means it is necessary to work with the square root of the value of reduction.
- From the value of the new usable area set to the projection of the building, and within the limits of projection identified, is calculated the final volume to be built according to the restrictions of the Coefficient of Utilization (C.U., in Brazil C.A.).

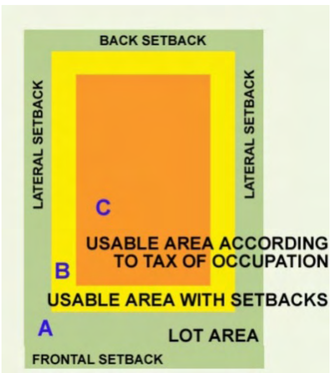

Figure 5 – Representation of main urban parameters

New Script: Calculation of “AreaLot A” and calculation of “AreaUsable B” resulting from the subtraction of the setbacks. If “AreaUsable B” > RO (Rate of Occupation authorized by law), do “AreaUsable B” * Scale Factor. Scale Factor = “AreaLot A” * RO / “AreaUsable B”. Considering the the scale must be applied apart in each axes “x” and “y”, this means to apply the square root of Scale Factor in each axe. “AreaUsable B” * √Scale Factor in one axe and “AreaUsable B” * √ Scale Factor in the other axe = “AreaUsableAdapted

C". After that, to generate the Final Volume: "AreaLot A" * CU (Coefficient of Utilization authorized by law) / "AreaUsabelAdapted C" = Number of Floors to be built ("Pav"). "Pav" * 3m = Maximum Height of the envelop.

4.3. DECODING OF THE IDEAS OF LUCIO COSTA THROUGH CREATING RULES OF URBAN PARAMETERS THAT PRESENT THE MAXIMUM ENVELOPE DEFINED BY HIM.

Lucio Costa didn't stipulate parameters to be followed the new blocks from the expansion of the occupation of Pilot-Plan. As representative of modernist urban design, he drew the urban landscape in a conclusive way, what means to draw the urban territory projecting its final form. Together with Oscar Niemeyer he was responsible for the design of large part of the buildings in the first super-blocks. When he explains the intentions in the form of parameters they are vague, and because of that the simulations promoted in this case study had the goal to represent the three-dimensional form and, above all, to build the logic rules that could tell about the volumetric intention of Lucio Costa. The rules and the visualization of the rules were drawn up with the employment of software City Engine – Esri (Figure 6).

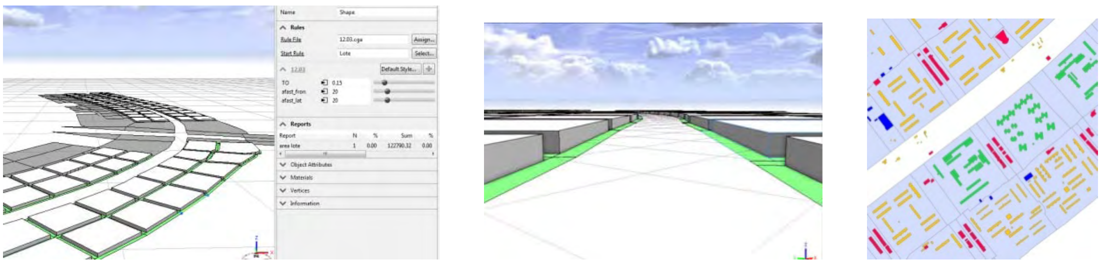

Figure 6 – (a) Decoding of the drawings and the volumetric intention of Lucio Costa. It´s interesting to observe the similarity with the first drawings (Figure 01) and the relation of parameters considered as initial attributes. (b) Visual perception of setback and height. (c) Observe how the occupation in green are example of differences pattern of occupation, although follow the generic parameters proposed by Lucio Costa.

This study of the simulation of the maximum envelope favored understandings about perception of landscape, perspectives and views of space designed. Allowed to understanding, for example, on the scale of the user, the impact of the elements placed in the vertical axis, because when the parameter of height is equivalent to the parameter of frontal setback, the vertical element gives the impression of being larger than the horizontal element (Figure 6-b). Changes of values on attributes were tested, to promote understanding of the possible compositions of the landscape, as the use of City Engine allows the dynamic modeling of volumetric results while changing the attributes established on the "rules" programed.(Figure 6-a)

When Lucio Costa wrote about the expectations of landscape designed, he established only the setbacks and maximum height, but didn't define the rate of maximum occupancy per block, even though he wrote about the intention to preserve expressive natural areas with large trees among buildings. It´s observed that blocks with buildings designed by him have a recognized standard, but the others projected later by other architects presents the same setbacks and height, but the volumetric language is quite different, not characterized by prismatic volumes of modern architecture. (Figure 6-c).

4.4. STUDY OF THE EXISTENCE OF AREAS IN CHANGE FOR NEW OCCUPATIONS

As registered by bibliographic research that reports the views of urban planners who operate at the scene of the reality of Brasilia and studied the issues that are pressuring the transformations of landscape, and through diagnostics produced by public institutions, Brasilia still has areas not built which can be used in the area of the Pilot-Plan. But the point is how maintain and reproduce the essence of the landscape and urban design proposed by Lucio Costa and Niemeyer, decoding these values on contemporary parameters to authorize interventions that doesn't change the urban heritage.

The evaluation began investigating, initially, the proposal of the Master Plan and the parameters set forth for what Lucio Costa defines as residential scale (the four scales which are: bucolic, gregarious, monumental and residential), and were created rules to analyzed each sector this residential scale. (Figure 7).

Figure 7 – (a) Residential Sector Blocks 100, 200 and 300 (b) Residential Blocks 400; (c) Residential Blocks 700; (d) Commercial Blocks

It was observed the definition of a set of parameters established for the blocks of the sectors 100, 200 and 300; another set for the blocks of the sector 400; another set for the blocks 700 characterized by collective housing; and another set for the commercial blocks, placed between the super-blocks. In the sectors of blocks 100, 200 and 300 the current parameters proposed occupancy rate of 15 %, setbacks of 20 meters and buildings maximum height of 6 floors, but do not determine limiting of heights, which ends up resulting in 7 because of the useful area in the terrace, what is not adequate to the initial proposal.

To view this proposed envelope for these sectors was generated a logic rule: calculation of the area of the block, application of setbacks, calculation of usable area withdrawn from the setbacks, reduction of the envelope of the usable projection area by scale factor applied in both axis of the footprint, vertical extrude according to 6 floors and, as they establish the maximum height the Coefficient of Utilization is not applied. (Figure 8).

Figure 8. (a) Rules. (b)Result of the rules.

The same procedure of rules creation was carried out for the blocks of sector 400, with the parameters: maximum height of 12 meters where there are no piers; 15 meters where there are piers, but which must occupy only 30% of the area of projection; the incredible rate of occupancy of 100%; and setbacks only to control the projections of piers. For the blocks of 700 sector there is variation in the parameters, as there are different uses: the residential use receives Rate of Occupancy of 20%, maximum height of 8.5 m and Coefficients of Utilization Basic 0.2 and Maximum 0.4; and other uses arrive at 100% of Rate of Occupancy, Coefficient of Utilization 1.8 and maximum height 8.5 m. To the commercial sector the Rate of Occupation is

100%, maximum height of 6 m, Coefficient of Utilization 2.0 and, in case of lot dismemberment the minimum lot is 36 m^2 and in case of lot unions the maximum lot is 140 m^2.

Performed the construction of the rules to represent authorized parameters for each of the 4 zones, was promoted to the comparison between the authorized and practiced volumes. The rules were structured so as to represent the volumes authorized versus the volumes practiced in the same volumetric reference, to allow the comparisons. Through association of colors it is possible to identify who predominates - the authorized or the practiced volume, so that the larger composes the maximum envelope and contains in its interior the smaller one. This comparative study was applied to the rules of the groups of residential zoning occupancy and the commercial zoning one. (Figure 9)

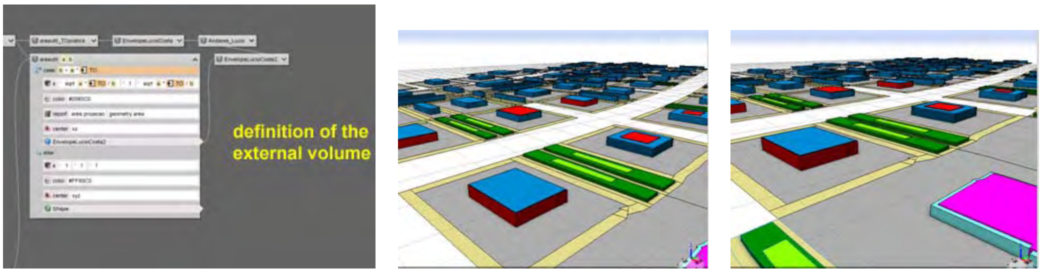

Figure 9. (a) Rules to build the inner and the external volumes. (b) Comparison of predominant volume – the authorized versus the practiced – differences in colors are due to different zonings.

4.5. ANALYSIS OF THE SUITABILITY OF URBAN PARAMETERS PROPOSED BY THE LEGISLATION FOR THE USE AND OCCUPATION OF THE SOIL IN FACE OF THE LOGIC OF LUCIO COSTA

The objective of the rules is the visualization of parameters to support the decision-making process for new interventions. Because of that, the first step is to evaluate if the parameters proposed by PPCUB (Plan for Preservation of Urban Heritage of Brasilia - SEDHAB) are in fact meeting the maintenance of ideal proposed by Lucio Costa.

The first analysis reflected rate of occupancy proposed. By analyzing the relationship between the rates, especially in blocks where the buildings were designed by Lucio Costa and Niemeyer, it was observed the average rate practiced between 10 and 15 %, even in the zone of blocks 400, lower than the values proposed to be adopted. In the region of blocks 700 the rate of occupancy practiced is around 20 to 30%, what means a little greater than the proposed for the residential area, but quite lower than the proposed rates in the blocks with other uses.

In a general sense, the rates of occupancy proposed by PPCUB are larger than those practiced today and are larger than those practiced by Lucio Costa. It´s possible to say that the Pilot-Plan is in risk of changing the landscape values, because of market pressure to promote new layers in replacing the existing ones and, more importantly, because it was also observed vague areas or with low occupancy rate that will have legal support for increasing occupation, especially in the north wing of the territory.(Figure 10).

The north wing is characterized by the concentration of blocks with higher rates of occupancy and, at the same time, with concentration of higher number of blocks with low occupancy rates. The point is due to legal permission for densification, due to the effect of neighborhood typology already denser, and by the fact of presenting a landscape not so close to the design of Lucio Costa as the south wing does, the north wing has the risk of going through significant and worrying transformations.

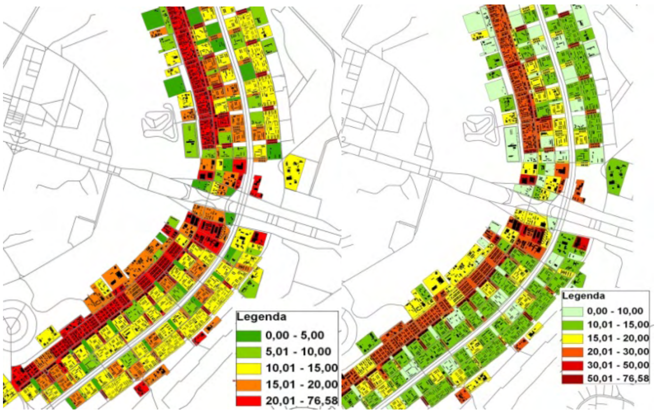

Figure 10 – Distribution of building density – rates of occupancy

4.6. PRESENTATION OF THE LOGIC OF PARAMETRIC MODELING OF TERRITORIAL OCCUPATION FOR THE MANAGEMENT OF COLLECTIVE HERITAGE AND LANDSCAPE.

Once structured the rules in the form of scripts or algebras which reflect the expectations of maximum envelopes that are approaching the Lucio Costa ideal; and once structured the rules which translate the PPCUB values, the system favors the visualization of landscapes modeled for both references. The rules generated demonstrate not only the different references, as they are also prepared for simulating the different sets of parameters, because as the modeling is dynamic, the process of viewing allows the user to change parameters and visualized their effects in reality. The whole process functions as a support to characterizing, analysis and support to decision making. (Figure 11).

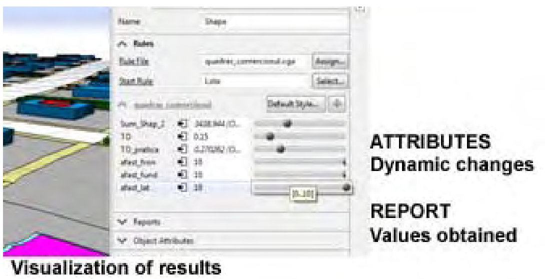

Figure 11 – Changes on attributes, resulting in dynamic visualization and production of reports with new values

5 CONCLUSIONS

The Parametric Modeling of Territorial Occupation is a new way to promote the visualization of different steps of the management process of the landscape: characterization, analysis of potential and constraints, analysis of proposed values and decisions making in face of possibilities. It allows, in particular, that the different agents of the transformation of the territory can act as decoders of values of an era, and not just drawing according to their individual wills.

This promotes the discussion about urban design and not about the urban designer, about the architecture and not the architect. The individual manifestations will continue to happen, on the scale of the individual lots, but the actions that are results on the scale of collective will can be well-orchestrated.

The eloquence of the visualization makes it easier the exchange of ideas, and promotes the capacity of understanding. The dynamic representation, which responds in synchrony to changes in parameters, allows the user to work with relative values, and not in an absolute sense. The context is evaluated and the vision of all is favored. The development of rules to model the 3D aspects of the city is a way to simulate the maximum constructive authorized by planning legislation (maximum envelopes), so that it can be reapplied in any other situation of definition of parameters in urban master plans and in laws for land use and occupation.

Finally, the construction of rules favors the teaching of architecture and urban planning, because it enables professionals to organize logical reasoning which translates their ideals. It creates a new language and a new mode of operation on the territory, constituting in new paradigm in territorial management.

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IMAGES SOURCES

Fig. 1: Lúcio Costa, Brasília 57-85, 1985) and adapted from SEDHAB, 2013.

Fig. 2: Lúcio Costa, 1985 and Aldo Paviani, 2013.

Fig. 3: SEDHAB, 2011.

Figg. 4, 5, 6, 7, 8, 9, 10, 11: The authors.

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SMART MEDITERRANEAN LOGICS

OLD - NEW DIMENSIONS AND TRANSFORMATIONS OF TERRITORIES AND CITES-PORTS IN MEDITERRANEAN

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ABSTRACT

The land coast, with particular emphasis the port-city, are in fact used more and more like a menu in which different users increasingly move freely according to their needs.

The new definition parameters with respect to which the landscapes are recognizable, articulating configurations, immutable, and not concluded, but on the contrary, variables are always open and more leads, not the placement of functions, but the interaction between subjects, and actually pushed social, cultural, political and economic.

The port city now seems more like a miscellany, and a composite variable, the definition of which combine multiple devices and whose understanding and operational management appears to be no longer in the perimeter of registers and formal, but the identification of rules and tactics logical drive and able to predict particular outcomes and the evolution of the different dynamics and vocations.

'Dream City', 'Dream Lands' and 'Dream Country' will constitute the new benchmarks in the definition of geographies based on imagination, perception and use of spaces and scenarios from the sensitivity of each individual and class user, until the size of the global imaginary fantasy, with respect to which space, urbanity and territories are distinguished as 'complementary' or 'complementary' depending on the specific 'action brands' and 'areas of opportunity'.

KEYWORDS

Mediterranean, Desire territories, New logics

1 INTRODUCTION

The territorial geographies are determinate today, more and more, not by spatial and temporal factors but, in fact, by informational and relational ones, in respect to which, the urban maps and territories are perceived as distorted on compressions and expansions.

The new definition parameters, respect to which the landscapes are recognizable, articulating not concluded and immutable but open and variable configurations, are increasingly derivations, not of functions placement, but of the interaction between subjects, social, cultural, political and economic realities and incentives.

Topics and times at the base of territories structure and definition are, in fact, profoundly changed, the processes speed makes long-term planning operations, in fact, useless and misleading, and meanwhile the multitude of demands and requirements impose an ever-increasing interventions transformability and inflection.

The landscape now appears more like a miscellany, composite and variable, defined with multiple devices and whose understanding and operational management appears to be no longer on registers and formal context perimeter, but on logical rules and tactics identification, capable to driving and predicting possible outcomes and dynamic and different vocations evolution.

These processes give rise to scenarios dilatation and global interconnections proliferation for which the landscapes design and management depends no longer today only on the needs of its inhabitants, but also, and in a non-negligible way, on the perspectives and exchange identification and understanding of logics imposed by new needs and feelings of those who have access to and flows in these territories even temporarily.

2 LOGICAL GEOGRAPHY OF DESIRE TERRITORIES

So the landscape are configured today under an energy field action determined by habits, vocations, aspirations and wills, imposed and proposed, whether by individuals, groups, than by communities.

Fig. 1 Crumpled City

The multiplicity of instances, in the globalization era, might suggest a landscapes saturation with a degenerating process leading at specific identities dissolution. In reality this dynamic don't degrade the landscape, but rather enriches and strengthens the landscapes. The landscapes are so active subjects of a territorial dimension moving from rigid definition in areas and facilities to the soft definition in devices and connections.

We are assisting to the transition from:

Logic of Stress > Logic of Empathies.

The return to nature desire inevitably introduces changes in the relationship between solids and voids turning the “green” from being just a urban complement, infiltrated and often almost accidental, in an important and articulated organization and space-time modulation device able to modulate it, to interact and interface with weight and percentage surface to the built.

The strengthened natural system not only becomes a potential alternative to the infrastructure system in favour of a pedestrian mobility, bicycle or any other alternative to the car, but in a way even more interesting, it assumes the role of a reliever and a diaphragm replacing limits and tensions for empathy and exchange between the parties.

The urban limit, however, is dissolving completely and permanently in the landscape and in the same way the boundary between public space and building, in terms of area and permeability, tends to dissolve.

Hybridization, in this view, seems to impose itself strongly as a new way of resolving spatial and formal disputes, mingling and overlapping, prefiguring urban realities made of multi-purpose convertible and usable spaces and systems, at the same time in a different way, and objects as buildings, infrastructure, social spaces and energy sources.

Logic of Agreements > Logic of Resonances

The revaluation of each single reality enriches the territory defining it as a set of independent and, at the same time, consistent and concurrent specificities in the definition of the set.

This constitutes an important shift in territory design and action because it inserts and gives role also to minor realities, while the already worthy recognized areas are, in this way, unmarked, freed by an excessive pressure, which redistributes itself in adjacent areas, recovering breath and quality.

Constantly changing, the logical dynamics clarification and understanding involve the choice and the proposition of directions able to determine and drive the renewal and the interface between different territory’s devices, outlining new configurations, prepositions, evolving and alternatives geographies of landscape.

In this logical context, the landscape takes shape, therefore, in new geographies no longer tied to the traditional categories of natural and artificial or urban and agricultural. In the new dimension, the territory, in fact, founds these natures mixed and overwritten and, as a generator and, at the same time, scenario of forces acting on different levels distances and times, distinguishes and organizes itself, however, respect to their valences:

- Propulsive, as a generator of new arrangements, configurations;
- Potential, as reinforcement of situations and processes already in place;
- Connective, as an articulating binder not only at physical level, but also cognitive;
- Suspensive, as a pause or a buffer.

While the oscillation of these values respect to different planes, distances and times of investigation in which the landscapes are defined in their complexity, reveals a certain relativity of the modern territories, at least in their definition, this does not match a contingent or contradictory character, in fact, the modern landscapes are assuming different geographies compared to the operating interpretation, but all different propositions are summarized in the overall configuration of each landscape.

A striking example of all these changes is provided, undoubtedly, by the Mediterranean coastal system: here the landscape has always had a determinant role, taking always shape as a factor in the territory's definition; according to Braudel, in fact, extending between the mountains and the sea, vines and olive trees mark its boundaries, and it is perhaps for this reason that here more than anywhere else, undoubtedly, it shows the logic change effects.

At first sight, the basin looks like, in fact, a kaleidoscopic, complex and articulate scenarios system with undefined contours where geographies mingle, overlap and fade to the point that define them appears difficult, if not misleading, here more than anywhere else detects Gausa:

"ancient geographical borders, aimed at curbing the new emerging city, gave way, almost suddenly, in front of various scales of a new actions field, much more complex, elusive and vital, in which latent nucleus and consolidated nodes, uncertain margins and friction areas, consolidated fabrics and unfinished textures are living together, announcing the new hybrid and gradually ambivalent condition (between natural and artificial) of a new urban landscape planning"(Gausa 2010).

New scenarios result in new propositions, and then the new logics become the projects, researches and visions engine as Multi-Hiper Barcelona-Catalunya, Picity, Città Adriatico, … where the landscape, as active element, territorial converter, defines the set in

"a complex array of 'point' and 'counterpoint' - of intertwined fingers – reported to basic, flexible and intermittent standards, open to possible changes but always aware of the tactic disposition of the development and relation spaces" (Gausa 2010).

3 MEDITERRANEAN TERRITORY AND CITY-PORT

The Mediterranean coasts possess an accumulation of exceptional urban places that are uniquely rich, layered and complex, and whose physical and geographical features have enabled them to play a fundamental role in the development of civilisations. The port cities around the Mediterranean are highly sophisticated artefacts of major heritage value and are the outcome of a process dating back to the beginning of time but also expressing the varied, many-sided present day as well as looking forward to the future.

But the complex connotations of this urban fabric cannot simply be explained as a consequence or a product of the interaction between the morphology of the Mediterranean territory, the evolution of a single civilisation, or the result of applying different rules. More interestingly, they are the end product of contaminations and cross-fertilisations that were mainly spontaneous and peaceful and that came about thanks to the contacts, exchanges and interchanges between the various populations and cultures of the basin. Because of these processes, which took place over time and across cultures, each Mediterranean port city developed its own identity and each one is completely different from the others, whilst at the same time being undeniably and indissolubly connected to them as an inextricable part of a whole system.

For centuries the relationships between these various urban agglomerations have been defined by describing the differences and analogies between their particular features and stylistic elements. But in the face of today's ongoing, rapid transformations, we may now need to think about this from a different perspective, in terms of a more complex dimension that refers to the propositions and rules that currently define this contemporary urban fabric, whether internally – dealing with its own dynamics and needs – or externally, insofar as it is latently an interconnected whole even though its parts are unique and particular.

These implicit, immanent interconnections between the coastal urban fabrics of the Mediterranean, as they are commonly perceived and recognised, cannot be explained by or limited exclusively to the recurrence of typological or formal models (which are also found in non-Mediterranean areas) nor can they be given a simple geographic explanation. Instead, they seem to imply and be the expression of a much more significant rationale that continues to exist, even in the face of the distortions that are being generated by current processes.

This intensification of the networks of physical, economic and cultural exchange have gradually led to a reduction of distances; maps and domains are increasingly being defined in terms of compression and saturation. Since it is the aim of these dynamics to restructure and define the whole world as a single global network, it might have been expected that the Mediterranean and its coastal urban structures would have lost their role as Europe's centre of gravity, and become peripheral. But on the contrary, thanks to the systemic reality that defines and regulates the Mediterranean basin as a unique whole and – at the same time – as a multiple corollary of particular individual features, it has reconfirmed its position and has indeed strengthened it, and has become the most important basin for receiving the inward flows of all the migratory currents that relate to tourism, new residence, immigration, and work.

The land coast, with particular emphasis the Mediterranean port-city, are used more and more like a menu in which different users increasingly move freely according to their needs.

The new definition parameters with respect to which the landscapes are recognizable, articulating configurations, immutable, and not concluded, but on the contrary, variables are always open and more leads, not the placement of functions, but the interaction between subjects, and actually pushed social, cultural, political and economic.

The port city now seems more like a miscellany, and a composite variable, the definition of which combine multiple devices and whose understanding and operational management appears to be no longer in the perimeter of registers and formal, but the identification of rules and tactics logical drive and able to predict particular outcomes and the evolution of the different dynamics and vocations.

'Dream City', 'Dream Lands' and 'Dream Country' will constitute the new benchmarks in the definition of geographies based on imagination, perception and use of spaces and scenarios from the sensitivity of each individual and class user, until the size of the global imaginary fantasy, with respect to which space, urbanity and territories are distinguished as 'complementary' or 'complementary' depending on the specific 'action brands' and 'areas of opportunity'.

The concepts of limit and shape related to the determination of urban systems have lost their meaning and sense in the face of current processes.

Topics and times at the base of the structure and definition of the territories are, in fact, profoundly changed the speed of the process makes it, in fact, useless and misleading operations of long-term planning, while the multitude of demands and pressures require ever-increasing convertibility and variability interventions.

The area, if some time is taken on the meaning of the integrated system, now looks more like a mixture, composite and variable definitions which contribute to a variety of devices and whose understanding and operational management appears to be no longer in the scope of records and formal, but the identification of logical rules and tactics to guide and predict the outcome and development of the different dynamics and vocations.

The urban face of these dynamics, can and must, therefore, still play a key role in the structuring and establishment of territories in general and urban areas in particular, but not with more radical actions and bakery additives, as with the renewal of propositions, concepts and applications.

If the whole country is today under the action of an energy field which is constantly changing, the planner's action, can no longer be in control with a static, fixed design, but which includes the development and understanding of logical dynamics of choice and the proposition becomes the addresses of those to be determined, driving, the renewal of the various interface devices spatial convertible new geographies and emerging alternatives, in which the response to the problems of sustainability is not a limit, but as resource capable of providing answers to the needs of daily living.

The landscape, in that sense, it seems, in fact, become more and more potential and power to influence the definition of plans and strategies. The growing attention to ecology, the willingness to give up resources and polluting the turning tourism and economic interests, in general, in contexts in which natural and artificial environments are showing more and more comprehensive, extensive and branched, is that if the past have been the settlements, with their development, to lead the transformation of the territories, today, are without doubt the landscape.

Branching and infiltrating the settlements and increasingly taking the role of the devices themselves, while over land and in the system, such as connection networks, like infrastructure, and as structural factors and structuring, the landscapes become, today, in the articulation of green, private and public, wild, agricultural and urban water, river or sea and also built, which is full of gaps, the new ordering element and link the different contexts and realities.

Today's dynamics and processes and as compared to other more technologically evolved or more structurally functional systems and scenarios, each of these Mediterranean port-cities seems to be maintaining its peculiarities and upholding the importance of its particular role in relation to the wider world geography, whilst identifying an ‘increased’ complexity that is the consequence of a genetic, intrinsic and permanent predisposition to embrace an ‘open’, flexible, but always dynamically coherent evolution.

Clementi looks like the coasts of the Mediterranean connote, in this context, logic, peculiarly for the fact that "for hundreds of kilometers, rooted and nomadic populations intersect at different times of the day, week, seasons, places that do not are designed for those who live there, but to pander to the processes of a market, a tourist economy more competitive" (Clementi 1995) .

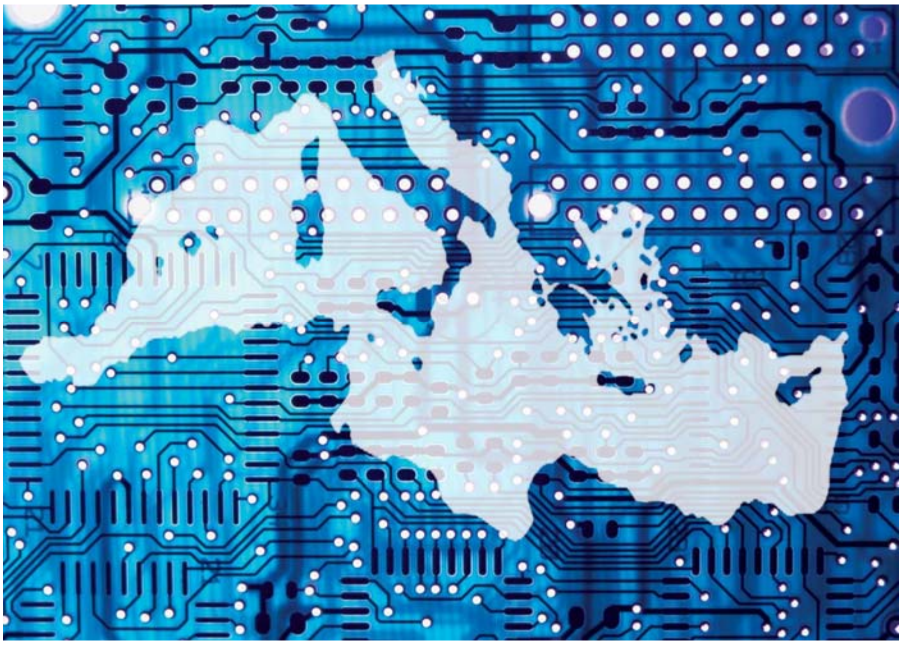

Fig. 2 Mediterranean area as network

It 'clear that today in the design and management of the different scenarios that define the Mediterranean coast are not only important from the needs and desires of the population stable, which also have less and less, but also and increasingly, identification and understanding of perspectives and logical changes that are imposed by new needs and sensitivities of who joins and uses only temporarily and partially this space.
Tourism, in this context, although it always plays an important role, it has acquired and is acquiring an ever more decisive, revealing values and meanings increasingly varied and complex, well beyond the limited and traditional view of seasonal-related practices for bathing.
The economic importance coated, for the temporary Mediterranean coastal areas and variety of users is the fact that a major if not the first goals of the actions of transformation today is undoubtedly increase of palatability, by creating expectations and ease of enjoyment for an ever increasing number of subjects.
If the Mediterranean was once a system of relational devices and is now a system of trans-devices and other devices (devices of/between/among/with/in devices), today more than ever it presents itself as the theatre of excesses: an intricate system of correspondences in which each port-city, within itself, exhibits the variations of relational logics that engage and connect all scales, the whole basin, and the global system, in terms of its non-spatial, but international, proximity or distance from the others.
The Mediterranean port cities, which are linked not merely by formal similarities (or by their similarities of form), but with respect to a number of key concepts (their interactions, exchanges, dependencies) in a more underlying, intrinsic way, can be identified and defined using a logical analogy according to which as the system of the Mediterranean basin they are something like a biological organism. In this different perspective they reveal themselves to be perfect space-systemic workshops whose greater or lesser complexity of interconnectedness defines the Mediterranean itself as a relational phenomenological model that embodies, in summary form, the logics and relationships of the global network as a whole.

4 CONCLUSION

In the simultaneous concomitances and competitive links of different territorial/urban situations and their demands, their rapid variation over time, and faced with the now obvious need for sustainability that the economic crisis has rendered mandatory, today's contradictory, de-structured and changeable circumstances are bringing about an ever-increasing, ever-faster flexibility and transformability of paradigms that can no longer be regarded as models for rupturing ancient equilibriums, structures, and organizations in a logical perspective markedly different from the past, but as a re-structuring of their coherence, interconnectedness and continuity, in and between the various urbanized settings and landscapes.
In the Mediterranean regions is evident, therefore, perhaps more than elsewhere, what we remember Ricci as emphasizing "Landscape and Environment Society are the great themes of ethical confrontation, economic and political crisis after. The culture of the development plan can't remain insensitive or to pretend that these problems do not overwhelm forcing her to profound changes.
In few years the global crisis has brought forth a different sense of social values and economic changes that the objectives of the change. A new geography of desire is changing so fast development processes that produces the crisis itself in the economic and cultural aggregates or more resistant to the forces of change, making them suddenly old, out of time.
The direct relationship between activities and places is no longer a necessary condition. Cities tend to lose a physical connotation defined to assume the size of the fluid fields of relationships. Reduces the need of land, intended as a space to move and communicate, increases the demand for "security" than the size of environmental risk and significantly increases the need for landscapes in which to live and identify with.

The recent economic and energy crisis is changing decisively the way of thinking about the future and its forms" (Ricci 2012) .

The different geographies of desire show, so, the articulation of different territories according to speed and capable of activating cycles and inter-turn, according to specific purposes and contexts, spaces, links and devices, thus defining new tactics choice of actions in the interface and interpolation processing with respect to the different proposals and demands imposed on the culture and lifestyle needs.

If the new size of the landscape is therefore on the scale today, one switch, the plurality of complexity and geographies through which it defines, in this sense, are nothing but the expression of the complexity of the interactions, not only within the unfolding of each particular scenario, but especially in the dialogue between local and global.

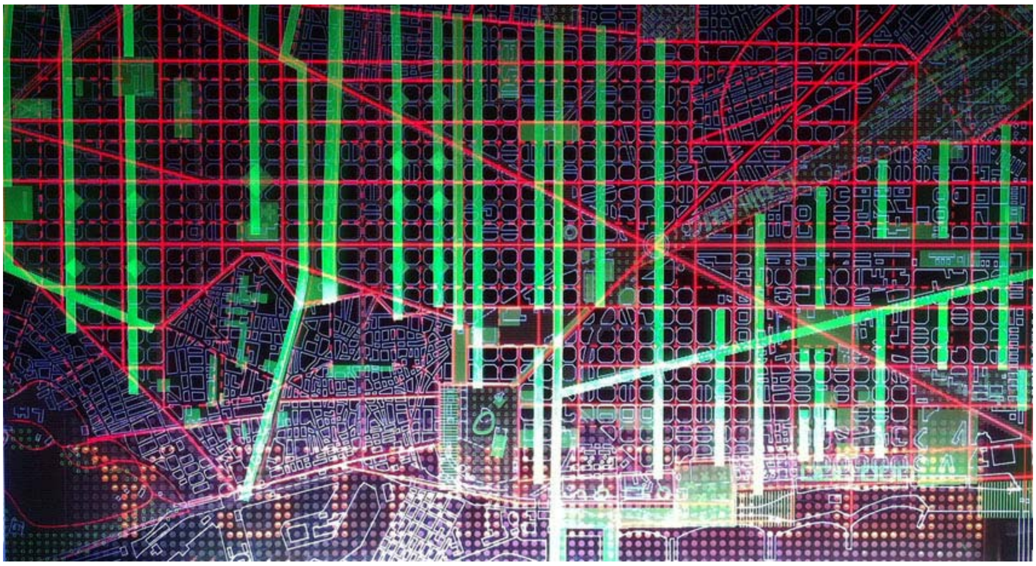

Fig. 3 Barcelona - Multi-string City (project by Gausa-Raveau Arcquitecture and GicLab UNIGE)

An increased size, which makes the territory similar to a network, a network, in which the vertical and transverse connections have assumed much more strength and valence of the horizontal ones, so that, today affects more timely a transformation on the whole system that the contrary.

The micro-scale and large-scale rediscover and reacquire thus their centrality in the triumph of localism and the landscape is strengthened and enriched by new instances of self-feeding it into a virtuous circle.

The rapidly evolving urban dynamics increasingly require us to rethink real, perceived, and lived spaces in the awareness that representing the environment on the basis of subjective perceptions is not only a way of organizing behavior in a territory but that in the same sense, territories themselves become platforms for personal decisions by users who according to their own needs, interests, and desires are in ever more independent ways defining new geographies and systematic.

The Mediterranean port cities, which are linked not merely by formal similarities (or by their similarities of form), but with respect to a number of key concepts (their interactions, exchanges, dependencies) in a more underlying, intrinsic way, can be identified and defined using a logical analogy according to which as the system of the Mediterranean basin they are something like a biological organism. In this different perspective they reveal themselves to be perfect space-systemic workshops whose greater or lesser complexity of interconnectedness defines the Mediterranean itself as a relational phenomenological model that embodies, in summary form, the logics and relationships of the global network as a whole.

On the one hand because of their structural complexity, their internal mixed, and their strong interactivity within (and with respect to) the basin as a system, and on the other because of their strong desire to affirm themselves and be protagonists within (and with respect to) the global level, the Mediterranean territories show that without any loss of meaning they can fully intercept and absorb the various logical and use-related modifications imposed by today's dynamics and equally, in this process, can reveal that in response to the new demands and stresses they are able to suggest, develop, and propose paradigmatic scenarios and tactics that are expressed in the conjunction, conversion, harmonization and completion of the existing, whether or not it has heritage value.

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IMAGES SOURCES

Fig. 1: Crumpled City

Fig. 2: Mediterranean area as network

Fig. 3: Barcelona - Multi-string City (project by Gausa-Raveau Arcquitecture and GicLab UNIGE)

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The most important and recent articles to remember in this relation are:

Nan Emanuela (2013), “Megalomaninteligenti: le città mediterranee tra antichi genomi e nuovi paradigmi”, in di Gausa Navarro M., Ricci M. e Scaglione P., a cura di Nan E. e Canessa N. V. e Marengo M., *AUM01 Atlante Urbano Mediterraneo 01*, Trento/Barcellona.

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MAPPING SMART REGIONS

AN EXPLORATORY APPROACH

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ABSTRACT

The paper presents the results of an exploratory approach aimed at extending the ranking procedures normally used in studying the socioeconomics determinants of smart growth at the regional level.

Most of these studies adopt a methodological procedure which essentially consists of the following steps: a) identification of the pertinent elementary indicators according to the study objectives; b) data selection and processing; c) combination of the elementary indicators by multivariate statistical techniques aimed at obtaining a robust synthetic index to rank the observation units.

In the procedure a relational dimension is mainly subsumed in the system oriented perspective adopted in selecting the indicators which would best represent the system determinants depending on the goals of the analysis (step a).

In order to get deeper insights into the smartness profile of the European regions, this study makes an effort to account of the relational dimension also in steps b and c of the procedure. The novelties of the proposed approach are twofold. First, by computing region-to-region distances associated with the selected indicators it extends the conventional ranking procedure (step c). Second, it uses a relational database (step b), dealing with the regional participation to the FP7-ICT project, to modify the distances and investigate its impact on the interpretation of the regional positioning.

The main results of this exercise seem to suggest that regional collaborations would have a positive role in regional convergence process. By providing an opportunity to get contacts with the areas endowed with a comparatively more robust smartness profile, regions may have a chance to enhance their own smartness profile.

KEYWORDS

Regional smart growth, region-to-region distances, regional collaboration, regional performance indices.

1 INTRODUCTION: CONCEPTUAL REMARKS AND AIMS OF THE STUDY

Smartness has become the latest fix in urban and regional studies. In Europe, its popularity owes a lot to the EU 2020 strategy which gave a shake to usual ways to view cities and regions. Eventually, it spurred stimuli to revise conventional thinking about how well behaved notions such as built places, living conditions, information flows, ICT networks and sustainable path of growth stick together and make sense in the everyday life of ordinary people as well as in stakeholders' decision-making.

Broadly speaking, smartness is perceived as a necessary attribute of almost every components and processes meant to set up, by means of modern ICT devices, pro-active and open innovation territorial systems, allowing for greater involvement of more educated and ICT connected people. This notion basically underpins the working definition for smart city lately proposed by the European Union (2014): 'A Smart City is a city seeking to address public issues via ICT-based solutions on the basis of a multi-stakeholder, municipally based partnership' (p.9)

When viewed in the light of the most recent arguments about the evolution of spatial systems, such as cities and regions (Batty, 2013, Portugali, 2000), however, smartness is but an "emergent" property, which results from the complex intertwine of many different cognizant agents, operating in a situated context.

Not unexpectedly, therefore, statements about smart territory require to discuss both the its conceptual understanding and descriptive account, as well as the observer's goal in leveraging that very notion. Making explicit the last aspect, in fact, seems to be what fundamentally distinguishes the current conceptualization efforts from earlier ones which had to deal with different although equally relevant urban and spatial issues.

This undertaking mobilizes an additional and so far largely overlooked perspective, which has to do with the ability of an urban/regional system to develop, thanks to the dramatic progress of ICTs, a so called reflective perspective (see Occelli, 2012) and whose underlying dimension is intrinsically relational. Such a dimension in fact relies on the joint consideration of: a) the ways agents, both as observers and as active participants in the community life interact with and perceive the different components of territorial smartness; b) the acknowledgement of the systemic (networked) nature of the bundle of elementary components which concur to qualify a certain level of smartness..

The former aspect has been recently addressed in a study which argues how by engaging in a learning process which leverages different observation windows, a regional system could acquire new capability and therefore achieve higher smartness levels (Occelli, Poggio and Sciullo, 2013).

The latter topic is at the core of many studies conducted by the Directorates of the European Commission to provide a global (European) perspective for assessing, at the regional level, the various socioeconomics determinants of smart growth (see for example Annoni and Dijkstra, 2013, Charron, Dijkstra and Lapuente, 2014, Hollanders, Rivera and Roman, 2012, Soete, 2011). In this respect, the progress made by some of these institutions for making easier the online access of comparative indicators as well as of the original data (as, for example, in the case of the Digital Agenda dash board, www.digital.agenda.eu) is certainly to be appreciated.

The core approach of most of these studies relies on a methodological procedure which essentially consists of the following steps: a) identification of the pertinent elementary indicators according to the study objectives; b) data selection and processing to implement the selected indicators for the observation units (e.g. regions, cities); c) combination of the elementary indicators by multivariate statistical techniques aimed at obtaining a robust synthetic index to rank the observation units.

It is worth noting that in such a procedure the relational dimension is mainly subsumed in the system oriented perspective adopted in selecting the indicators which would best represent the system determinants depending on the goals of the analysis (step a).

In order to get deeper insights into the smartness profile of the European regions, this study makes an effort to account of the relational dimension also in steps b and c of the procedure. In the following, section 2 describes the methodological approach which has been developed. Its novelties are twofold. First, by computing region-to-region distances associated with the selected indicators it extends the conventional ranking procedure (step c). Second, it uses a relational database (step b), dealing with the regional participation to the FP7-ICT project, to modify the distances and investigate its impact on the interpretation of the regional positioning. Section 3 presents the main results of the exploratory analysis and section 4 makes some conclusive remarks.

2 METHODOLOGICAL APPROACH

The main goal of the approach is to enrich the traditional ranking approach typically used to position European regions. More specifically it aims at extending the utilization of a synthetic index of regional performances by considering region-to-region distances, which in this application are derived from processing a set of indicators representing the regional smartness profile.

The approach builds upon earlier studies which were carried at Ires Piemonte also as a part of the activities of the Piedmont ICT Observatory (IRES, 2013, PICTO, 2013). In those studies, a lot of works has been done to identify and implement measurement indicators allowing for a meaningful account of the Piedmont smart growth profile, at both national and European level. The present analysis takes advantage of the experience gained in those studies and focuses on a set of indicators, selected according to a twofold criterion of regional coverage and temporal updating.

2.1 INDICATOR SELECTIONS

The 266 NUTS2 regions belonging to the EU28 member states are investigated. The indicator set consists of 9 elementary indicators, shown Tab.1, organized by three main descriptive profiles of regional smartness: absorptive capacity, innovation system and digital agenda (see, PICTO, 2013).

It is worth noting that the indicator set is rather heterogeneous, both as type of variables included and temporal reference, i.e. the digital agenda profile being the only one recently updated.

To provide comparable measures, the elementary indicators have been normalized between 0 and 1000, by using a MIN-MAX formula. Regional synthetic indices have then been computed by applying two different techniques:

- Simple Averages of the set of normalized elementary indicators. The resulting Synthetic Index is used for ranking the regions;
- Principal Component Analysis, carried out with the STATA software package. Representative indices for the analytic profiles are derived, which are used for computing region-to-region distances among regions (this operation mainly refers to step c of the core approach mentioned in the introduction)[1].

[1] The PCs for the Absorptive Capacity and Innovation System profiles accounts for 94 % of the variance of the original indicators. The PCA for the Digital Agenda profile accounts for about 78%.

PROFILE	INDICATORS AND MEASUREMENT UNITS	PIEDMONT	ITALY	EU28	YEAR
Absorptive capacity	A. First and second stage of tertiary education attainment (ISCED 5 and 6) - % of total	15,1	15,7	27,6	2012
	B. Human Resources in Science and Technology (HRST total)[2] - % of total population 15-74 y	21,9	21,2	30,3	2012
	C. Human Resources in Science and Technology (HRST core) - % of total population 15-74 y	7,3	7,0	12,1	2012
Innovation System	D. Total R&D personnel and researchers - % of active population	1,13	0,91	1,08	2011
	E. Total intramural R&D Expenditure - % of GDP	1,88	1,25	2,04	2011
	F. Patents application to the European Patent Office – per million of inhabitants	105,3	72,4	111,4	2009
Digital Agenda	G. Household with broadband access - % of households	65	68	79	2013
	H. Individuals regularly using the Internet (at least once a week) - % of individuals	57	56	72	2013
	I. Individuals who ordered goods or services for private use - % of individuals	19	20	47	2013

Tab.1 List of indicators by analytic profile

2.2 CALCULATING THE REGIONAL DISTANCES

The notion of distance is here understood as a two by two measure of regional dissimilarities for a set of selected indicators. In this case, the regional distances are based on the PCA values associated with the three analytic profiles. Let Xij be the indicator matrix, where i indicates the region (i=1, l,.. N, where N=266) and j represents the PC value for an analytic profile (j= 1,....K, with K= 3). Each element, dil of the Dil regional distance matrix is calculated as:

$$d_{i,l} = \sqrt[2]{\frac{\sum_{j=1}^{k}(Xij-Xlj)^2}{k}} \quad (1).$$

To visualize the Dii matrix in a 2-dimensional space a Multidimensional Scaling metric iterative algorithm has been applied using the UCINET software package. This technique permits to map the NxN distance values in a 2-dimensional space in such a way that the original distances among regions are preserved as well as possible. Besides making it possible to visualize the original data, the mapping allows us to have a more effective representation of the positioning of regions within the overall European regional space.

[2] HRST is defined according to the Canberra Manual as a person fulfilling at least one of the following conditions: Qualified (successfully completed education at the third level in a S&T field of study; Employed (not formally qualified as above, but employed in a S&T occupation where the above qualifications are normally required).The conditions of the above educational or occupational requirements are considered according to internationally harmonized standards (ISCED and ISCO).
The HRST TOTAL indicator measures the percentage of persons qualified OR employed in S&T; the HRST CORE indicator measures the percentage of persons qualified AND employed in S&T.

2.3 UPDATING REGIONAL DISTANCE BY RELATIONAL DATA

A strong assumption made in this study is that collaborations or partnerships among regions, whereby these are relational entities by definition, may reduce the regional distances, which in this application, are based on regional structural determinants.

To explore the impact of such an assumption, we made reference to the network of regional collaboration, obtained from the database which records the participations to the FP7-ICT projects (European Commission, 2013)[3].

Operationally, each cell of the D_{il} matrix (1) has been multiplied by a coefficient, c_{il}, calculated from the matrix of regional partnerships in FP7-ICT projects as follows:

$$c_{il} = \frac{1}{1+\ln(1+Pil)} \qquad (2)$$

where p_{il} is the number of regional collaborations established in the FP7-ICT projects. From (2) a new distance matrix, ED_{il}. is obtained which can be processed to provide and a new visualization of the European regional space.

Making reference to the approach mentioned in the introduction, it is worth underlining that this operation can be viewed as a refinement step b of the procedure.

3 MAIN RESULTS

Table 1 lists the best and worst performing regions according to the Synthetic Index. It also displays the values of both the elementary indicators and the regional mean distances as well as the distances to Piedmont from each region.

			Ranking										*Distances*	
			Absorptive Capacity			Innovation System			Digital Agenda			*Synthetic Index*	*Mean value*	*to Piedmont*
Rank	NUTS	Name	A	B	C	D	E	F	G	H	I			
1	DK01	Hovedstaden	46,2	47,1	24,0	3,68	5,08	293,8	87	94	83	*784,1*	*4,13*	*5,02*
2	FI1B	Helsinki	48,9	50,9	23,6	2,88	4,35	414,4	92	93	73	*779,2*	*4,05*	*5,01*
3	UKI1	Inner London	63,0	59,4	28,4	2,04	1,21	89,74	94	93	82	*747,6*	*4,33*	*5,60*
4	SE11	Stockholm	44,4	50	22,6	2,18	3,77	425,4	93	95	77	*747,5*	*3,62*	*4,65*
5	BE31	Prov. Wallon	51,2	47,9	19,6	3,13	8,92	230,0	82	85	52	*725,6*	*4,34*	*4,94*
262	EL24	Sterea Ellada	17,2	15,5	5,8	0,32	0,44	6,61	40	42	15	*58,4*	*2,85*	*4,37*
263	RO22	Sud-Est	12,2	13,4	5,1	0,07	0,11	0,30	56	45	4	*49,8*	*2,86*	*4,04*
264	RO21	Nord-Est	13,1	14,1	6,5	0,1	0,3	0,53	47	43	7	*45,2*	*2,90*	*4,09*
265	EL22	Ionia Nisia	14,7	13,5	5,6	0,13	0,09	3,91	40	42	15	*36,6*	*3,00*	*4,15*
266	RO31	Sud-Muntenia	11,5	12,7	5,3	0,11	0,38	0,39	50	39	6	*31,1*	*3,03*	*3,58*
203	**ITC1**	**Piedmont**	**15,1**	**21,9**	**7,3**	**1,13**	**1,88**	**105,3**	**65**	**57**	**19**	***221,85***	***2,05***	*0*
	IT	Italy	15,7	21,2	7,0	0,91	1,25	72,5	68	56	20			
	EU28	Eu. Union	27,6	30,3	12,1	1,08	2,04	111,4	79	72	47			

Tab.1 Elementary indicators, synthetic indices and distances for the 5 top and bottom regions in the regional ranking

(*) Make reference to Table 1 for the alphabetic encoding of the elementary indicators

3 A technical note describing this collaborative network for Piedmont is available from the authors upon request.

An examination of the table shows that Piedmont is in lower part of the ranking (it ranks 203 out of 266 regions). Weaknesses are more significant for the Absorptive and Digital Agenda profiles.

It is worth noting that, overall the best performing regions hare higher mean distance values than the regions at the bottom of the ranking. This suggests that the best performing regions are relatively more isolated, as clearly shown in the MDS visualization of Fig.1[4].

Distances from the best performing regions to Piedmont are also greater those from the worst performing ones.

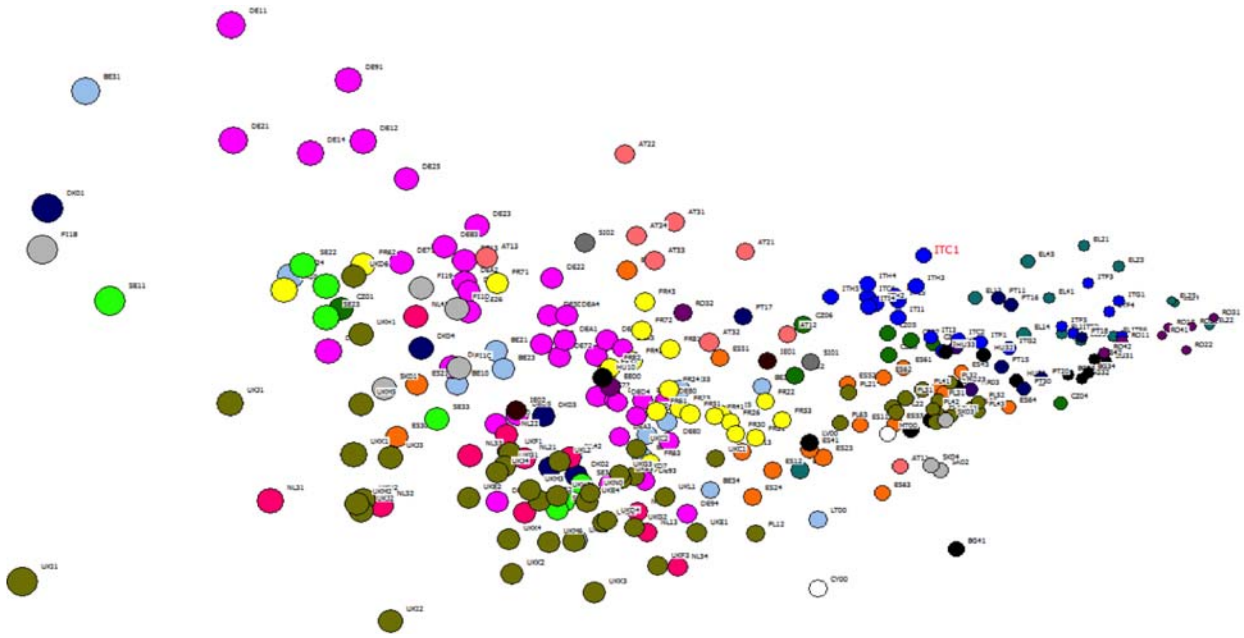

Fig.1 MDS visualization of the distribution of the European regions according to the D distance matrix (*)

(*) The size of dots is proportional to the value of the Synthetic Index. Blue dots: Italy; pink dots: Germany; yellow dots: France, Green dots: UK; orange dots: Spain.

The map of Fig.1 makes it straightforward to appreciate the regional proximity space, thus providing a richer interpretative lens of the regional smartness profiles. As for Piedmont, for example, it shows that: a) the region is situated in right part of the map, where the less performing regions are grouped; b) the region is far away from the best performing regions many of which stand alone in the left part of the map; c) its surrounding regions are mostly Italian.

When considering the impact of the updated regional distances ED (see eq.2), a quite different layout appears, Fig.2. Not unexpectedly, regions appear more evenly scattered and the regions surrounding Piedmont are also different.

[4] A map for each main descriptive profile of regional smartness (absorptive capacity, innovation system and digital agenda) has also been produced and is available from the authors upon request.

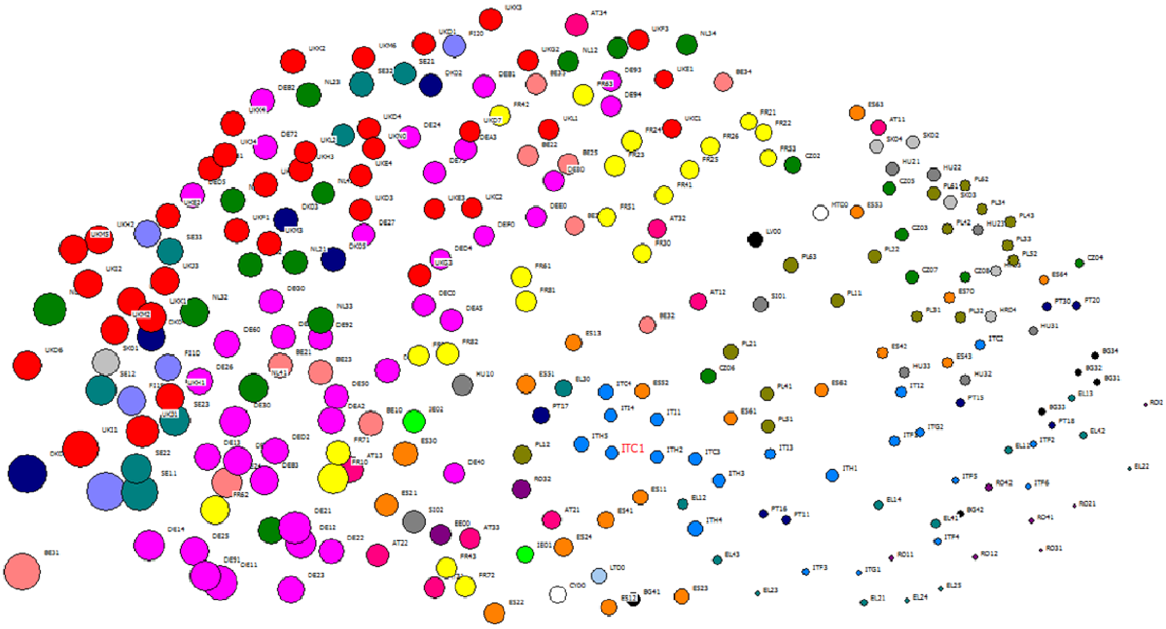

Fig.2 MDS visualization of the distribution of the European regions according to the ED distance matrix (*)

(*) The size of dots is proportional to the value of the Synthetic Index. Blue dots: Italy; pink dots: Germany; yellow dots: France, Green dots: UK ; orange dots: Spain.

Changes in the pattern of Fig.2 can be more easily appreciated by comparing the distributions of the D and ED distance values for Piedmont and for the all regions, whereby the values are ranked from the highest to the lowest value of the regional Synthetic Index, Fig.3. Their examination shows that the ED distance matrix does make the regions get closer to each other and that the effect seems relatively more accentuated positive for the Piedmont region, Fig.3a.

If, therefore, we maintain the original argument that regional collaborations would have a positive role in regional convergence processes, it is not unlikely that the FP7-ICT partnerships might have given Piedmont an opportunity to get contacts with the European regions endowed with a comparatively more robust smartness profile, thus giving the region a chance to enhance its own profile.

We expect in fact that as a result of the ED matrix application a shuffling in the regions surrounding Piedmont will occur and tend to bring closer those regions with a more robust smartness profile.

To explore the hypothesis we computed the means of the normalized elementary indicators for the group of regions (those included in the first distribution quartile) closest to Piedmont according to the D and ED distance matrices and compared them with the Piedmont profile.

The results of the investigation are displayed in Fig.4. They show that the Piedmont Innovation System profile is relatively robust and performs better also after the shuffling. The latter seems to be more successful in bringing Piedmont closer to regions with relatively stronger Absorptive Capacity and Digital Agenda profiles.

3. CONCLUDING REMARKS

This study is a contribution to refine current approaches to the assessment of regional smartness. It contends that sound methodological approaches have an encompassing role in making more sense-able territorial evidence. Methodological refinements in fact can have a positive impact on the recognition of regional smartness profiles and on how to inform smartness policy oriented initiatives in practice.

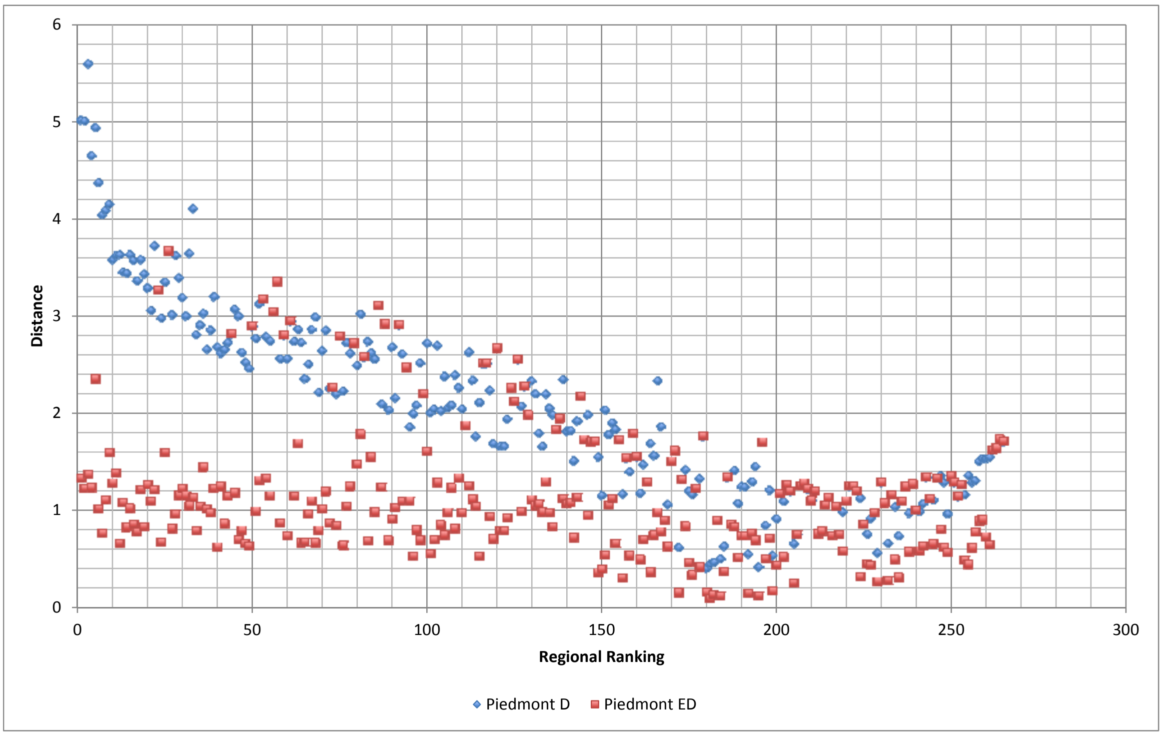

Fig.3a Region to Piedmont distances

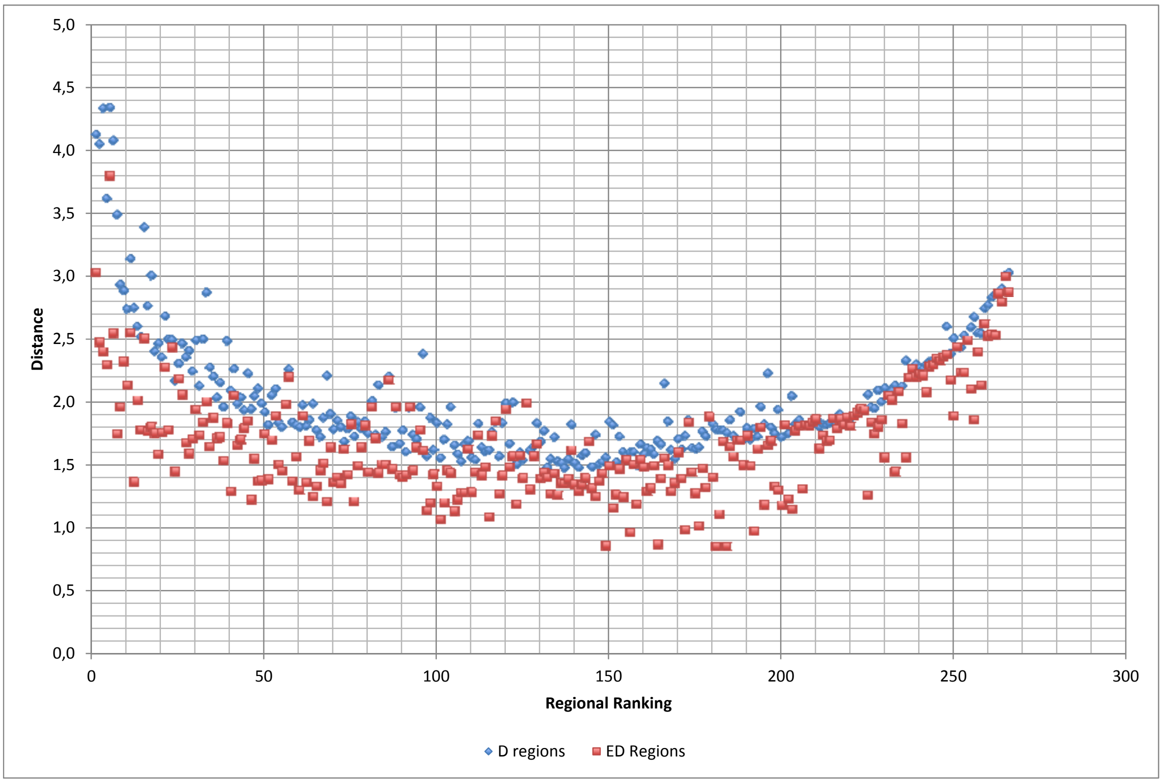

Fig.3b Mean regional distances

Fig.3 Region to Piedmont (D and ED) distances (3a) and of the mean regional (D and ED) distances (3b), by regions ranked by the Synthetic Index value

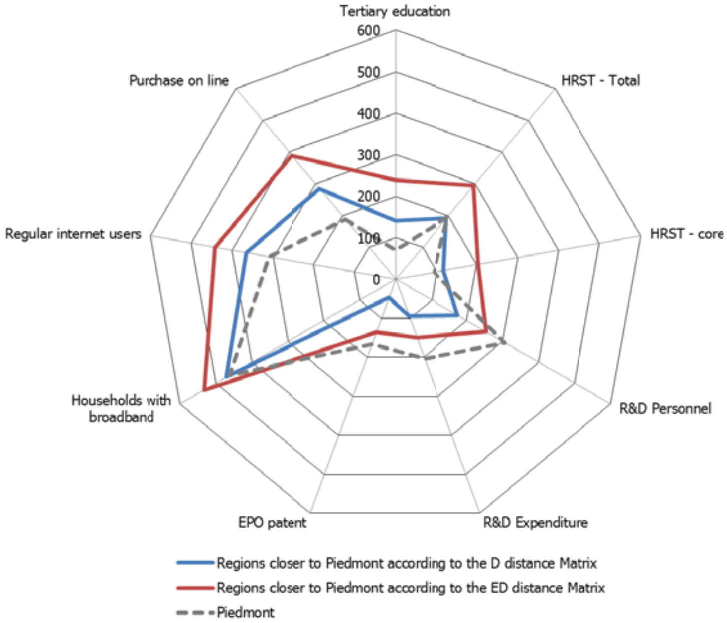

Fig.4 Indicators' profiles for Piedmont and the group of regions closer to Piedmont according to the D and ED distances

This contention ultimately underlies the Europe 2020 strategy and inform several of the key recommendation made by Espon for more effective place-based 2020 policy actions (Espon, 2014).

In this respect further work is needed to sharpen the approach, improving the methodological side, i.e. by developing a network centric multi-layered analysis, and gathering a wider set of pertinent relational data.

On a broader ground, this paper is, to some extent, a challenge to the current fix about smartness. It suggests a more modest view, one which builds on the contention that, after all, smartness is in the eye of the beholder. Training the ability to see smartness and create the conditions for stakeholders to progressively build it, is therefore, is a major endeavor to be undertaken.

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Fig.1 : Eurostat

Figg. 2, 3, 4: Eurostat , Digital Agenda Scoreboard.

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PLANNING UN-SUSTAINABLE DEVELOPMENT OF MEZZOGIORNO

METHODS AND STRATEGIES FOR PLANNING HUMAN SUSTAINABLE DEVELOPMENT

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ABSTRACT

Growing like “wildfire”, traffic congestion, the spread of pollution, the inefficiency of the services, the chaotic mix of land uses, lack of green are some of the features, unfortunately now become familiar in cities across the world.

This is an interesting time for both examine the tools available to urban planners expression of for the analysis and definition of policies both to see how they have adapted to the new conditions.

A betterenvironment and qualitylandscapes are necessary conditions for attractinginvestments, assets and people. But they are not sufficient. It shouldalsobe a social and humanlandscapequality to trigger local development.

For example, consider the network of "slow city". It was founded as a cultural and proposal of new lifestyle. But that possesses significant practical implications in terms of more balanced regional development, because polycentric. The same report city / country is improved by slow development of these practices. They are able to reduce the depopulation and activities to the centers of larger size, reducing costs (congestion, agglomeration, overuse of resources) both in the areas of concentration in the internal ones (better use of resources, maintenance / control of the territory, etc.).

KEYWORDS

Development, Sustainability, Recycling

1 INTRODUCTION

The crisis of the city sit as a place of maximum concentration and specialization of activities on the territory undeferrable makes a radical rethinking of the scientific and technical the specific discipline of those who, like us, studying the city for to understand, to identify ways of guidance and control, to define trajectories of evolution. Growing like "wildfire", traffic congestion, the spread of pollution, the inefficiency of the services, the chaotic mix of land uses, lack of green are some of the features, unfortunately now become familiar in cities across the world.

They are some of the inevitable consequences of the enormous concentration of population and activities that cities have become more serious consequences were often from the high speed of growth and lack of planning and coordination, not only. These are some of the factors behind the recent major changes with the appearance of new development models mark not only in urban areas but the entire territory.

This is an interesting time for both examine the tools available to urban planners expression of for the analysis and definition of policies both to see how they have adapted to the new conditions.

1.2 THE CURRENT FRAMEWORK

The general framework of departure gives us a reality southern characterized by now well-known historical and Shortcomings that greatly reduce the attractiveness of the area: the network of physical infrastructure, the level of specialization of services (extremely low) in the low participation of different actors the various projects, in other words, the limited availability of capital in Mezzogiorno (which means poor coordination in the activities and actions very often means conflict between different actors instead of cooperation):

- institutional fragility;
- increasing level of lawlessness,
- lack of innovative capacity of cities which results in reduced production processes of wealth.

Also the potential in Mezzogiorno is still very high, because:

- Mezzogiorno has a lovely location in the Mediterranean who is a context in a dynamic evolution: the South itself as a great platform logistics - with its port facilities, its transportation infrastructure - in a more interesting relationship with the Far East, and other geographic locations (the north-western and the south-east) of the South itself;
- Mezzogiorno has a high potential consequent to his unique cultural landscape, which is characterized by its artistic heritage, architectural, environmental, cultural, unique in the world for its extraordinary beauty;
- the creativity of its people and the innovative capacity of some of its research facilities remains high.

The question that arises is: why this potential is hard to translate into concrete reality? Hard to translate into greater ability to attract and entrepreneurial skills? Hard to translate into greater competitiveness? Why does not reduce the gap between expert knowledge (new knowledge, research) and practical knowledge (practices)?

The town and city networks are the critical element in promoting economic development in the South. Urban issues, environmental issues and the issue of culture are closely intertwined: one leads to the other and vice versa. For example, economic development, can be born as a reaction to environmental degradation, and generate or less capacity for self-organization. Of course, we do not have recipes: we can only prepare proposals and considering very carefully the results of that trial.

2 UN-SUSTAINABLE DEVELOPMENT IN THE SOUTH

Today there is no programmatic document regional, provincial or municipal level that does not make formal reference to the promotion of sustainable development. But the "facts" go in a completely different direction from the "principles." You may remember some of these "facts":

- continued loss of biodiversity in many areas;
- the increasing scarcity of water resources, natural, scenic;
- the pollution of soil, air, water (with human and eco system damage to the human health).

Environmental degradation is the general context in which it accelerates – above a certain threshold then critical – the progressive loss of employment, reduction in the level of income, loss of ability to export etc., namely the economic and social degradation.

Sustainable development is characterized by a strong promotion of "relations" and then for the promotion of synergies through coordination of actions / choices. The savings from synergies are to be considered today the most significant economies of scale or agglomeration.

The environment is one of the "commons" that everyone can enjoy, as well as the land, climate stability, water, landscape, cultural heritage, etc. For example, if we focus our attention on the environment as a common good it becomes a resource to be preserved and protected in a responsible manner, exceeding the vision of the environment to be "used" instrumentally and to take the necessary resources to the economic system that waste products for download.

The reality is that in the South the most important areas in industrial tradition have become sites of major environmental crisis. Many of these are port areas / coastal. I'm a pretty well-known as the industrial areas of Taranto, Augusta-Priolo, which must be added those of Naples (Bagnoli-Coroglio), all the Domitian coast. They are in "competition" with Livorno, Piombino, Portomarghera, etc. The negative impacts on eco natural system and human health are massive.

Taranto (with the largest steelworks in Europe is included among the 14 areas with the highest environmental risk due to the concentration of industry (Ilva, Eni, Edison, Cementir, etc.). Resulting therefore pollutants such as benzene, carbon monoxide, sulfur , nitric oxide, zinc, chromium, lead, cadmium, arsenic, particulate matter and nanoparticles. At Priolo, where he was made one of the largest petrochemical complexes in Europe (Erg, Esso, Syntal, Isab Energy, Polimeri Europa, etc.), The ecological damage at the same time respect the land, air and sea water, with the well-known consequences on the health and eco systemic.

Fig. 1 ILVA Taranto

The metropolitan area of Naples (where the incinerator is located the largest in Europe) has a fine particulate pollution among the highest in Italy combined with the pollution of the waters of the Gulf, with the mismanagement of waste on the territory (from the rest of the country), with the illegal building. Widespread environmental degradation characterized in short, in a more or less homogeneous, the cities of the South In fact, prevailed – in the industrial activity of the southern cities – an attitude utilitarian / instrumental towards the environment.

Fig. 2 Incinerator of Acerra, Naples

It was regarded as a quarry from which to extract everything you need to produce and how to dump waste.
How can you get out of this situation of "vicious circularity" which increases the discomfort, marginalization and suffering? We need a highly innovative / creative to avoid systemic collapse eco overall and then to actually implement sustainability in our cities. It is an essential element that is based on the quality of human capital and social capital. These are the two most important forms of capital to promote sustainable human development.

2.2 LANDSCAPE IN THE CITIES OF MEZZOGIORNO

The problem of Mezzogiorno has been interpreted as an urban issue (Cafiero 1977). In fact, the wealth of a country or a region is produced in the city. Yet it still lacks a national urban policy / south.
The cities of Mezzogiorno are more demographically too large in relation to their productive capacity and employment, and therefore (not being self sufficient / self sustainable) require a continuous transfer of public spending. In recent years inward investment has been represented in particular by the EU structural funds, with poor results due to the dispersion of those investments to objectives and areas not well explained. The use of EU funds for urban regeneration in the period 2000-2006 on the axis it is preferred to disperse the available resources rather than concentrating them in specific integrated projects, reducing its effectiveness. The landscape quality is a formidable factor in the competition between attractive territory and represents a comparative advantage in a geographic location to another. A degraded landscape is not attractive, but rather rejects investment activities. The question becomes: how to transform this potential resource of Mezzogiorno in real asset in the promotion of local development? How to preserve, enhance and

manage the assets for the urban regeneration of the city and the region? The knowledge / culture, preservation of cultural heritage that sees the cultural and natural resources as a catalyst for tourism development but also to add value to local production of goods and services related to local identity represent circuits of value creation that integrate the strategic model of new urban base.

2.3 CITIES ARE INCUBATORS OF NEW CREATIVITY

Today there are about 60 cities in the world have themselves with this label: Vancouver, Toronto, Ottawa, Glasgow, Yokohama, Brisbane, are just some of the most famous examples. It is mostly coastal cities and ports.

Fig. 3 View of a new Smart City

Often they have chosen to base their new development strategy on the creative industries (media, design etc.), integrating the production of traditional physical infrastructure (urbanization, equipment, specialized services, financial services, etc.) with infrastructure assets (urban landscape attractive, lively cultural atmosphere, etc.). In this way, they are becoming more and more attractive not only for tourists but also to the highly skilled workforce and external investment.

A creative city requires, however, beyond all the different definitions, a strategy that is based on a strong vision of the future in the long term. The construction of this vision is itself a creative act. In turn, it requires a creative governance and leadership as creative to be implemented in time and space.

The thread that binds all, however, the successful experiences of creative cities is the ability to combine multiple and heterogeneous elements, the ability to synthesize original, weaving together elements of tradition, which constitute the identity of the city, with modernizing more push prompted by an increasingly globalized.Another element that characterizes good practice is a strong investment in education / training and research, to promote a common way of thinking, critical and creative together.

3 SLOW CITY: STRATEGIES OF SUSTAINABLE DEVELOPMENT

At the macro level lacks a national policy for the city. Interesting experiences are found only in a few cities, and in particular in the city of small size.

The experiences of the "virtuous community," Grid "Slow City" may offer a number of good practices from which to learn how to make the circuit saving, reuse, recovery, recycling, reclamation, renewable, and most importantly how to transform the ecological, territorial in cultural / civil values.They offer interesting interpretations of what is called "good governance" especially from an environmental perspective (often caught in a systemic dimension). Represent concrete examples of creativity to promote sustainability. For example, consider the network of "slow city". It was founded as a cultural and proposal of new lifestyle. But that possesses significant practical implications in terms of more balanced regional development, because polycentric. The same report city / country is improved by slow development of these practices. They are able to reduce the depopulation and activities to the centers of larger size, reducing costs (congestion, agglomeration, overuse of resources) both in the areas of concentration in the internal ones (better use of resources, maintenance / control of the territory, etc.).
The slow city were born as a reaction to the faster, the bigger, the North American culture of instant cities, and have embraced a philosophy (shared both Abbiategrasso, Chiavenna, Fontanellato that from Amalfi, Positano, Pollica, Trani, Francavilla al Mare, up of slow city of Sicily etc.) reaction to the increasing de-contextualization.

Fig. 4 CitySlow, scheme

This culture is very slow assonant culture of sustainable development. It produced trajectories of local self-sustainability. The development strategy of slow city starts from the recognition and enhancement of local identity, of what is specific in the territory, culture and geography of places and determines a comparative advantage. The culture promotes a slow redevelopment of the area, enhancing agricultural production (especially biological), craft production, livestock production, the gastronomic etc..
At the same time preserves the landscape and makes it attractive for the application farm, thanks to a multifunctional approach, which protects the use values but also the values of existence of the landscape itself.

4 CHARACTERISTICS FOR A NEW GOVERNANCE

A new governance is absolutely essential to promote creativity / innovation and to improve the resilience of ecological, economic, social, cultural city and then to actually implement sustainability. Through the preservation, enhancement and regeneration of the "places", the involvement of the third sector contributes significantly to urban resilience.

Since 2008, we see a steady reduction of available public resources and therefore the need to achieve the maximum result, the maximum efficiency in the use of increasingly scarce resources that you have. It is clear that in this context the processes of efficient use of available local resources (planning, efficient / effective, etc.). Become absolutely essential for urban policies.

These assessment processes, in other words, should serve to innovate / adapt constantly and creatively policies that are being implemented in the territories in choosing among alternatives.

The new urban governance must bridge the gap between theoretical and practical operational practices processing, building bridges of communication between the city and research, in order to transform scientific knowledge into urban policies for sustainable development.

The new governance must be based on solid theoretical foundations and empirical evidence of good. It always promotes new partnerships between public, private and civil sector / social. A new governance is required at both strategic and tactical operational and to stimulate innovation.

A feature of the innovative governance is the recognized importance, particularly in the experiments, projects - pilot, the specific catalyst actions, which must be carefully evaluated in their impacts in the short, medium and long term, in order to produce new knowledge and better choices.

5 CONCLUSIONS

A better environment and quality landscapes are necessary conditions for attracting investments, assets and people. But they are not sufficient. It should also be a social and human landscape quality to trigger local development. However, if you want to carry out the general principles of a new development which respects the environment and human and sustainable development, we need to invest in creativity and innovation.Many cities in Europe and the world are moving in the direction of the green economy, with employment benefits as well as economic and environmental well. Are significant examples of New York, San Francisco, Boston, etc. How are denser networks and circular relationships between research, business, public institutions, providers of finance and civil society, the greater the success.

The brownfield sites and the port areas are the entry point where you can try out a development strategy that turns problems into opportunities. Need entrepreneurs capable of organizing the recovery, reuse, recycling, regeneration of materials in the production of compost in the clean economy, in the handicraft production of excellence in the field of knowledge / culture, stimulating circularization.

Mezzogiorno is an area in which the model of sustainable human development can be applied with success from its town if you fail to meet certain conditions, which promote new energy "from below." And necessary to promote cultural workshops, to develop and test new paths towards a culture less crushed economically and more open in the reciprocal exchange / intersubjective, interdependencies, capable of enhancing relationships, to consider the values itself, and not only instrumental values, the medium-long term and not just short.

The above is essential to integrate resilience ecological / economic capital with the cultural one. Without the spread of this culture, any effort exclusively technical, organizational, management is doomed to failure.

The South will be able to configure itself concretely as a great laboratory for experimentation / reconfiguration of this strategy?

Fig. 5 Green Jobs, scheme

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Fig. 3: IBM Sources

Fig. 5: Center for American Progress

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THE FACTORS INFLUENCING TRANSPORT ENERGY CONSUMPTION IN URBAN AREAS

A REVIEW

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ABSTRACT

Transport energy consumption accounts for about one third of total energy consumption in EU. Despite significant advances in transport technology and fuel formulation, transport energy consumption has increased in most EU countries over the last three decades. This increase in consumption occurred as a result of factors such as higher car ownership, a growth in automobile use and an increase in vehicle distances traveled. As travel and land-use are a function of one another, it is often hypothesized that changing urban structure can result in changes in energy consumption. Understanding how different land use characteristics may influence travel behaviour and the corresponding energy consumption is crucial for planners and policy makers in order to develop strategic actions to shrink the environmental footprint of the urban transportation sector. The aim of this article is to review the current literature on the connections between land use, travel behavior and energy consumption. In particular, this paper seeks to identify the determinants of transport energy consumption in urban areas by reviewing evidence from empirical studies. To this aim, nine characteristics of land use are presented and their effects on both travel behaviour and energy use are discussed Our review shown that, in contrast to the focus on the effect of the built environment on travel, only few researchers have empirically investigated the linkage between the built environment and transportation energy use. The research described in this paper has been developed within the PON 04a2_E Smart Energy Master project. It represents part of a much broader research project aimed at the development of an integrated model of urban energy efficiency.

KEYWORDS

Transport energy consumption; Land use; Travel behavior

1 BACKGROUND AND GOALS

The energy challenge is one of the biggest issues facing Europe today. In 2012, EU-28 final energy consumption reached 1.104 Mtoe - approximately 15% of the world's energy consumption (Eurostat, 2012). A third of this amount was consumed by the transport sector (31.7%), the most energy-demanding sector, followed by households (26.6%), the industrial sector (25.3%) and services (20.4%). Over recent decades, there has been a decoupling of the energy consumption from the GDP although transport energy consumption has increased much more than in other sectors (European Commission 2012). Long-term forecast to 2030 suggest that energy consumption in Europe will increase in all major sectors and that the transport sector will experience the most rapid growth, increasing by 28% between 2000 and 2030 (European Commission, 2003).

Analyzing the transport energy consumption in the 27 European Countries at 2012 is possible to observe that there are large variations between countries.

Differences in income levels, fuel prices, urban structures and life-styles are some factors that explain these differences. These variations are even more noticeable at urban scale, especially comparing European cities with American and Asian cities. The overall energy use per passenger kilometer varies between 3,20 MJ/p.Km of US cities and 1,40 MJ/p.Km of high income Asian cities, while in the Western European cities energy use per passenger kilometer is 2.17 MJ/p.km (Kenworthy and Laube, 2001). Over the last two decades, significant advances in transport technology and fuel formulation has been reached. Due to national fiscal measures increasing taxes on inefficient cars and to high motor fuel prices, the specific consumption of new cars has decreased by 2.1 %/year on average for the EU between 1990 and 2010 (European Commission, 2012). However, neither the energy efficiency performances of new cars, nor national fiscal measures alone have shown to be able to reduce transport energy consumption (ibid). A first explanation of these trends may be found in the evolution of travel behaviour. The current trend is for more and longer trips mostly by private car and a reduction in the share of public transport in passenger traffic (European Commission, 2007). These changes in travel behaviour in turns are considered the results of important changes on urban features (Gakenheimer, 1999; Camagni et al., 2002; Li, 2010).

Given these premises, it is clear that transport energy consumption, travel behaviour and land use characteristics are strongly related. Understanding these connections is crucial for land-use planners and policy makers in order to implement strategies to shape sustainable mobility and to design and evaluate land use and transport policies aimed at reducing transport energy consumption in urban areas.

The purpose of this article is to review the current literature on the influence of land use characteristics on travel behavior, and further, on energy consumption.

In particular, this paper seeks to identify the determinants of transport energy consumption in urban areas by reviewing evidence from empirical studies. Despite some studies have identify the socio-economic profile of the population as the main explanation for travel behaviour and energy consumption (Stead et al., 2000; Mindali et al., 2004; Echenique et al., 2012), this discussion is limited to the influence of land use characteristics on travel behaviour and energy consumption. Indeed, although we recognize that land use factors are certainly not the only factors influencing both travel behaviour and energy consumption, we argue that they can provide the infrastructural and spatial conditions for a sustainable lifestyle, or, inversely, spatial constraints that can impede the adoption of such a lifestyle.

In addition, we to point out that land use factors can be worked out (within a certain extent) more directly by local planning instruments.

The work is organized as follow: the first part aims to briefly discuss the literature on the connection between land use, travel behavior and energy consumption. The second part focuses on nine land use characteristics that may affect travel behaviour and transport energy consumption. Finally, conclusion and major findings are presented.

1 CURRENT LITTERATURE

Stimulated by the increasing awareness that trends in urban mobility patterns are unsustainable, there is a large and still growing number of empirical studies on the relationships between urban form and travel patterns. A substantial body of literature on this theme has been produced since the 80's. Only between 2000 and 2009, more than 200 articles have been published on scientific journals (Ewing and Cervero, 2010). These studies usually examine one or more hypotheses about the expected effects of specific land use characteristics on trip frequency, trip lengths and travel mode or about the effects of changes in these characteristics either through the course of time or through planning policies. Aggregate studies on these themes were more favored in the early stage of the research, although some aggregate study has been produced in recent years. Yet, surprisingly, despite the substantial body of literature, still little consensus has been reached to date about how the built environment affects travel behavior. Some researchers, such as Boarnet and Sarmiento (1998) and Giuliano and Small (1993), showed that land use variables provided little explanatory power for observed travel. Others, including Krizek (2003) and Shen (2000), found that households change travel behavior when locating in differing built environments.

So far, relatively few researchers have empirically investigated the linkage between built environment and transportation energy use. It may be due to the lack of reliable energy data or because it has been often assumed that when longer distances are driven, more energy is consumed. Furthermore, many studies, such as those of Dodson and Sipe (2008), focus on home-to-work travel only to quantify the sustainability of travel patterns. Only in studies focusing on a small-enclosed area, different kinds of trips have been incorporated, as was done by Saunders et al. (2008). Even less conclusive is the extent to which the urban form impacts household energy consumption. Some authors believe that built environment factors such as higher density are expected to lead to a decrease in transportation energy consumption (Newman and Kenworthy, 1988; Karathodorou et al., 2010 among others). Some are more cautious and suggest that urban form factors are, at most, playing a partial role. Other factors, such as income and fuel prices are more important in influencing travel and energy consumption (Mindali et al., 2004; Susilo and Stead 2008).

Despite built environment, mobility patterns and energy consumption intertwine with each other, the existing studies has investigated how built environment affects people's travel behavior and travel outcomes (i.e. energy consumption and emission) in an isolated way. Only in recent years studies such as Liu and Shen (2011) or Brownstone and Golob (2009) has attempted to provide an unified pictures of the relationships between built environment, travel behaviour and transport energy consumption. These studies have specify and estimate structural equation models, a very powerful statistical modeling technique to handle a large number of endogenous and exogenous variables and to estimate the interactions among these variables by calculating direct effects, indirect effects, and total effects.

In the next section, nine characteristics of land use are presented and their effects on both travel behaviour and energy use are discussed. This work has necessitated a certain amount of compartmentalism into discrete land use categories. For this reason, some definitions may be overlapping or nested within each other. However, an explicit categorization of land use characteristics results very useful for the identification of the similarities and the differences between studies.

2.1 CITY SIZE

An important contribution in the study of the relationships between city size and energy efficiency is offered by Banister (1992). Analayzing a sample of English cities, he found that the higher is the population, the lower is the pre-capita transport energy consumption. However, Banister observes that London is not an energy-efficient city and that English cities, which contain an excess of 25,000 persons but smaller than London, were the most energy-efficient. The results of this research show that energy efficiency is expected to increases with increasing population, but when the city size is over its critical level, energy efficiency tends to decrease because of congestion. Many researchers including Banister said that the efficiency would be better as the size of city grew but it would be worse in cities bigger than the optimal size. However, there is no consensus about the optimum size of efficient city.

2.2 URBAN STRUCTURE

Bertaud (2003) defines the urban structure as "the physical outcome of the subtle interactions over centuries between land markets, and topography, infrastructure, regulations, and taxation". In land use and transport research, concept such as "compact city" or "decentralized concentration" have been commonly used to describe different type of urban structure. However, evidence on the impacts of urban structure on transport energy consumption remain scarse. An important exception is the study of Shim et al. (2006). These authors have empirically investigate the relationships between urban form and energy consumption, using a sample of 61 Korean cities. They used the Gini coefficient for population concentration as a factor indicating the degree of population concentration. They studied and classified the cities as mononuclear or multinuclei with regard to the center distribution. By comparing the population Gini coefficient with yearly gasoline consumption per automobile and per person, Shim and his colleagues found that the energy efficiency is generally low in mononuclear cities, whereas the energy efficiency is high in multinuclei cities.

2.3 ROAD DENSITY

The road density, generally measured as the ratio of road length per urban area, is a useful parameter able to synthetically describe the provision of road infrastructures of a certain urban area. Su (2011) studied the effect of freeway road density, congestion and population density on household gasoline consumption in 50 U.S. urban areas. Using both semiparametric and parametric approaches, he found that households living in those urban areas with higher freeway densities, higher levels of congestion, or lower population densities consume more gasoline. Based on these findings, he concluded that "since gasoline consumption and road density are positively correlated, building more roads to reduce congestion clearly is not a good idea". The hypothesis of a positive relationship between road density and travel demand in terms of vehicle miles traveled has been tested in various studies (Fulton et. al., 2000; Nolan and Cowart, 2000 among others) with results supporting the hypothesis. These studies support the concept of induced demand, in accordance with which the additions to roadway capacity result in increases in vehicle travel on the roadway above the level that occurred before the capacity addition.

2.4 POPULAION DENSITY

Population density, measured as the number of people, dwellings or households per square kilometers is probably the land use factor that has received more attention in the literature. One of the most cited studies on the relationships between density and energy consumption is that by Newman and Kenworthy (1989).

Using a sample of 32 cities in different countries and continents, they tested the influence of population density levels on the consumption of gasoline. These authors found that low-density metropolitan areas exhibit a higher pre-capita transport energy consumption and an almost total predominance of automobile use. In contrast, high-density metropolitan areas have a lower pre-capita transport energy consumption thanks to a greater share of public transport in passenger traffic. The conventional wisdom that there is a negative correlation between urban density and energy consumption in the transportation sector has been further supported by various studies. Karathodorou et al. (2010) used 84 cities from 42 different countries to investigate the impact of urban density on fuel demand. They concluded that density affects fuel consumption mostly through variations in the car stock and in the distances travelled rather than through fuel consumption per kilometer. Brownstone and Golob (2009) used the California subsample of the 2001 US National Household Travel Survey to test the impact of residential density on vehicle usage and energy consumption. Specifying a simultaneous equation model, they found that population density affects households' fuel consumption trough two main paths of influence: density directly influences vehicle usage, and both density and usage influence fuel consumption. Banister (1998) suggests that there are two important reasons why population density may reduce the ecological impact of mobility. First, higher density patterns result in a reduction of average distances between home and place of work; second, high densities may offer the proper conditions to foster successful public transport. These two hypothesis have been confirmed in numerous studies. For instance, Cervero and Murakami (2009) found a significant inverse effect of population density on vehicle miles travelled, while Giuliano and Narayan (2003) found that high level of density are positively related with a greater share in public transport.

2.5 LAND USE MIX

Land use mix is a measure of the integration of different activities (e.g. dwellings, workplaces, shops, schools and medical services) in a same area. Different measures of land use mix have been proposed in the literature like entropy indices (the variety of different uses in a neighborhood) or dissimilarity indices (the number of adjacent parcels with different uses). Both methods result in scores from 0 (least mixed use) to 1 (most mixed use). Another way to measure land use mix is using the jobs/housing balance ratio. Several studies have tested the hypothesis that mixed land use settlements allow for more walking and cycling trips and/or reduce travel distances. Wang et al. (2013) studied the relationships between land use mix and vehicle distance travel and emissions in conventional and smart growth communities. They found that vehicle miles traveled and CO2 emissions are lower for households that reside in mixed land use neighborhoods with good network connections. They suggest that as a long-term strategy, CO2 emissions reductions from smart growth developments can be substantial. Analysis by Sperry et al (2012) on a typical mixed-use site in suburban Dallas, shown that total trips increased, indicating induced travel, but many of these were walking trips, so total vehicle travel declined.

2.6 NEIGHBORHOOD DESIGHN

Neighborhood design includes street network characteristics within an area. Design can be measured using various indices, including intersection density, portion of four-way intersections, and portion of dead-end streets. Design is also measured as sidewalk coverage, numbers of pedestrian crossings or others physical variables that characterize pedestrian-oriented environments. Many studies tested the hypothesis that high intersection density and great street connectivity are positively related with a greater share of walking and cycling, as they shorten access distances to opportunities. Larco et al. (2010) studied 14 multifamily housing developments in Eugene, Oregon. Using both descriptive statistics and regression models, they found that increasing connectivity can significantly increase use of alternative modes. In particular, residents of more-connected developments were more than twice as likely to walk or bike to local amenities than residents in less connected locations. Urban sites with small blocks and extensive sidewalk systems were found to have, on average, three times the pedestrian volumes of suburban sites with large blocks and short or incomplete sidewalk systems.

2.7 LOCATION

Location refers to the relative position of a certain urban area with respect to the city center or, more in general, with respect to those areas with high concentration of urban activities. Several studies have analyzed the relationships between geographical location and energy consumption. Using multivariate analyses, Naess, 2010 tested the influence of dwellings' location on travel and energy use in the Hangzhou Metropolitan Area, China. The location of dwelling was described using three variables: location of the dwelling relative to i) the city center of Hangzhou ii) the closest second-order center iii) the closest third-order center. His analysis shown that living close to the city center contributes to less overall travel, a higher proportion of trips by bicycle and on foot, and lower consumption of energy for transport. The location of the dwelling relative to the closest second-order and third-order center also has some influence on transport energy consumption, but not to the same extent as proximity to the city center. Naess and Sandeberg (1996) analyzed the commuting transport energy consumption of six important Swedish companies' employs. Their analysis indicate that the geographical location of jobs has a strong impact on commuting energy use. In particular, they found that employees of workplaces in peripheral, low-density parts of the urban area are far more frequent car drivers and use considerably more energy for journeys to work than employees of workplaces located in central high-density areas.

2.8 DESTINATION ACCESSIBILITY

Since the seminal pare by Hansen (1959), many definitions of accessibility and relative measures have been proposed in the literature (see Geurs and van Wee, 2004 for an extended review). However, in research on the influence of the built environment on travel behaviour, accessibility has been often measured using relatively simple indicators such as the number of jobs within a certain travel time. Levinson (1998) studied the effects of accessibility on the journey to work. Using data from a travel survey in the Metropolitan Area of Washington, he found that residences in job-rich areas and workplaces in housing-rich areas are associated with shorter commutes. Moniruzzaman and Páez (2012) investigated the implications of accessibility to transit and by transit for mode shares in the city of Hamilton, Canada. Modelling transit shares by means of a logistic regression, they found that accessibility by transit is a significant predictor of modal share. Owen and Levinson (2013) calculate accessibility for both transit and auto in Minneapolis urban area. They found that the modal accessibility disparity (i.e. the ratio between transit and car accessibility) is a valuable predictor of commute mode share.

2.9 DISTANCE TO TRANSIT

Distance to transit is a measure of the ease to access to public transport facilities. It can be measured as the straight-line distance or the network distance to a certain transport facility. As distance to transit represents the proximity of the demand (population and employees) to stops or stations on the network, many studies has tested the hypothesis of a direct relationship between distance to transit and transit likelihood. Crowly et al. (2009) examined how variations in walking distance to transit are related to mode choice as well as to car ownership and use. Their analysis shown a strong association between walk access and transit use, not only during peak hours but also throughout the day, concluding that the promotion of focused development within a convenient walking distance of transit service can significantly affect transit ridership even in a relatively low-density area.

3 CONCLUSIONS

With the growth in automobile use and increase in daily distance travelled, the transportation sector's shares of energy consumption is significant and increasing. As travel and land-use are a function of one another, many research has tested the hypothesis that changing urban structure can result in changes in energy consumption. Understanding how different land use characteristics may influence travel behaviour and the corresponding energy consumption is crucial for planners and policy makers in order to develop strategic actions to shrink the environmental footprint of the urban transportation sector.

FACTORS	EXPECTED IMPACTS
City size	Energy efficiency is expected to increases with increasing population, but when the city size is over its critical level, energy efficiency tends to decrease because of congestion.
Urban Structure	Energy efficiency is generally low in mononuclear cities, whereas the energy efficiency is high in multinuclei cities. However, positives studies about this are lacking.
Road density	An increase of road density is expected to increase energy consumption. According to the concept of induced demand, additions to roadway capacity result in increases in vehicle travel on the roadway (and the network) above the level that occurred before the capacity addition
Population density	Density has a significant inverse effect on energy consumption through several channels: increase in density are associated with i) shorter distance travelled ii) a highest use of public transport and iii) a higher ownership of fuel efficient private vehicles.
Land use mix	Mixed land use settlements allow for more walking and cycling trips. Traditional neighborhoods have shorter trips than car-oriented suburbs.
Neighborhood design	Neighborhood characterized by high intersection density and great street connectivity exhibit a greater share of walking and cycling, as they shorten access distances to opportunities.
Location	Some research has found a negative correlation between the distance to the city center and the transport energy consumption: living close to the city center contributes to less overall travel, a higher proportion of trips by bicycle and on foot, and a lower consumption of energy for transport.
Destination accessibility	Residences in job-rich areas and workplaces in housing-rich areas are associated with shorter commutes. Urban areas characterized by high transit accessibility level are associated with a great share in public transport.
Distance to transit	Distance to transit is considered the most important factor influencing public transport use.

Tab. 1 Factors influencing transport energy consumption

In this article a review of the current literature on the connection among land use, travel behavior and transport energy consumption has been presented. In particular, this article has identify and discussed nine land use characteristics that may influence transport energy consumption in urban areas by analyzing evidence from empirical studies. This review has explicitly categorised the literature according to discrete aspects of built environment, which allows for a clearer identification of the similarities and differences between studies.

The review has shown that there is a large amount of literature from around the world on the relationships between urban form and travel characteristics. Yet, surprisingly, despite the substantial body of literature, evidence remains so far contradictory. Van Wee (2002) identified several reasons of the causes for different results from research, including the difference in the width of the sample analyzed, the geographical scale, and cultural differences among countries, which may result in other effects of the same land-use concepts. In contrast to the focus on the effects of the built environment on travel behaviour, only few researchers have empirically investigated the linkage between the built environment and transportation energy use. Much of the empirical literature on transport energy consumption presents estimates derived from city level data, which account for variations within the cities but ignores the variability of land use patterns between places of the same city. Even at a more disaggregated scale, research in this field have often considered only few aspects of the built environment. These issues therefore call for more empirical work and more sophisticated and comprehensive description of the built environment. It is not enough to describe urban areas using aggregate statistics at city levels, nor using general characteristics such as density, size and distance to nearest center. In order to have a deeper understanding of land use-energy connection, we need to move towards a more integrated and 'seamless' description of the built environment at both the neighborhood and the metropolitan scale.

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AN INTEGRATED URBAN SYSTEM AND ENERGY CONSUMPTION MODEL: RESIDENTIAL BUILDINGS

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ABSTRACT

This paper describes a segment of research conducted within the project PON 04a2_E Smart Energy Master for the energetic government of the territory conducted by the Department of Civil, Architectural and Environment Engineering, University of Naples "Federico II".

In particular, this article is part of the study carried out for the definition of the comprehension/interpretation model that correlates buildings, city's activities and users' behaviour in order to promote energy savings. In detail, this segment of the research wants to define the residential variables to be used in the model. For this purpose a knowledge framework at international level has been defined, to estimate the energy requirements of residential buildings and the identification of a set of parameters, whose variation has a significant influence on the energy consumption of residential buildings.

Then, the goals of the work are the analysis and the comparison of the different models related to the energy requirements of residential buildings at urban scale, and the selection of a set of parameters, that according to the scientific literature, has a direct influence on the energy consumptions of buildings.

KEYWORDS

Residential building energy model; Residential energy consumption.

1 INTRODUCTION

The paper describes a segment of the research activity carried out within the project PON 04a2_E Smart Energy Master for the energetic government of the territory, which aims to develop a comprehension / interpretive model at territorial level between city, buildings and user behaviours to promote energy savings. For the development of the model, the first phase of research has focused on the review of the scientific literature produced at international level related to these issues, considering all the sectors constituting the urban system.

The comprehension phase aimed to identify the relationships between energy consumption, urban, building and socio-economics characteristics and users' behaviours. In particular, this paper aims to identify the parameters that affect residential buildings energy consumption.

This research activity is part of a broader analysis which includes the study of all the different aspects – urban form and function, public buildings, mobility and socio-economic characteristics – influencing city energy consumption, in order to develop a model for the understanding and the interpretation of the whole phenomenon.

The first part of the paper analyses the main policies introduced in Europe to reduce energy consumption in the residential sector. Then, the research identifies, describes and compares the most recent models for estimating energy consumption, in order to choose a comprehension/interpretive synthetic model common to all analysis fields of the project. Finally, the studies that analyse separately the environmental, structural, social and economic factors that directly affect the energy requirements residential buildings have been carried out.

2 COMMUNITY STRATEGIES TO REDUCE ENERGY CONSUMPTION OF RESIDENTIAL BUILDINGS

The European Union, in order to identify a new community strategy for future growth based on higher levels of sustainability, has started a few years ago, a process of negotiation between the member states to define shared future goals of intervention, following the expiry of the *Kyoto Protocol* (2012). In 2009 this negotiation has led to a first concrete result, with the approval by the legislative bodies of the European Directive 2009/29/EC that commits Member States to reduce overall emissions of greenhouse gases by at least 20% by 2020 compared to the emission values recorded in 1990.

In particular, within that time horizon, the member states, through the definition of the 20-20-20 strategy, target to achievement of three main objectives: the reduction of global energy consumption (-20%), the reduction of greenhouse gases (-20%) and the increase of the consumption of energy produced from renewable sources (+20%).

In defining these strategies, the European governing bodies, based on the economic crisis that affected many European cities, identified the need to integrate different policy objectives such as reducing greenhouse gas (GHG) emissions, securing energy supply and supporting growth, competitiveness and jobs through a high technology, cost effective and resource efficient (European Commission Bruxelles, 27.3.2013 COM(2013) 169 final).

To continue with greater conviction in this direction, the European Union has recently also launched a review of the Climate-Energy Package, with the aim of providing a framework of sufficient certainty to the investors, with the identification of new objectives for the more longer time horizon of 2030. This extension of time, as recently clarified by the European Commission in the Green Paper (2013) "A 2030 framework for climate and energy policies", aims to stimulate further innovation and application technologies low carbon content and to allow the European Union, in view of future global agreements for post-2020 climate, to have a clear policy line to follow during negotiations.

In the last years, the application of European strategies for sustainability required a major effort by the Member States in order to adapt the different economic and regulatory systems to achieve the set objectives. In addition, one more complicated step of the implementation process was the definition of the individual targets that each Member State was committed to achieve.

In Italy, these EU guidelines have been implemented with the approval of some laws, regulations compliances and programming documents: the National Action Plan for Renewable Energy (2010) and the National Action Plan for Energy Efficiency (2011) are among the most important documents.

The achieving of a significant improvement in the energy efficiency of residential buildings is one of the main measures planned to reach the objectives set by the 20-20-20 strategy. The analysis of data on energy consumptions shows (Tab.1) the importance of this measure, in fact, not surprisingly, the sector with the highest energy consumption is the residential, which accounts for approximately 23% of total energy consumption in Europe (Eurostat, 2013).

	TOTAL		INDUSTRY		TRANSPORT		RESIDENTIAL		SERVICES	
	2001	2011	2001	2011	2001	2011	2001	2011	2001	2011
EU-28	1.150	1.109	330	288	346	366	303	275	128	141
Italy	125,98	122,31	38,77	30,13	42,94	42,04	28,92	31,32	11,99	15,75

Tab. 1 Final energy consumption, by sector, in million ton. of oil equivalent (Eurostat 2013)

In particular, for this sector has been expected to achieve the specific objectives of efficiency, to reduce power consumption drastically.

With the Directive 2010/31/EU that updates the previous Directive 2002/91/UE, it was determined that the Member States must establish a shared method for calculating the integrated energy performance of buildings, adopt the measures necessary to ensure that minimum requirements are set to energy performance requirements for buildings or building units and introduce a system of certification of the energy performance in order to achieve optimal levels of costs.

In Italy the implementation of these directives has happened gradually over the years with the adoption of different legislative instruments, in particular, Law 10/91 – *Rules for the Implementation of the national Energy Plan in the field of rational use of energy, energy conservation and development of renewable sources of energy*" – has been the first to address energy savings for buildings and to rationalize the consumption of renewable energy. In particular, this law proposed a method for the evaluation of winter energy balance of a building.

Subsequently, the Legislative Decree N°192 of 19/08/2005 established the criteria, conditions and procedures for improving the energy performance of buildings in order to promote the development, enhancement and integration of renewable energy sources and energy diversification. Finally, with the Ministerial Decree of 26/06/2009 the previous regulatory guidance regarding the definition of national guidelines for energy certification of buildings have been implemented and integrated.

3 THE DETERMINANT ELEMENTS OF RESIDENTIAL BUILDINGS ENERGY CONSUMPTION

3.1 KNOWLEDGE FRAMEWORK OF MODELS

As previously mentioned, this part of the research has the purpose of supporting the choice of the comprehension/interpretation model common to all fields of analysis within the Project Smart Energy Master and of identifying the key factors that influence the energy consumption of the urban residential sector. Therefore, an in-depth analysis was carried out for the selection of the most important models for estimating the energy consumption of residential buildings proposed by the scientific literature and developed worldwide. For greater relevancy of the objectives of the research project, it has been decided to focus on the models that use a statistical and engineering bottom-up approach. The statistical techniques determine the final energy consumption by analysing the energy bills and through sociological researches. The engineering techniques are based on the study of the physical characteristics of the building and they also allow identifying the effects deriving from the use of new building technologies.

The choice of the models to be described and analysed has been based on two main criteria: the most recent developed models and those applicable also to a territorial level of suburban scale.

The *Residential Building Energy Consumption Model* is a model developed as part of a research conducted at the Faculty of Urban Construction and Environmental Engineering of Chongqing University, in China. This is a bottom-up model of statistical type that implements the method of neural networks, which in its operation tends to reproduce the structure of the human brain. The benefits arising from the application of a neural model are multiple and one of these is the extraordinary adaptability of the model to the system that is object of the study, particularly if applicated to a complex nonlinear system.

This model was developed on the NET platform and uses the language Cshap, which is based on SQL Server 2005, and allows simulating the energy consumption of residential buildings at urban scale. To make more reliable predictions, the model has been trained through the use of historical energy data.

This study has been divided into two phases: in the first phase, nineteen indicators have been selected, then the application of the neural model has allowed to identify meaningful relationships between each indicator and energy consumptions, so that the list of indicators was reduced to sixteen.

One of the main limitations of this study for the verification of the potential application of the neural networks model is the use of a small number of indicators respect to the real computing capacity.

In conclusion, this work has allowed us to define the direct dependence of the energy consumptions not only with the physical characteristics of buildings, but also with the socio-economic factors.

The *Method to Analyze Large Data Sets to Inform of Residential Electricity Consumption Data-Driven Energy Efficiency* was developed as part of the research activities carried out at the Department of Civil and Environmental Engineering at Stanford University. This method seeks to overcome some of the major limitations present in other models. In particular, the research activities for the implementation of this model have focused on the identification and classification of the most significant variables related to the physical properties of buildings affecting the consumption of electricity, to the choice of data collected through smart devices and to the development of a method based on the factor analysis that allows the model to identify the most influential variables (Kavousian *et al.* 2012).

Specifically, the study has led to the identification of four main categories of variables: location of buildings and weather conditions, physical characteristics of the building, home appliances and electrical systems and occupants' behaviour. This articulation was also used as the basic scheme for structuring an online survey consisting of 114 questions, to collect part of the necessary information for the construction of the model. Other data were collected through the installation of devices for measuring energy consumption. The sample selected for this study consists of nine hundred and fifty-two households. A limitation of this model is that households selected for the collection of data belong exclusively to upper-middle class and have a high standard of education.

In order to reduce the initial large number of variables, the researchers have used the method of factor analysis (regression) that allowed them to eliminate the variables that were not significant.

In particular, they have identified 22 variables that are most representative of the households' behaviour with respect to energy consumption.

The Residential electricity consumption in Portugal analyses the energy consumption in the residential sector, paying particular attention to the influence of the housing and households characteristics. In Portugal, the residential sector accounts for about 17% of total final energy consumption of the country and for 21% of total consumption of electricity.

The study determines the residential electricity consumption per capita at two different scales: they use data to 2001 aggregated for municipality (top-down) and data collected through surveys on the consumer expenditure conducted among 2005 and 2006, aggregated for single family (bottom-up).

The study area analysed includes a total population of 10 million people living in 278 municipalities of mainland Portugal.

Although the scale of detail of data is different, the models were chosen in such a way as to be comparable. In particular, for both models, researchers used the method of Ordinary Least Squares (OLS) regression to estimate the coefficient of the model, and the dependent variable in both scales is the natural logarithm of electricity consumption per capita. For both scales of analysis, the income, the number of people per household and the age of the dwelling were the considered variables. In the bottom-up model has been included the number of electrical appliances used, a dummy variable for the presence of children, a dummy variable for the type of employment, the surface, the type of dwelling, the level of urbanization and a dummy variable for the different geographical areas. These variables have been put into the bottom-up model, because in the previous studies many of these were found to be among the most influential on electricity consumption.

Most of the data on the characteristics of the municipalities for the top-down models have been collected from the online database of the Statistical Office Portuguese, the Instituto Nacional de Estatística (INE), while the demographics of the population and housing characteristics from the Portugal census (INE 2003). The data for the bottom-up analysis have been collected through a survey on consumer spending (INE 2008). The survey was conducted on a sample of 7,925 households in the period between October 2005 and October 2006.

A first finding of the analysis of the results of the two models is that they are consistent with each other and with the other examples present in the scientific bibliography. All the statistically significant coefficients have the sign expected at both levels of analysis. In terms of exposure R-squared, the top-down model shows a better goodness of fit compared to the bottom-up one.

This results suggest that policy decisions that take into account only the income of families don't affect much on the variation in energy consumption for residential buildings, because other aspects such as the demographic structure of the population and housing characteristics are more influential.

The *Residential Building Typology* is a bottom-up model of engineering type that uses the method of archetypes. This study was carried out by the research group THEBES of Polytechnic University of Turin, and has the objective to determine the energy requirements (heating and domestic hot water) of residential buildings through the analysis of buildings' characteristics.

The various studies carried out in different countries participating in the project aim to identify a common structure for the classification of building types. The data on building types developed during the project are published and can be accessed through a special web tool. For each country participating in the project, the national typology will be presented in the form of a matrix-type photograph of the buildings, organized according to the period of construction and building size.

The study conducted by the research unit of the Polytechnic of Turin, through the analysis of the Italian existing building stock, identified a matrix of building types, consisting of 32 buildings-types. In the matrix, the different types of building have been divided by two main variables: the time of construction and the average size. Depending on the construction period, eight different categories are identified (up to 1900, 1901-1920, 1921-1945, 1946-1960, 1961-1975, and 1976 to 1990, 1991 to 2005, from 2005), while the average size of construction allow to identify four categories (single-family homes, townhouses, multifamily buildings, blocks of flats).

Specifically, for each building-type, the annual energy consumptions of primary energy for heating and domestic hot water have been identified, and the numerical value assigned was calculated taking into account the different physical characteristics of the building (construction type and type of plants). For each type of building, a technical data sheet has been compiled, including all the features necessary for the calculation of building energy consumptions.

One of the problems emerging from the analysis of this study is the lack of information regarding the energy demand of buildings for cooling.

The Community Domestic Energy Model (CDEM) is a bottom-up model of engineering type that uses the method of archetypes for estimating CO_2 emission, basing on the study of the physical characteristics of the building, the leaks heat, the internal temperature and the energy flows of dwellings (Kavgic 2010).

This model calculates energy consumption through a classification of the residential buildings according to two main features, which are the form and the age of the building. By the combination of these two features, 47 different classes of buildings have been identified, each of which have been assigned primary and secondary input parameters.

The secondary input parameters were used exclusively to support the calculation of the primary input parameters. In total, in order to implement the model, 27 input parameters have been considered and divided into five primary categories: location, geometry of buildings, construction features, services and population.

To complete the identification of the classes, the next step was to determine the energy consumption and CO_2 emissions totals for each class of buildings. With this goal, they used the Building Research Establishment Domestic Energy Model (BREDEM) that allows to calculate the final energy consumption for space and water heating, cooking, lighting and operation of appliances.

This model developed in the United Kingdom is based on Standard Assessment Procedure (SAP) standards and it is among the most widely used and reliable models; it uses a combination of physical and empirical relationships to compute the energy consumption of a house (Anderson *et al.* 2002).

In conclusion, the description of the study of comprehension models for calculating of energy requirements for residential buildings, has allowed us to get to the definition of a general framework (Tab. 2) on the progress of the research, identifying the main problems and possible future developments.

MODEL	TYPE OF BOTTOM-UP MODEL	NATION	YEAR	POSITIVE ASPECTS	CRITICAL POINTS
Residential Building Energy Consumption Model	Neural Network	CHN	2012	Identification of the influence that the 16 parameters have on the energy consumptions.	Selection of a reduced number of parameters in the initial phase.
Method to Analyze Large Data Sets of Residential Electricity Consumption to Inform Data-Driven Energy Efficiency	Factor analysis	USA	2012	The building characteristics determine 42% of the variability in residential electricity consumption, whereas occupant behaviour explains 4.2%.	The data for energy consumption are referred to a sample of persons belonging to one social category.
Residential electricity consumption in Portugal	Regression	PRT	2011	The results indicate that policy measures that only take into consideration the income of households in Portugal might not be as effective as expected.	The importance of the demographic structure of the population and the characteristics of the dwellings and their equipment should be taken into account.
Residential Building Typology	Archetypes	EU	2010	Identification of 32 different archetypes of buildings.	In the study is neglected the estimation of the energy needed to cool buildings.
Community Domestic Energy Model (CDEM)	Archetypes	GBR	2009	Identification of 47 different archetypes of buildings.	In the study is neglected the behaviour of the occupants and their influence on energy consumptions.

Tab. 2 Summary Table of bottom-up models analyzed

3.2 THE SET OF PARAMETERS

As a final result of this segment of the research, it has come to identify the set of parameters that have a direct correlation with the energy consumptions of residential buildings. To arrive at the definition of this set of parameters, an in-depth literature analysis has been carried out to study some researches that analyse individual aspects belonging to environmental, structural, social and economic sectors were selected.

A first important result of this study is that the scientific literature produced in recent years, for this particular area of research, is very wide. Among these researches, the privileged studies that have come to the determination of the relations between the parameters and energy consumption by using a large sample of data are essential.

The parameters identified are classified according to subsystem of reference (environmental subsystem, physical subsystem, socio-anthropogenic subsystem) and for each one of these, a summary table containing all the information collected with bibliographic study was created (Tab. 3). In addition, when possible, a weight is assigned to the parameter, calculated as the average percentage change in energy consumption, with every other condition unchanged, moving from one class, (number range) in which each parameter is subdivided, to the next.

ID	SUBSYSTEM	PARAMETERS	NATION	YEAR	SAMPLE OF SURVEY	Weight
1	Environmental	Climatic zone	*GRC*	*2007*	Greek residential building heritage	23%
2	Environmental	Green areas	USA	2002	178 buildings	10%
3	Physical	Building size	NLD	2012	300.000 buildings	14%
			NLD	2009	15.000 buildings	
4	Physical	Building age	ITA	2011	Italian residential building heritage	14%
			NLD	2012	300.000 buildings	
5	Physical	Surface	CHN	2009	124 households e 3 building types	19%
			GBR	2008	200 buildings	
6	Physical	Compactness factor	ITA	2013	40.000 buildings	n.d.
7	Socio-Anthropic	Size of households	Olanda	2009	180.000 households	n.d.
8	Socio-Anthropic	Household income	Olanda	2009	180.000 households	n.d.
9	Socio-Anthropic	Age of residents	USA	2002	United States Census	n.d.

Tab. 3: The main parameters that affect significantly on energy consumption in residential buildings.

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INTEGRATED URBAN SYSTEM AND ENERGY CONSUMPTION MODEL: PUBLIC AND SINGULAR BUILDINGS

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ABSTRACT

The present paper illustrates the results of the first steps of a study on one aspect investigated as the preliminary step of the definition of the analysis - comprehension model of the relation between: city, buildings, and user behavior, for the reduction of energy consumption within the research project “Smart Energy Master” for the energetic governance of the territory (PON_MIUR n. pos. 04a2_00120 CUP Ricerca: E61H12000130005), at the Department of Civil, Building and Environmental Engineering - University of Naples Federico II, principal investigator prof. Carmela Gargiulo.

Specifically the literary review aimed at determining if, and in what measure, the presence of public and singular buildings is present in the energy consumption estimate models, proposed by the scientific community, for the city or neighborhood scale .

The difficulties in defining the weight of these singular buildings on the total energy consumption and the impossibility to define mean values that are significant for all subsets and different types as well as for each one, have forced model makers to either ignore them completely or chose a portion of this specific stock to include.

KEYWORDS

SEM, Smart Energy Master, Energy, Public, Singular, Buildings

1 INTRODUCTION

Nations and governments have initiated strategies and actions to reduce our dependence from non renewable sources and our global energy consumption because of climatic change, and the necessity to translate our society to an ecologically sustainable model.

Some studies (EU Commission 2011) cite that cities and their surroundings areas consume the 80% of final energy in the European Union and more than two thirds of the population lives in urban areas.

Others (European Institute for Energy Research EIFER 2012a, 2012b) that on the European continent, cities are currently responsible for approximately 70% of the overall primary European energy consumption, and this share is expected to increase to 75% by 2030.

Analysis of the building stock of the EU (EU Report 2010) has shown that a large part, about 60%, was produced between the sixties and the eighties and anyway after the second world war. In the countries of the Mediterranean basin this percentage grows to about 70- 75 %. In Italy specifically the percentage is about 65%. These buildings, produced in a time before energy consumption reduction legislation, inspired by the energy crisis of the seventies came into effect, present a very low energy performance.

Since efficiency of the use of energy represents one of the main mechanisms for the reduction of CO^2 emissions, and the building sector weighs heavily on the total consumption there are ample margins of potential energy savings.

The studies on energy consumption of the building sector are usually divided in residential and non residential, and the focus of the literary review has been on the later.

The phenomenon of high energy consumption and low energy efficiency of public buildings is common, which means there is a great energy saving potential; these include the public service sector and buildings.

The service sector, in the major industrialized countries, has a very important role in the economy but only a marginal one in the ranking of the energy consumption of the various sectors.

It is less energy intensive than the residential, transport, and industry sectors, amounting to an estimated 13-15% of the total energy consumption; but its energy demands have been in constant growth in the past years[1].

In Italy a recent study (Rapporto Annuale sull'Efficienza Energetica, 2013) has estimated the specific Energy consumption of buildings (kWh/year/m^2) of the service sector depending on the different functions and services offered that include hotels, schools, malls, retail buildings, offices, restaurants and other services.

The energy intensity of these buildings varies from a minimum of 112-114 kWh/year/m^2 for offices, restaurants and other services, to a maximum of 182 kWh/year/m^2 for hotels.

Function plays an important part in the energy consumption profile of a building but it not the only defining characteristic. Indeed, it is well known (Fabbri et al., 2012) that energy building behavior is not only related to the construction period but also to the architectural, morphological and technological solutions that characterize each building.

1.2 MODELLING THE BUILT ENVIRONMENT

To comprehend a complex and dynamic system, such as the built environment and its relation to energy consumption, we need a model to interpret the relevant data collected and to inform decision making.

1 Energy consumption of non residential buildings, that include service functions, commerce, and public administration are in continuous and strong growth from 9.5 Mtep in 1995 to 20 Mtep in 2010. In 2010 the energy and electricity use intensity of the service sector have registered and increase of 1.8% and 0,5% respectively compared to the year before.

Scale, resolution and relevance of the data vary and so do the measurement units; a direct comparison and correlation is difficult.

The multidimensional nature of the objectives, projects and energy policies adds another peculiar facet to the problem. Ordinary methods used in economic – behavior analysis are not adequate to describe the energetic- environment relation.

The availability of data and the costs involved in collecting them are key to defining the data that can be collected for energy consumption models designed for existing buildings.

For individual buildings energy consumption models generally require an amount and resolution of data that are not practical or economical to collect for large numbers of buildings.

Multi-building models need to be based on data inputs capable of providing a robust and computationally practicable methodology, giving results with an acceptable degree of accuracy.

And, in the absence of individual building surveys, these data inputs will be governed ultimately by access to suitable sources of mass data.

Because data may be difficult to access, it may be necessary to infer input values for a model, basing the inferences on relationships to other data that are both appropriate, accessible, robust and should have a verifiable provenance. For example, thermal performance of building envelopes may be inferred from the age of a building, due to the influence of building regulations.

The models used to evaluate the energy demand of the existing built patrimony can be divided in three groups (Heiple S. et al 2008, Kavgic M et al 2010):

- top-down: that use energy consumption data on an urban scale, that compared to the climatic information and the results of the statistical and population surveys are used to determine the mean value of consumption of buildings. These models are able to compare different economic variables, but they do not allow us to distinguish the spatial energy consumption variations;
- bottom-up: they use the data produced by the simulation of each building depending on their specific characteristics; the results are then collated to determine the energy consumption of the neighborhood or city or to evaluate the energy savings brought by requalification interventions. To get good results on an urban scale they need great quantities of data;
- hybrid: study the energy demand of some prototype buildings and they extrapolate them to evaluate the consumption of the city. Through a detailed spatial representation of the built environment, introducing the socio-economic data it is possible to associate to each building its consumption so that it may be compared to benchmark values. Reference buildings can also be generated through simulation, using default values for certain key inputs. Such a simulated standard can create a scale of comparison based on particular code or market standards.

The basic building information such as building age, building area, operating hours, the number of office workers and the climatic conditions all affect the building energy consumption, but the impact of climatic conditions on the energy consumption is very complex to integrate in the analysis.

2 PUBLIC AND SINGULAR BUILDINGS

As decision makers are under pressure to take large-scale actions to reduce energy consumed of regions, districts, or building sub-sectors as a whole; studies aimed at extending building level models to quantify energy consumption of a neighborhood, district, or city region have come into closer scrutiny.

The building stock has not been designed as a single unit of either construction, or operation, so energy consumption modeling of the stock covers many more combinations of variables than a single building.

Energy consumption in buildings is heavily dependent on the functions housed and the number of users; therefore buildings that house public or specialized private services or that cater to multiple and numerous users will be very different from the more frequent residential buildings.

Public buildings should be considered in a wider sense: they are necessarily both publicly owned and those used by the public.

Amongst them buildings for:

- offices,
- sports,
- education,
- healthcare,
- mixed public use,
- penitentiaries,
- barracks,
- museums
- churches

To which we should add buildings for:

- public events and conference centers,
- cultural events and shows
- hospitality and tourism

we should exclude solely social housing since it can be assimilated to generic residential functions.

Within the non-residential sector the diversity in terms of typology is vast (Buildings Performance Institute Europe 2011), and compared to the residential one it is more usual to have multiple functions coexisting in the same building.

Building age, ownership, and use pose unique challenges which affect assessment design. On a mechanical level, energy consumption patterns in non-residential buildings are vastly different from those in residential ones.

Thus, primary classification of nondomestic buildings generally follows its function. Producing a numerous range; even a simple classification, such as the N-DEEM model, is based on ten primary categories of nondomestic buildings. Each primary class or bulk type is attributed to an expected value of energy intensity, which is sometimes derived by aggregating energy intensity of sub-categories. For example, in the N-DEEM model, the primary category of health comprises of surgeries, health centers, nursing homes, and hospitals. In a different approach, (Coffey et al. 2009) sub-categorize buildings based on age and maintenance quality of a building.

Another example is the German portion of the TABULA project (Amtmann et al 2012), that has identified four main parameters to define non-residential buildings: utilization, construction use, compactness/size of the building and the mechanical systems. Eleven categories have been identified together with four different construction year classes, chosen by considering special architectural characteristics and building materials typical of the construction periods.

The case of this form of standardization based on building use rather than its construction and physical characteristics is strong in the context of non-domestic buildings where variability in energy consumption between two buildings is dominated by the demand for activity related services (Prez-Lombard L 2008).

In the "Europe's buildings under the microscope" survey (B.P.I.E 2011), a broad classification of the sector focused on seven categories: educational buildings, offices, hospitals, hotels and restaurants, sports facilities, wholesale and retail trade services buildings and other types of energy consuming buildings. And in each, a wide division between various subcategories is evident. The retail and wholesale buildings comprise the largest portion of the non-residential stock in the European panorama. Since heating and cooling conditions may differ substantially from other categories due to large areas of wholesale buildings often being used only for storage purposes, these buildings are dissimilar from others. Within the subcategory retail and wholesale also pronounced differences were pointed out: within this sector there is no homogeneity in terms of size, usage pattern (use hours) and construction style. This requires special attention when looking at the retail and wholesale sub-sectors.

The survey states that office buildings are the second biggest category with a floor space corresponding to 25% of the total non-residential floor space. These buildings have similar heating and cooling conditions to residential buildings although their use is more limited in terms of time. Time defines educational buildings as well, which count for less than 20% of the entire non-residential floor space, since they are reported to have a similar usage pattern.

Hospitals, which weigh little on the total floor space balance, 7% of total non-residential floor space, weigh instead heavily on the energy balance since they have continuous usage patterns, where energy demand can vary substantially depending on the services provided, from consultation rooms to surgery rooms.

Another variability factor for existing buildings is the wide variety of technologies that are tied usually to the construction era; we could broadly divide them in:

- historical buildings (masonry)
- built between the twenties and the forties (mixed masonry and brick)
- built between the forties and the eighties (concrete non insulated structures)
- built after the eighties (concrete insulated structures)

Public buildings for their number, exemplary value, direct intervention possibility and ample energy saving margins are of crucial interest for their potential to initiate a improvement of the urban fabric.

Therefore this part of the built environment has a central role in the norms that originate from the Energy Performance of Buildings Directive (EPBD) and the definitions relative to Nearly Zero-Energy Buildings in fact the article 9, paragraph 1, of the EPBD directive, sanctions that member States must: "provide so that:

a) within the 31st of December 2020 all new buildings are Nearly Zero-Energy;

b) from the 31st of December 2018 all new buildings used and owned by public entities are Nearly Zero-Energy".

For existing buildings in general the directive stipulates that following the example of the public sector strategies should be implemented to transform them in Nearly Zero-Energy buildings.

At the moment we are falling behind the timetable since the implementation plan isn't defined yet, in Italy an official definition of Nearly Zero-Energy has not been postulated (Progressi realizzati dagli stati membri in materia di edifici a energia quasi zero, 2013) and in general "*The measures to reduce emissions and to increase renewable energy are effective "only in theory", rather than in reality*" (Gargiulo et al 2012).

The attention on this sector is evident but, primarily because it is the dominant overall consumer of energy within the building stock and it plays a critical role in meeting overall carbon-reduction targets set by governments, a vast majority of published literature on the topic of consumption modeling and energy conservation strategies deals with the domestic building stock.

Another possible reason for the lack of studies on the presence of public and singular buildings within the building stock may be that large-scale assessment of the non-domestic sector is often infeasible or difficult due to the aforementioned sheer diversity of use, activities, and ownership structures within it.

But since variability in energy consumption between two buildings is dominated by the demand for activity related services (Prez-Lombard et al. 2008) the use of standardization based on building use rather than its construction and physical characteristics is strong in the context of non-domestic buildings.

Some studies conducted in Italy (Caputo et al. 2013) have tried to broaden the analysis scope of the building stock including non residential commercial buildings and the sources of energy consumption include heating, cooling, cooking, domestic hot water, lights and appliances.

Adopting some simple hypothesis taken from the UNI TS 11300 norms, the energy consumption, the efficiency of the characteristics of the building stock are assumed; in particular from the UNI TS 11300-2, (2008) the typical efficiencies of heating systems reported in and the typical efficiencies and UNI TS 11300-3, (2010) of cooling systems.

To determine the percentage of the building stock to be attributed to residential or commercial use, statistical data provided by the National Census, which is focused on residential utilization, was used and further elaborated.

Taking the ''total dwelling area'' of each census tract, the net total residential volume was calculated and the gross residential volume was estimated based on the correction factor reported in the standard UNI TS 11300-1 (2008).

The volume of commercial buildings was then estimated as the difference between the total building volume obtained by the dimensional data extracted from the maps and the residential volume available for each census tract.

Still the study did not consider the service sector or other buildings such as schools, hospitals, barracks, churches, etc.

Because of the sheer size of the assets involved and the functional diversification of the public buildings it appears obvious that they are an important quota of the entire built environment, even if smaller by far than the residential building one. Therefore an improvement in their energy efficiency can contribute to the effectiveness of energy policies.

We should consider as well the peculiar characteristics of this part of the built environment that can deliver, for equal volumes, larger energy savings than those obtained by other segments of the built environment because of:

- specific high energy use functions;
- the use of buildings adapted to functions different from the original ones;
- the higher energy demand per volume unit that derives from scarce control of public spending
- low maintenance of the buildings and mechanical systems

to initiate actions to reduce the energy consumption trough retrofits, a complete analysis of the energy consumption of this sector is fundamental to determine as well if:

- The magnitude of the supply contract with the energy provider is commensurate to the requirements for each building
- how energy demands change during the seasons and the time of day to corroborate the intervention strategies decisions
- compare the specific energy consumptions of different buildings to identify anomalies
- compare the detailed energy consumption of each building with the benchmark values for the specific building type.

Concerning methodological issues, retrofit actions are likely to be practically complex because they include other concepts, such as economic and aesthetic considerations, besides the energy and environmental aspects. The final choices depend on a variety of environmental technological and economic mechanisms.

3 PRELIMINARY RESULTS

Considering these difficulties, in the data collection moment, specific attention is needed to choose the parameters and indicators useful for our analysis. Briefly we shall describe the preliminary considerations that have guided our choices on this topic.

First a list of possible sources of relevant data was drawn, from these records we have then chosen the parameters that could bring us nearer to our optimal analysis data set.

Geomorphic data is easily collected through the consolidated instruments that are essential to the preliminary steps of any urban plan, determining surfaces, heights, volumes; still these needed to be enriched with info about use typologies. The presence of public and singular buildings was highlighted and in general the percentage of non residential functions for each edifice was quantified.

Therefore the following parameters are collected for the creation of the model:

Name of the parameter: Total floor area.

- typology: descriptive
- measurement unit: sq.m.
- description: Total floor area, is the sum of all useful floor areas of each storey above and below ground, usable attic included.
- calculation or survey method: survey from aerial photogrammetry
- ease or calculation and comparison: high

Name of the parameter: construction era.

- typology: descriptive
- measurement unit: range
- description: the construction era of the building useful to estimate the construction technologies
- calculation or survey method: survey from aerial photogrammetry building is hypnotized within the approximate era of the neighborhood
- ease or calculation and comparison: high

Name of the parameter: Net floor area.

- typology: descriptive
- measurement unit: sq.m.
- description: Net floor area, is the sum of all net floor areas of each storey above and below ground, usable attic included; estimated subtracting from the total floor area the external walls and the vertical connections.
- calculation or survey method: estimated percentile bearing on the total floor area derived from the construction era
- ease or calculation and comparison: high

Name of the parameter: building height.

- typology: descriptive
- measurement unit: m.

- description: building height, the vertical distance of the highest roof eave above the mean finished grade of the ground adjoining the building.
- calculation or survey method: survey from aerial photogrammetry
- ease or calculation and comparison: high

Name of the parameter: number of floors.

- typology: descriptive
- measurement unit: n.
- description: the number of above ground storeys.
- calculation or survey method: survey from aerial photogrammetry
- ease or calculation and comparison: high

Name of the parameter: air-conditioned volume.

- typology: descriptive
- measurement unit: cubic meters.
- description: the total building volume served by the mechanical systems.
- calculation or survey method: building footprint per building height
- ease or calculation and comparison: high

Name of the parameter: number of units.

- typology: descriptive
- measurement unit: n.
- description: the number of functional units of each building.
- calculation or survey method: data from land registry
- ease or calculation and comparison: low

Name of the parameter: form factor.

- typology: descriptive
- measurement unit: n.
- description: surface to volume ratio.
- calculation or survey method: survey from aerial photogrammetry
- ease or calculation and comparison: high

Name of the parameter: façade orientation.

- typology: descriptive
- measurement unit:
- description: degrees of the main building façade relative to the north.
- calculation or survey method: survey from aerial photogrammetry
- ease or calculation and comparison: high

Name of the parameter: degree days.

- typology: descriptive
- measurement unit: GG
- description: the sum of the average temperature on any given day, subtracted from the base temperature.
- calculation or survey method: from charts present in the norms
- ease or calculation and comparison: high

Name of the parameter: energy intensity.

- typology: performance
- measurement unit: kWh/sq.m./year
- description: the total energy used by the building per square meter each year.
- calculation or survey method: dividing the estimated energy consumption per unit of floor surface.
- ease or calculation and comparison: medium

Name of the parameter: function.

- typology: descriptive
- measurement unit: list
- description: the prevalent use of the building.
- calculation or survey method: survey from aerial 45° photogrammetry.
- ease or calculation and comparison: medium

Name of the parameter: education level.

- typology: descriptive
- measurement unit: list
- description: the type of educational function housed in the building.
- calculation or survey method: data from relevant public agency .
- ease or calculation and comparison: high

Name of the parameter: education level.

- typology: descriptive
- measurement unit: list
- description: the type of educational function housed in the building.
- calculation or survey method: data from relevant public agency .
- ease or calculation and comparison: high

Name of the parameter: healthcare service type.

- typology: descriptive
- measurement unit: list
- description: the type of healthcare service housed in the building.
- calculation or survey method: data from relevant public agency .
- ease or calculation and comparison: high

But, due to the extreme difficulty of retrieving data related to the age of each building, the age of the building, as mentioned, is hypnotized within the approximate era of the neighborhood; the kind of building technologies and the mechanical systems, each profoundly tied to energy consumption, have been momentarily excluded from the model.

To determine the energy intensity of each typology, consumption data needs to be collected from multiple energy suppliers and then geo referenced.

This data is collected by public offices but it is not introduced in a geographic information system and is therefore not useful to extrapolate the information we need; an accurate correlation on the building scale is needed that expurgates individual consumptions for privacy reasons.

4 CONCLUSIONS

Even if there aren't comprehensive models that include singular buildings, there are many studies that have considered the energy consumption of each subset and specific building type.

Analyzing the work done in this direction it is apparent that high energy use buildings, present as a small percentage of the building stock, still represent a large portion of the end use of thermal and electrical energy use on an urban scale.

Dividing the non residential building stock in commercial and service sectors, on the one side, and singular and public buildings on the other, it is evident that two different approaches are needed to include them in an urban energy model.

The first are characterized by ample surfaces with almost homogeneous hourly usage and comparable energy intensities; therefore they can be estimated and evaluated using prototypical example models as benchmarks for the whole sector, taking into account the specific and common considerations on building age, technologies, localization etc. that are used for the residential sector.

On the other hand singular and public buildings for their intrinsic extraordinary characteristics are more difficult to include. Energy intensity, hourly usage, end use of energy, user presence differ widely; therefore it's necessary to develop for each subset and building type a specific modeling unit that can consider its particular characteristics and be plugged in the global model as needed.

For each building type the specific energy intensity must be evaluated and tied to the characteristic that drives energy consumption; this characteristic may not be the overall surface of the building unit.

Still these analysis methods implement a partial view of the problem since they, for example, consider energy consumption tied to built volume, use, technological characteristics of the building envelope and ignore the type, age and control strategy of the mechanical systems.

Another critical point is the difficulty to correlate energy use in the building stock with the presence of onsite renewable source energy generation.

Because of their exemplary value, for public buildings, a repository of energy certification documentation is being created; even if the rating is a useful indicator to compare a building relative to another of the same type, or its expected benchmark, it does not correspond to its actual energy use and therefore it is not useful as a data source for energy consumption.

Still it could be useful for the definition of the technological characteristics of the building envelope and the mechanical systems if the simplified rating system, which infers characteristics from age, was not used.

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URBAN SMARTNESS VS URBAN COMPETITIVENESS

A COMPARISON OF ITALIAN CITIES RANKINGS

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ABSTRACT

This paper describes a part of the research carried out by the Department of Civil, Architectural and Environmental Engineering (DICEA) of the University of Naples "Federico II", within the *Project Smart Energy Master for the energy management of territory,* financed by PON 04a2_E R&C Axis II, from 2012 to 2015.

Today that the idea of smart city draws the attention of urban planners and policy makers and, at the same time, global competitiveness is considered essential for the success of a city, the paper aims to investigate the relationship between the concept of smart city and that of competitive city, identifying common characteristics and differences and answer the question: is "smartness" a new concept for urban studies?

The analysis has been conducted in the Italian context, comparing the competitive structure of Italian provinces with their performance as smart cities. To rank Italian provinces because of their level of competitiveness, a previous ranking, carried out in 1995, has been updated with the most recent data available and the new hierarchy, thus obtained, has been compared with that of Italian smartest cities proposed by Forum PA.

The benchmarking shows that smartness and competitiveness are strictly connected: today, a city needs to improve its smart quotient in order to be more attractive and so more competitive, in fact, the efficiency and livability of cities, sought by potential citizens, can be improved by using ICTs, as supported by the advocates of smart cities, and represent a strategic factor for gaining a competitive advantage.

KEYWORDS
Smart City; Urban Competitiveness; Benchmarking.

1 INTRODUCTION

Today, over 52% of the world's population lives in urban areas (The World Bank 2013), therefore cities are now nerve centers for the global economy. If from the '90 improved urban competitiveness was considered the path to economic nirvana (Begg 1999), nowadays, although cities competitiveness continues to be a central theme for planners and policy makers, a new paradigm of the city is emerging, that of smartness.

Indeed, despite the label "smart city" has recently become more widespread, its roots can be traced already in the end of '80s and early '90s (Papa, Gargiulo, Galderisi 2013) when, with a great effort of imagination, the concept of "wired city" appeared for the first time and the future development that the use of innovative technology would have brought to the transformation of the landscape was expected (Beguinot, Cardarelli 1992). In this scenario, where the not-so-new idea of smart city draws the attention of urban planners and policy makers and, at the same time, global competitiveness is still considered essential for the success of a city, the paper aims to investigate the relationship between the concept of smart city and that of competitive city, identifying common characteristics and differences.

In this paper we try to answer the question: is smartness a new concept for urban studies?

The analysis has been conducted in the Italian context, comparing the competitive structure of Italian provinces with their performance as smart cities.

For ranking Italian provinces because of their level of competitiveness, we have used, as starting point, a previous study carried out in 1995 at the Department of Urban and Regional Planning of the University of Naples "Federico II", that orders Italian provinces into 5 different classes because of the role that each plays in the competition at different scales (Galderisi, Gargiulo 2002).

We have updated this ranking with the most recent data available, exploiting the statistical methodology used in 1995 to identify the propensity to competition of Italian urban areas, and then, we have compared the new hierarchy thus obtained with that of Italian smart cities proposed by Forum PA, which classifies 101 Italian cities measuring their level of smartness based on 89 indicators (Forum PA 2013).

The benchmarking between the two rankings and the different variables used to define them allowed us to verify in which terms Italian smartest cities perform in the challenge for gaining a competitive advantage.

2 URBAN COMPETITIVENESS

In the era of globalization, urban competitiveness can be defined as the demonstrated ability of cities to attract capital, business, talent and visitors (The Economist 2012): those cities that become more globally linked and responsive to the competitive needs of business will attract investment and jobs while those that do not will decline (Rondinelli *et al.* 1998).

A myriad of ranking measuring country competitiveness first, city competitiveness then, can be found reading the scientific literature and surfing the Internet (Beaverstock *et al.* 1989, DATAR 2003, Taylor *et al.* 2004, Hall 2005): how do Italy and Italian cities perform?

In 2013, Italy ranks 44th according to the *World Competitiveness Scoreboard* (Institute for Management Development 2013) and 49th as reported by the *Global Competitiveness Report* (World Economic Forum 2013) and a comparable position is that of Italian cities, in fact, according to the global cities ranking proposed by The Economist Intelligence Unit – *Hot spots. Benchmarking global city competitiveness* – Milan ranks 47th and Rome is 50th out of 120. Moreover, the hierarchy made by The Economist shows that, despite the economic crisis that affected many Western countries, U.S. and European cities are the world's most competitive cities today, accounting for 24 of the top 30s (The Economist 2012), but Italy contradicts this trend.

A more detailed analysis of urban competitiveness in the Italian context is proposed in the next paragraph.

2.1 MEASURING THE LEVEL OF COMPETITIVENESS OF ITALIAN PROVINCES

Although several studies evaluate urban competitiveness at international level, only few focus exclusively on Italy; the analysis *"Processes of internationalization and evolution of urban systems: a reading of the competitive structure of Italian provinces*[1]*"* is one of them. It was carried out at the Department of Urban and Regional Planning (Di.Pi.S.T.) of the University of Naples "Federico II" in 1995; its aim was to investigate Italian provinces' level of competitiveness depending on the international, national and local context (Galderisi, Gargiulo 2002).

We have chosen to use this previous work as the baseline and take it a step further with a new set of measurements, the latest and most representative, in order to have a new, up-to-date, ranking of urban competitiveness in Italy.

2.1.1 VARIABLE SELECTION

Based on the scientific literature review about the past international researches on urban competitiveness (Bonnafous *et al.* 1991, Bonneville *et al.* 1991, Gibelli 1994, King 1991, Morandi 1994), the 1995 study identified six macro-areas considered strategic for gaining a competitive advantage at international scale:

- Mobility and Communication
- Economy
- Production
- Human Capital
- Research and Training
- Environment

Each of the six categories was composed of a flexible number of variables, for a total of 39, capable of measuring the level of competitiveness of the analyzed urban areas respect to a specific aspect.

We have modified some of the variables used in 1995: a number has been eliminated because today considered no longer representative, while some have been replaced by equivalent variables of which more recent data were available. In the end, a total of 31 variables have been selected (Tab. 1).

MOBILITY AND COMMUNICATION	*International airports*	ENVIRONMENT	Population density
	Passengers on international flights		Residential square meter price
	Networks for telephony and telematics		Hotel per 1000 population
	High-speed connections		Crimes per 1000 population
ECONOMY	Employed in firms/total number of employed	RESEARCH AND TRAINING	*Universities*
	Per capita income		Universities per 1000 population
	Household final consumption expenditure pp		Educational facilities
	Number of bank branches		*Number of patents*
	Per capita GDP		Number of patents per 1000 pop.
PRODUCTION	*Number of firms*	HUMAN CAPITAL	*Population*
	Number of firms per 1000 population		*Population of the provincial capital*
	Export/import		Economic Activity rate
	Enterprises growth rate		Unemployed per 1000 population
	Enterprises death rate		Graduated per 1000 population
	Exhibitions		Spending pp for recreation and culture
	Exhibitions per 1000 population		

Tab. 1 Selected variables by macro-area. Determinants are in italics to distinguish them from Indictors

1 "Processi di internazionalizzazione ed evoluzione dei sistemi urbani: una lettura della struttura competitiva delle province italiane".

As done in the study of reference, the variables can be split into two different groups:

- DETERMINANTS (12)
- INDICATORS (19).

Determinants are that variables discriminant for competitiveness on an international scale, while indicators, which are proportional to the demographic weight of the territorial systems to which they relate, are indicative for competitiveness on a local scale (Galderisi, Gargiulo 2002). Most indicators have a positive influence on urban competitiveness, but some others, such as the number of unemployed and crimes per 1000 population, act in a negative way.

We used different sources of data – ISTAT, Tagliacarne Institute, Infocamere, Ministry of Economic Development – but, for a few number of provinces[2] some of the data was missing.

2.1.2 RANKING METHODOLOGY

The 110 provinces composing Italy have been articulated into five classes according to the different level of competitiveness, due to the greater or lesser presence of those resources identified as strategic for the creation of a competitive advantage: those provinces with a consolidated role on the international scene belong to the *first class;* those potentially international belong to the *second class;* those of national relevance belong to the *third class;* those potentially national belong to the *fourth class;* those provinces of local level belong to the *fifth class* (Galderisi, Gargiulo 2002).

Determinant variables have been exclusively used to identify those provinces of international level, or first class: for each of the twelve determinants, the 110 cases have been ranked and only those which were at the top of the ranking (1st; 2nd) with respect to each variable have been included in the first class.

A different and more complex methodology has been used in the case of indicators: each of the nineteen rankings – one for each indicator – has been divided into five ranges of equal size, corresponding to the five classes of competitiveness. Considering the totality of the indicators, the frequency with which each province falls within one or another of the five ranges/classes, has allowed us to allocate each province to the class in which it falls more frequently (Tab. 2).

Looking at the results obtained, more than half of the cases fell in fifth class, so it has been chosen to recalibrate some of the classification in order to better understand the differences amongst Italian provinces and have a more significant distribution of the cases into the five classes of competitiveness: the rankings in which over 50% of the values fell in one of the five classes have been recalibrated.

For the recalibration, we have calculated the variation between the last value of a class and the first of the following one and, when the gap was greater than 20%, we have re-classified the observations into five classes, excluding the upper one, which we then joined to the new first (or second, or third, ...) class.

We have recalibrated each ranking as many times as the number of variations between two consecutive classes was higher than 20%. For example, the *"Hotels per 1000 population"* ranking has been recalibrated because the 92.7% of the cases fell into the fifth class and the second class didn't exist; this happened because the performances of the provinces of first class, Bolzano and Rimini, were extremely higher that the others, creating a distribution of the cases biased towards the last class. We have recalibrated the classification by calculating the variation between the last value of the first class and the first value of the third one; saw that the variation was higher than 45% (>20%), we have repeated the division of all the cases in five classes, excluding Bolzano and Rimini, which we have then joined to the new first class created.

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[2] For the most recent provinces – Barletta-Andria-Trani, Carbonia-Inglesias, Fermo, Medio-Campidano, Monza e della Brianza, Ogliastra, Olbia-Tempio – data for three indicators were missing, while for the province of Cremona and Padova only data for one indicator were missing.

Province	CLASS I	II	III	IV	V	Province	CLASS I	II	III	IV	V
Belluno	6	4	3	2	4	Cremona	2	4	2	7	3
Bologna	6	2	6	4	1	Cuneo	4	2	4	6	3
Bolzano/*Bozen*	9	2	1	5	2	L'Aquila	2	3	2	8	4
Milano	6	4	5	1	3	Lodi	1	5	1	7	5
Modena	6	4	4	4	1	Nuoro	1	3	3	6	6
Reggio nell'Emilia	5	4	3	5	2	Pescara	1	1	4	10	3
Rimini	6	4	4	4	1	Piacenza	3	3	3	6	4
Arezzo	0	7	4	4	4	Ravenna	4	1	5	7	2
Ascoli Piceno	2	5	4	5	3	Salerno	1	0	3	8	7
Bergamo	3	6	3	5	2	Teramo	1	6	2	7	3
Brescia	2	7	2	7	1	Torino	3	2	5	8	1
Fermo	4	5	1	2	4	Trento	4	4	4	6	1
Firenze	2	10	3	3	1	Vicenza	3	4	3	5	4
Genova	1	7	3	6	2	Agrigento	1	0	1	5	12
Lecco	3	5	3	4	4	Aosta	4	4	3	1	7
Lucca	0	7	4	7	1	Asti	2	2	3	5	7
Macerata	3	6	5	3	2	Avellino	1	1	3	5	9
Mantova	3	5	2	4	5	Barletta-Andria-Trani	0	2	2	4	8
Massa-Carrara	0	8	3	5	3	Benevento	1	2	2	4	10
Monza e della Brianza	4	6	2	1	4	Brindisi	0	2	0	6	11
Padova	2	6	6	3	1	Caltanissetta	0	1	2	3	13
Parma	4	5	5	3	2	Campobasso	2	0	2	7	8
Pesaro e Urbino	3	6	4	4	2	Carbonia-Iglesias	0	0	2	5	9
Pistoia	0	6	5	6	2	Caserta	2	2	2	2	11
Roma	4	5	3	3	4	Catania	0	1	4	5	9
Siena	2	7	4	4	2	Catanzaro	0	3	3	2	11
Sondrio	2	6	2	4	5	Cosenza	1	2	0	4	12
Grosseto	0	6	3	4	6	Crotone	1	0	2	1	15
Alessandria	2	1	7	5	4	Enna	1	0	2	2	14
Biella	2	3	5	5	4	Foggia	0	3	1	4	11
Como	4	3	6	5	1	Frosinone	1	3	5	4	6
Ferrara	3	4	7	3	2	Isernia	2	3	2	4	8
Forlì-Cesena	3	4	5	5	2	Latina	0	3	5	5	6
Gorizia	1	3	6	5	4	Lecce	1	2	0	8	8
Imperia	1	5	6	3	4	Matera	2	1	0	7	9
Livorno	0	4	5	5	5	Medio Campidano	1	1	2	2	10
Novara	1	4	5	4	5	Messina	1	2	2	7	7
Pavia	2	2	7	3	5	Napoli	4	1	1	5	8
Perugia	2	5	6	4	2	Ogliastra	0	2	2	3	9
Pisa	3	4	7	2	3	Olbia-Tempio	1	4	1	3	7
Pordenone	4	3	5	3	4	Oristano	1	1	2	2	13
Prato	2	5	5	3	4	Palermo	1	2	1	4	11
Treviso	4	3	6	3	3	Potenza	1	1	3	7	7
Trieste	3	5	5	2	4	Ragusa	2	1	1	3	12
Udine	2	5	6	4	2	Reggio di Calabria	1	0	2	5	11
Varese	2	5	7	3	2	Rieti	1	4	1	4	9
Venezia	0	4	8	4	3	Rovigo	2	3	5	3	6
Verbano-Cusio-Ossola	3	2	5	5	4	Sassari	0	2	4	4	9
Vercelli	2	3	5	4	5	Savona	2	4	3	4	6
Verona	1	6	7	4	1	Siracusa	1	2	0	4	12
La Spezia	0	6	3	6	4	Taranto	1	1	4	2	11
Ancona	2	5	4	7	1	Terni	1	3	4	4	7
Bari	0	1	6	7	5	Trapani	0	1	2	3	13
Cagliari	0	1	6	6	6	Vibo Valentia	0	1	1	3	14
Chieti	1	4	4	5	5	Viterbo	0	3	4	6	6

Tab. 2 Frequency of the provinces with respect to the five classes of competitiveness

Furthermore, for this indicator the recalibration has been used twice because also the variation between the last value of the third class and the first value of the fourth one was higher than 20%.

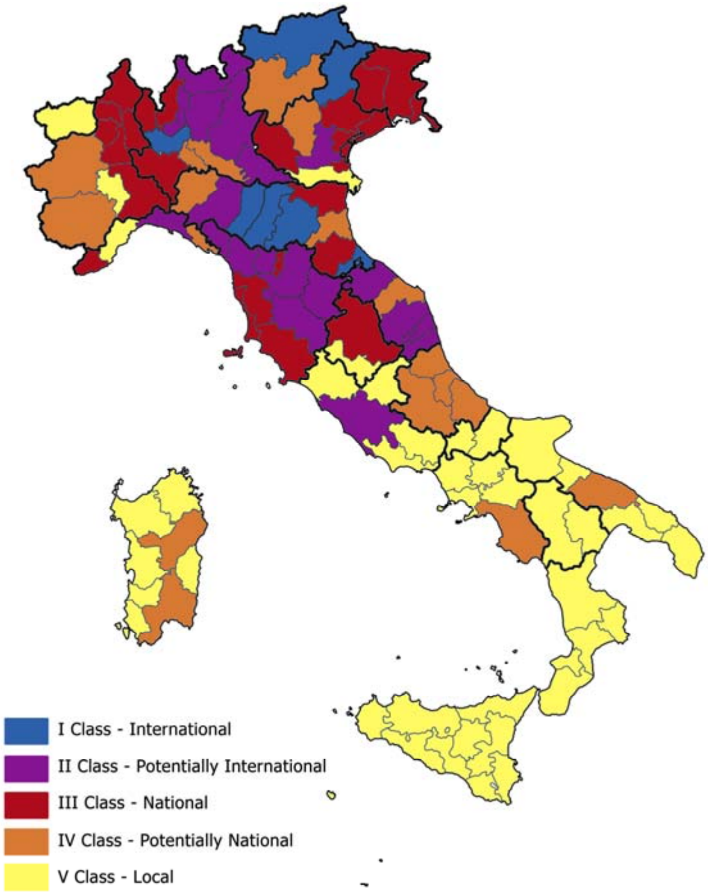

Fig. 1 Ranking the level of competitiveness of Italian provinces

In some cases, when a province showed the same frequency in two or three classes, its assignment to a class rather than another depended on the type of indicator: we considered “Economy” and “Production” the most highly weighted macro-areas. For example, in the case of Brescia, which showed the same frequency in second and fourth class, the allocation to the second class seemed more appropriate because five out of seven indicators for which Brescia ranked in second class belong to the “Economy” and ”Production” areas.

2.1.3 RESULTS

The analysis of data in relation to the two different groups of variables – determinants and indicators – has given rise to different considerations.

Considering the first group of variables, the provinces of Milan and Rome are rated as the Italian two most competitive urban systems with a consolidated role at the international scale; in fact, Milan dominates eleven out of twelve rakings, while Rome is at the top of nine out of twelve of them. Furthermore, Bologna has stood out positively by occupying the second position for the *Per-capita Income* and *Exhibition* variables.

Different information was provided looking at indicators (Fig. 1): the considerable gap between North-Central Italy and the South is the first result: if only five North-Central provinces falls in fifth class (Aoste, Asti, Savona, Gorizia, Terni), excluding Abruzzi, there isn't any South province in the first three classes and only four are in the fourth one (Bari, Salerno, Cagliari, Nuoro).

Further evidence has been brought by the case of Rome, which was previously identified as province of international level, and now ranks in second class; one possible reason can be that the second group of variables, the indicators, gives a measure of resources endowment proportional to the population weight of the urban system and the province of Rome, strong by an absolute point of view, loses its relevance.

A positive finding is that of Emilia Romagna, the Italian region with the highest number of provinces belonging to the first class – four out of nine – and an overall high level of competitiveness. The case of Emilia Romagna shows that a polycentric urban structure can positively influence the regional system as a whole. Together with Emilia Romagna, Tuscany has stood out for a widespread medium-high level of competitiveness, in fact, although none of its provinces has international relevance, all of them belong to the second (six out of ten) or third class (four out of ten).

An additional finding that might seem unexpected is that of the province of Turin, which has fallen in fourth class, among those provinces potentially national, despite other studies have considered it as an urban area with an international level of competitiveness. A possible explanation of this result could be found in the scale adopted by this analysis: for some leading urban realities, the provincial level could have led to a flattening of the relevance of the strategic resources of their capital city (Galderisi, Gargiulo 2002).

3 URBAN SMARTNESS

Since the beginning of 2000s, a large debate on what it is called "smart city" has attracted the interest of the scientific community, becoming a topic of great importance.

The idea of this new urban dimension, that has to be built through the conscious inclusion of technological innovation into the systemic structure of the city (Fistola 2013), is not new, but its origins can be traced in the '80s, when the development of ICTs has started to clear distances and people began thinking to the city as a limitless space (Papa, Gargiulo, Galderisi 2013).

Although there is a plenty of studies focusing on urban smartness, a shared definition of the concept is still missing, but the scientific literature agrees to consider *smart* a city well performing in six macro-areas: Economy, Environment, Mobility, Governance, People, Living (Komninos 2002; Giffinger *et al.* 2007; Shapiro 2008; Van Soom 2009).

Several cities are developing a great number of initiatives aiming to become smarter, many of these are gathered in the report "Mapping Smart City in the EU" – commissioned by the European Parliament's Industry, Research and Energy Committee – that defines the success of a smart city on the depth and effectiveness of targeted improvement within each initiative and on the coherence or balance of the portfolio of initiatives across the city (EU 2014). In addition to it, the report identifies the countries with the highest number of smart cities and Italy ranks third, following the UK and Spain.

A different point of view is that of Boyd Cohen's *Smart City Wheel,* defined as "a holistic framework for considering all of the key components of what makes a city smart" (Cohen 2012) and used for drawing up a list of the ten European smartest cities, in which Italy doesn't appear.

Focusing on the Italian context, several studies have ranked Italian cities because of their level of smartness, each of which using different variables and data (Between 2013, Forum PA 2013).

In this analysis, we have decided to consider the ranking made by Forum PA in order to have a hierarchy of Italian smart cities.

3.1 MEASURING THE LEVEL OF SMARTNESS OF ITALIAN CITIES

ICity Rate is the annual report drawn up by Forum PA, a company specialized in facilitating knowledge exchange on innovation between public and private stakeholders. The report aims to support the decision making of public administrations by providing a picture of the Italian situation related to the economic, social and environmental dynamics (Forum PA 2013). The analysis assessed 103 provincial capitals on 110[3].

3.1.1 VARIABLE SELECTION

Starting from the wide range of information and data available to the public administration today, Forum PA has selected a total of eighty-nine variables describing six different macro-areas, the same mentioned above and widespread in the literature: Economy, Environment, Mobility, Governance, People, Living. All the indicators have been aggregated into one final index, called *the Smart City Index*.

Different type of data sources have been used for the analysis, such as ISTAT, UNIONCAMERE, ANCI, Openpolis and ActionAID; although the smart city index ranks 103 provincial capitals, a great number of variables used by Forum PA refers to the province as a whole, because for many indicators data of municipal level don't exist .

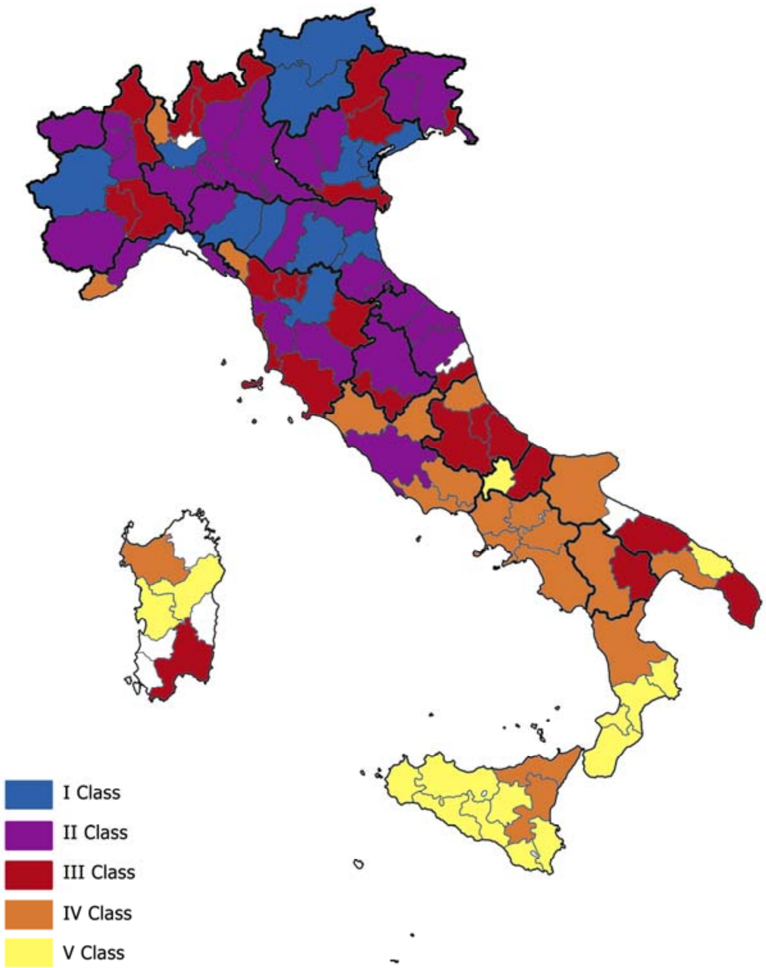

Fig. 2 Ranking the level of smartness of Italian cities.

3 Data for the provinces of Monza e Brianza, Fermo, Barletta, Ogliastra, Medio Campidano, Olbia Tempio, Carbonia-Iglesias were missing.

3.1.2 RESULTS

In order to have a comparable picture of Italian urban competitiveness and smartness, we have divided the ranking made by Forum PA into five classes[4] (Fig. 2).

A first finding is that North-Central Italy hosts the cities with the highest overall rank, while South Italian cities perform relatively poorly; not surprisingly Cagliari, the least worst of them, ranks 43th.

In North-Central Italy, two urban realities dominate the others, Trentino Alto Adige and Emilia Romagna: Trento and Bolzano are respectively first and eleventh in the Forum PA ranking, both falling in first class, while Emilia Romagna includes only cities of first (four out of nine) or second (five out of nine) class and, among them, Bologna ranks second.

Further result is that of the regions hosting the cities with the wickedest performances, which are Campania, Calabria and Sicily that include only cities of fourth and fifth class.

4 BENCHMARKING ITALIAN COMPETITIVENESS AND SMARTNESS

After having separately analyzed the level of urban competitiveness and smartness in Italy, we have compared the two rankings discussed above, in order to identify common characteristics and differences.

Firstly, we should point out that a different scale has been used to build the two classifications: while that by Forum PA refers to the municipal level of the 103 capital cities, our analysis deals with the province as a whole. Furthermore, for greater accuracy, it is important to emphasize that despite a strong similarities between the six macro-areas used to measure urban competitiveness and smartness, the indicators within each macro-area often differ: none of the indicators within the “Environment”, “Mobility” and “Governance” areas within the Smart City Index is included in the Competitiveness Index, even though eighteen out of thirty one variables used to measure competitiveness are included in that shaping urban smartness.

These premises allow us to begin comparing the two rankings.

The most significant evidence that stands out is the North-South divide, noticeable in both classifications: a leader North-Central Italy includes urban systems of international or potentially international competitiveness and, at the same time, cities with a high smart quotient, despite a laggard South Italy that hosts almost only provinces of local level and cities with a quite low smart quotient. This is confirmed by the best and worst performing regions: Emilia Romagna and Sicily are respectively at the top and bottom of the two rankings.

The case of Rome represents another point of convergence between competitiveness and smartness; in fact, it falls in second class in both circumstances and not in first, even though Rome is the capital of Italy.

Nevertheless, beyond these similarities, there are also relevant differences to point out.

For example, there is a group of North provinces which ranks relatively poorly in competitiveness but performs well in smartness: Torino, Trento and Ravenna are provinces of fourth class of competitiveness, but at the same time are in the top 10 of the smartest cities, moreover Aosta belongs to fifth class of competitiveness and second class of smartness.

The case of Turin can be explained looking at the different scale used for the two classifications, in fact, Turin can be considered among the smartest Italian cities with a good performance also from a competitive perspective, but, as mentioned above, its competitive strength is weakened by the merge with its neighboring municipalities. A different reason explains the cases of Trento and Aosta, in fact, the analysis of their position in the rankings respect each of the six macro-areas within the Smart City Index shows that Trento and Aosta respectively dominate the “Environment” and “Mobility” categories, whose indicators are

4 We have divided the range by 5 (number of classes).

not taken into account in the Competitiveness Index, while they both perform relatively poorly across the “Economic” area, which instead represents the main category shaping urban competitiveness.

A similar argument may explain the cases of some Southern cities – Lecce, Matera and Cosenza – which are provinces of fifth class of competitiveness but third class of smartness: among the six macro-areas, Lecce occupies the best position in the “Governance” category (23rd), Matera in the “Environment” area (12th) and Cosenza in the “Mobility” one (32nd), which not coincidentally are the three macro-areas whose variables are not included among those measuring competitiveness.

Although these are the most evident contradictions, one more difference between the two rankings is that all the South but Sicily and Calabria doesn’t fall in the last class of smartness as it does for competitiveness, but it belongs to the fourth. Naples and Potenza are two of these cases, interesting to investigate.

By conducting a deeper analysis on the smart city classification, it emerges that Naples and Potenza perform very well in the “Governance” macro-area, ranking respectively 17th and 16th and this very good result is mainly due to a group of variables which measure the urban planning and development tools endowment of the two cities, but this finding seems inconsistent with Naples’ underperformance in the “Environment”, “Living” and “People” categories and Potenza’s underperformance in the “Living”, “Mobility” and “Economy” macro-areas, in which these cities languish further down.

5 CONCLUSIONS

This research has provided a contribution in the effort to understand if the label “smart city” may fall in the branch of studies that supports research on the competitive city, whose definition dates back to the late ‘80s. Looking at both six macro-areas considered strategic for making a city competitive and/or smart, as well as benchmarking the two maps (Fig. 1; Fig.2), similarities are evident. Nevertheless, looking at the variables within each macro-area, some differences come out, suggesting that the idea of smart city comes from that of competitive, but it evolves differently: if a competitive city aims to attract human and financial capital, a smart city aims also to improve the quality of life of its users by using ICTs to maximize the efficiency of urban spaces (Tiboni, Rossetti 2012); however, *“because in the 21st century a city’s attractiveness is directly related to its ability to offer the basic services that support growth opportunities, build economic value and create competitive differentiation, potential inhabitants, of both the commercial and residential variety, are a discriminating lot, and they are looking for cities that operate efficiently and purposefully. They are looking for smarter cities”* (IBM 2012). This means that today a city needs to improve its smart quotient in order to be more attractive and so more competitive. Not surprisingly, cases like Milan, Bologna and Bolzano show that a competitive province is always bolster by a smart capital city.

Taking the cue from this finding, it would be necessary to measure Italian urban competitiveness at municipal scale to better compare this ranking with that of smartness.

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URBAN SYSTEMS AND ENERGY CONSUMPTIONS

A CRITICAL APPROACH

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ABSTRACT

City transformations are also due to the development of new energy sources, which have influenced economy and lifestyles, as well as the physical and functional organization of urban systems. Cities are the key place where it is need to act for the achievement of strategic environmental objectives, such as reducing greenhouse gas emissions and energy saving. The hard resolution of these challenges depends on several factors: their multidimensional nature, the change of the economic and settlement development model, and also the complexity of the relationships between the elements that constitute the urban systems and that affect energy consumption. According to this awareness the *Project Smart Energy Master for the energy management of territory* financed by PON 04A2_00120 R & C Axis II, from 2012 to 2015 has been developed: it is aimed at supporting local authorities in the development of strategies for the reduction of energy consumption through actions designed to change behavior (in terms of use and energy consumption) and to improve the energy efficiency of equipment and infrastructure. With the goal of describing some of the results of the methodological phase of this project, this paper proposes a review of the major studies on the issue of energy consumption at the urban scale in the first section; in the second section the outcomes of the first phase of the development of the comprehension/interpretive model related to the identification of the set of physical/environmental variables at urban scale, that most affect the energy consumption, are described; the third makes a critical review of the reference scientific literature, characterised by a too sectoral approach, compared to the complexity of the topic.

KEYWORDS

Energy consumption; Holistic approach; Urban texture and energy; Urban form.

1 INTRODUCTION

At the beginning of the last century there were only a few cities with a million inhabitants, but nowadays there are more than 400 cities where a at least million people live (Earth Policy Institute). The current high rates both of population and urbanization are expected to continue growing (80% of the population will live in cities by 2030) and these trends make energy sustainability challenge at urban scale crucial to the future of whole world. This last statement can be explained by the fact that, as most people inhabit cities, which are enlarging more and more, the latter are responsible for a great part of greenhouse emissions and a huge rate of energy consumption as well. Cities gather economic, productive, and social activities (OECD 2010) and supporting all of them requires energy, that entails producing CO_2 emissions: in this regard, several researches suggest that cities consume up of the 75% of global energy and account for 78% of carbon emissions from human activities (UN-HABITAT 2006; Stern 2006; IEA 2008). Therefore, the importance of the urban areas to address and understand environmental and energy issues is widely acknowledged. The strict and complex relations between energy, climate change and land-use, which "together are the main interconnected driving forces of human-induced global change" (Pasimeni *et al.* 2014), prove that if cities are part of the problem, they are inevitably part of the solution too. Hence, the key role of the urban systems within both European and international strategies, to achieve energy and climate change mitigation and adaptation policy targets, (IPCC 2007; COM(2010) 639; COM(2011) 112) and the scientific debate on energy issue. Actually the study of the interaction between energy and the urban built environment started to be of considerable interest since the 70s, following the period of energy crisis (Beaumont *et al.* 1981; Littler and Thomas 1985; Owens 1986) but, the relationships between the physical and functional organization of cities and energy consumption are being studied and interpreted only recently. In this context, this paper reviews the literature on energy consumption at the urban scale with the aim to describe the results of the first phase of the development of the comprehension/interpretive model related to the identification of the set of physical and environmental variables at urban scale, that most affect the energy consumptions.

2 THE STATE OF CURRENT PRACTICE

According to energy consumption data of cities, over 60% is determined by mobility and buildings (IEA 2011); whereas on the one hand this state of affairs explains the great attention paid by scientific research to these fields of study, on the other it shows that energy consumption is highly dependent on both the configuration and the relationships between the components of the urban system. The buildings gather the activities that are the reason of the energy consumption (every human activity requires energy) and therefore they should be considered in relation to both their energy consumption and behavior of the users that are within them; the location of the activity involves the need to move, resulting in strong effects on the organization of the territory that cannot be overlooked in terms of resource consumption. Although this statement may seem simple and obvious, the urban dimension of research on energy consumption, defined here as the system and not the individual urban components, attracts much less interest than that of the building, that is very present within the literature.

Even though there is a great diversity of models, in terms of their purpose, features, capabilities and data requirements, related to the energy systems, which cuts across inevitably several sectors and disciplines the theoretical and application reference models for this review, refer to the main regional studies and those related to urban energy planning, in addition to the few works that have attempted to integrate the components of the urban system in the perspective of reducing energy consumption.

In current scientific literature in this field the main research branches can be synthesized as follows:

- studies related to urban morphology, with particular attention to the relationships between the urban density-urban form-transports (Banister *et al.* 1997; Williams *et al.* 2000; Salat and Morterol 2006; Cecere *et al.* 2009; Echenique *et al.* 2014);
- studies related to the solar gains and the heat loss of the urban texture, with reference to environmental and microclimatic variables (Kaiser 1996; Steemers 2003; Ratti and Morello 2005; Carneiro *et al.* 2009; Amado and Poggi 2014).

For both study areas the main results are described.

CATEGORY	RESEARCHES
Urban form-urban transport-energy consumption	Owens 1986; Newman and Kenworthy 1989; Breheny 1996; Banister *et al.* 1997; Alberti 1999; Williams *et al.* 2000; Ewing and Cervero 2001; Cecere *et al.* 2009; Holden and Norland. 2005; Salat and Morterol 2006; Andrews 2008; Ewing and Rong 2008; Pitt D. 2012; Ko 2013; Echenique *et al.* 2014.
Sunlight-solar gains-energy consumption	Givoni 1989; Baker et al 1996; Kaiser 1996; Baker and Steemers 2000; Hui 2001; Steemers 2003; Ratti and Morello 2005; Carneiro *et al.* 2009; Amado and Poggi 2014.

Tab.1 Literature review

2.1 URBAN FORM, TRANSPORT AND ENERGY

More and more policies focus on reducing greenhouse gas emissions in cities and as a consequence, a growing body of literature investigates the dependence of energy needs on the form, density and design of urban settlements.

The two main settlement models taken into consideration are those of the compact city and urban sprawl, and most scholars agree that the compact forms can affect strongly the reduction of energy consumption and greenhouse gas emissions too. Newman & Kenworthy (1989) have shown that there is an inverse correlation between urban density and energy consumption per capita, through the analysis of some thirty-two cities across the world. This study shows that the energy consumption due to transport is an inverse function of the density of population; therefore, the more the city is dispersed, the more it consumes energy, and the less sustainable it is. In addition, the cities that are characterized by a high density development, for instance Hong Kong, are the most efficient energy consumers, while low-density cities, such as those of North America and to a lesser extent those in Australia, are less efficient. Another example is New York, a compact city with a small carbon footprint in its core urban area, which annually produces about 7 tons of greenhouse gases, a small amount compared both to other major U.S. cities, and the national average of approximately 24.5 tons (Owen, 2010).

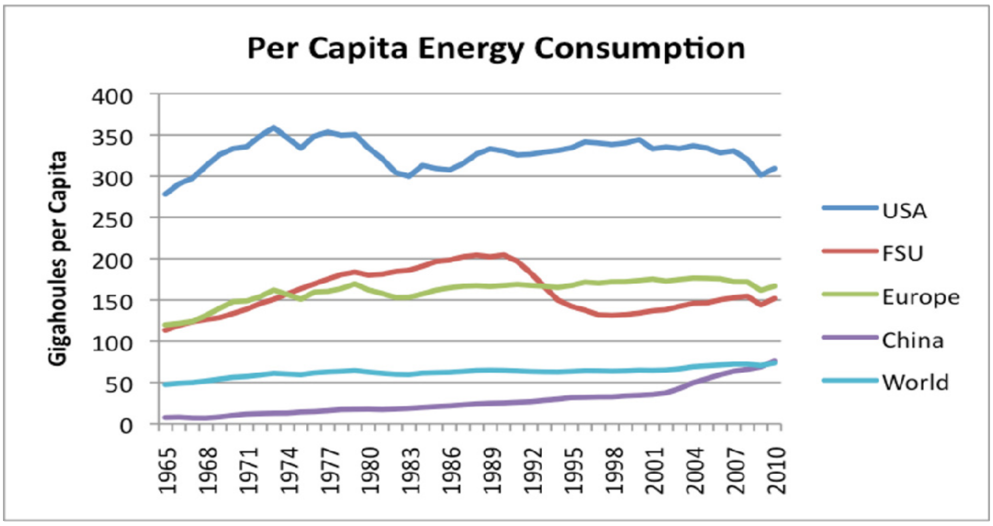

Fig. 1 Comparison between worldwide per capita energy consumptions

The fundamental reason of the remarkable consensus for more compact cities is related to mobility: low-density cities are, in fact, characterized by highly dispersed activity and a consequent heavy dependence on private transport. Even Owen (1986), analyzing the link between urban form, land use planning and energy consumption, argues that by minimizing the need to travel you can have a positive impact on the reduction of these consumptions, even though "at particular high-density, the energy consumption benefits may begin to be outweighed by the side benefits arising from congestion".

Holden and Norland (2005), Andrews (2008), Ewing and Rong (2008) and Pitt (2012) have carried out a comparison of the energy consumption of compact urban areas and energy consumption in areas affected by sprawl. The comparison demonstrates that urban sprawl is characterized by higher energy consumption, because the variable that is most influential is the size of the housing units: larger residences (terraced houses) localized especially in the suburban areas or in the expanding ones, compared to the apartments in central urban areas, require greater amounts of energy for different end uses (heating, cooling, etc.). In addition, the energy consumption per capita and for families in compact urban areas characterized by high density housing is lower than in areas with low population and territorial density (37,7 compared to 27,2 million Btu/year, Ko 2013)

2.2 SOLAR GAINS AND ENERGY CONSUMPTION

In contrast to the supporters of the compact city, who believe that the most important advantages are related to the least energy intensive activity pattern, that help to cope with climate change challenge, a lot of evidences on the influence of urban form and density on sunlight availability should be considered (McPherson 1994; Hui 2001). In fact, if the urban energy consumptions are related to the geometry and morphology, they also depend on the availability of daylight, and then from the urban microclimate (Steemers 2003; Ratti *et al.* 2005): "the outdoor temperature, wind speed and solar radiation to which an individual building is exposed is the local microclimate as modified by the 'structure' of the city, mainly of the neighbourhood where the building is located" (Givoni 1989).

Since the 1990's Banister, Baker and Steemers have been studying how the physical characteristics of an urban area, with particular attention to the buildings, influence the solar gains and the availability of sunlight. The barrier effect to solar radiation determined by the proximity of buildings affects, for example, the passive solar conditioning, the possibility of using photovoltaic technologies and so renewable energy sources, and on phenomena such as the urban heat island: the temperatures are higher in urban areas than in neighboring ones. A compact form with high levels of urban density can minimizes heat loss, exacerbating, at the same time, the urban heat island (Krishan *et al.* 2001). In this regard, many scholars have conducted research to understand whether and how much the presence of green areas and water bodies affects the urban microclimate and energy consumption. Bolund and Hunhammar (1999), Akbari *et al.* (2001), Yamamoto (2004) and Hong Ye *et al.* (2013) have found that the greater the presence of green areas in cities is, the lower the energy consumption and CO_2 emissions are. Trees promote natural ventilation, cool the air through the process of evapotranspiration, thus helping to keep buildings cooler in summer and warmer in the winter, as they can produce a barrier against the cold winds.
Before offering causes for reflections on this brief review, a set of physical and environmental variables to refer to the study of energy consumption at the urban scale, are proposed below.

3 A SET OF PHYSICAL AND ENVIRONMENTAL VARIABLES

The state of the art described above suggests that the study of energy consumption at the urban scale cannot be separated from the knowledge neither of the physical- characteristics of the study area, or of the climatic and environmental conditions and nor even of their relationships. Therefore, the present work wants to contribute to the development of a knowledge framework of the energy saving issue at the urban scale, proposing a set of variables to be used in the building up a new comprehension/interpretive model of city.
In order to identify these variables, it is also useful to illustrate a research conducted in Europe by the CSTB (Centre Scientifique et Technique du Bâtiment), which investigated the relationship between urban density, morphology of the city and the different forms that the various combinations may assume (especially with regard to the transport network, comparing the urban texture of some cities in Europe and Asia) in 2006. Salat & Nowacki, two of the CSTB researchers who conducted the research, studied a sample of one hundred neighborhoods in six cities in the world to measure the shape parameters that affect energy consumption; these parameters, integrated and correlated to each other, would produce an energy improvement of the city, far superior to that one caused by the interventions related to the isolation of the buildings and the optimization of distribution networks.
The identification of variables, based on the research described above, has taken into account both the numerous studies that have applied the bottom-up models (models that use disaggregated data to determine the energy consumption of different end uses related to individual or groups of buildings) and the few quantitative experiments carried out in groups of buildings or on the neighborhood scale (Howard *et al.* 2012; Soltani *et al.* 2012; Ugursal and Swan 2009; Ko and Radke 2013). This choice has been inevitable, as the vast majority of the scientific attention has been paid to the minute scale such as the building one. Two major categories of variables have been identified, the physical and environmental ones, (Table 2) which describe, respectively, the morphology and geometry of the urban texture and the climatic and context characteristics.

ID	CATEGORY	PARAMETERS	INCIDENCE ON ENERGY CONSUMPTION
1	physical variable	urban horizon angle	high
2	physical variable	aspect ratio	high
3	physical variable	territorial density	high
4	physical variable	population density	high
5	physical variable	surface/volume ratio	high
6	physical variable	building floor area	high
7	physical variable	slope	low
8	environmental variable	building function	high
9	environmental variable	building orientation	high
10	environmental variable	green area density	high
11	environmental variable	public transport network density	high
12	environmental variable	ventilation	low
13	environmental variable	sky view factor	low
14	environmental variable	albedo	low
15	environmental variable	climatic zone	low
16	environmental variable	degree days	low

Tab.2 Variable set

These parameters represent the most significant features and the most widely used in the studies carried out up to the present; their incidence on energy consumption can be assessed only qualitatively, according to the fact that both the interactions and the effects of urban form and geometry on energy consumptions still continue to be understudied and controversial (Alberti 1999). In practice, it is a set of variables based on the proposed literature review and not on empirical findings or field work.

It is worth noting that in this set of parameters there are many related to the urban form that should be taken into account not only in their specificity but, above all, deepening their relations, in order to achieve in a concrete way the objective of energy consumptions and greenhouse gas emissions reduction. The study of the interrelations that are established between the physical and environmental elements must not be carried out separately from those relating to other components of an urban system but, on the contrary, it is necessary to study them comprehensively, using a holistic approach to identify the elements and connections that have the greatest impact on energy consumption.

Therefore, the proposed variables represent only a first step in the development of a wider set of parameters with which to analyze and interpret the relationships between different components of an urban system from the energy saving perspective. This regard derives from the awareness that the experiments and the models developed so far have not studied sufficiently the urban significance of the energy issue, on which we want to offer cause for reflection in the following section.

4 THE NEED OF A DIFFERENT APPROACH TO ENERGY ISSUE AT URBAN SCALE

The multi-dimensional nature of the energy issue should make us reflect on the range of interventions to implement for the energy consumptions reduction, as well as on the study of the relationships between the components of the urban system and the energy so far made in the scientific literature. The scientific debate does not seem to have understood neither the energy value of urban areas, nor the importance of looking at urban planning disciplines as a new way of thinking about energy, compared to the current approach which is still inadequate, in contrast to the complexity of the topic. The majority of the research efforts are almost exclusively about the performance and energy efficiency of buildings, renewable energy plants and transport systems, rather than the urban system in its entirety and complexity. Quantitative and holistic studies that deal with energy issue at urban scale by considering the interactions among several urban components have not been attempted yet.

The reduction of energy consumption at the urban scale is tackled with a sectoral approach, by assessing the link between energy and just one urban component, and this risks to lead to an oversimplification of both the input information and, especially, of the results obtained. For example, within the LT model (Ratti *et al.* 2005), developed for the study of the relationships between urban form and energy consumption, the authors consider the parameters of the urban form selected independently from each other, without taking into account the connections between them. In contrast, in a study carried out in New York City (Howard *et al.* 2012) the energy consumptions of Manhattan are related to the use and floor area of buildings, without reference to geometry, morphology or microclimate of the area of study, except through some purely qualitative assessment: "as one would expect a consumption normalized by block area would show particularly high values for parts of the city where the buildings are tightly packed and tall".

What emerges from the researches that claim to study the energy consumptions at the urban scale is that the latter are either related to the physical structure of the study area (form, density, etc.), or are related to the building scale, considering buildings as "self-defined entities" (Ratti *et al.* 2005). Based on this state of affairs is possible to make two observations:

- the results are mostly qualitative, as these studies strongly depend on the context of the methods used, geographic region, climate and other specific conditions and so caution should be used when attempting to generalize or compare the results from one study to another. For example, in the cities of Northern Europe, because of the latitude and the consequent low solar inclination, urban density affects the solar accessibility more than in other urban areas (Strømann *et al.* 2012); however, if we think of the Mediterranean climates, where energy consumption is increasingly affected by the growing demand for air conditioning in summer, the dense urban settings, allowing to reduce direct heat gains by the effect of the mutual obstructions, appear to be more efficient.
- the conclusions may be uncertain and opposite, as in the case of the urban development forms: for example, the apparent paradox between the general tendency to densify in order to reduce transportation costs and to increase the energy efficiency of the city and the impact that this process has on the urban microclimate and even the quality of life in the city, still remains unsolved.

  Although the density has a deep relationship with the urban morphology, it is not sufficient alone to ensure high levels of quality and energy efficiency of cities.

Furthermore, referring to the building scale, the results of these studies may no longer be valid when the scale of intervention is expanded, because of the complex interactions that exist within an urban system (Bourdic and Salat 2012).

It is clear that the absence of a comprehensive theoretical framework does not allow to generalize individual results and make convincing conclusions. In this perspective, the role of researchers and urban planners in developing methods, techniques and strategies for the reduction of energy consumption in the city, already made difficult by the complexity both of the topic and urban systems, is even more daunting.

According to what has just been described, the interpretive paradigm used until now for the study of energy consumption at the urban scale turns out to be far from the holistic-systemic approach characterizing the management of territorial transformations. A systemic and cross approach of this type should be adopted in order to understand how to act on the relations between the elements that make up the urban system as a determinant of energy consumption. Broadening our vision and considering the city as a whole, would promote the adoption of a global vision that deals in an integrated manner with the overall city, the efficiency of its form and its infrastructure, the behavior of its users and the effectiveness of new technologies.

In this perspective the research project Smart Energy Master (SEM) has been developed, in line with existing EU policies that call for "a holistic approach to energy and environmental issues, as the many social, economic, cultural and natural components of urban systems are interwoven in a unique manner "(EU 2011). The SEM project, in fact, is aimed at the development of a model of energy efficiency of the territory, with reference to urban areas, and is characterized by a systemic approach based on the indissoluble relationship between transformations of the territory, urban planning, distribution of activities, the government of the mobility and energy habits of users.

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Fig. 1: http://www.eea.europa.eu/.

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CLIMATE CHANGE AND ENERGY SUSTAINABILITY

WHICH INNOVATIONS IN EUROPEAN STRATEGIES AND PLANS

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ABSTRACT

In recent years, the effects of climate change on urban areas have pushed more and more policy-makers and urban planners to deal with the management of territorial transformations in a systemic and multi-sector perspective, due to the complexity of the issue. In order to enhance the urban governance of climate change and cope with environmental sustainability, the concept of resilience can be used. In this perspective, the present work has a double purpose: on the one hand to reflect on he need to adopt a new comprehension/interpretive approach to the study of the city, which embraces the concept of resilience, and on the other hand to perform a reading of European strategies and plans oriented to mitigate the effects of climate change and to achieve the goals of energy and environmental sustainability. This paper describes some of the results of the knowledge framework of the *Project Smart Energy Master for the energy management of territory* financed by PON 04A2_00120 R & C Axis II, from 2012 to 2015 aimed at supporting local authorities in the development of strategies for the reduction of energy consumption through actions designed to change behavior (in terms of use and energy consumption) and to improve the energy efficiency of equipment and infrastructure. The paper is divided into three parts: the first is oriented to the definition of the new comprehension/interpretive approach; the second illustrates a series of recent innovations in planning tools of some European States due to the adoption of the concept of resilience; the third, finally, describes and compares the most innovative energy and environmental strategies aimed at contrasting and/or mitigate the effects of climate change, promoted in some European and Italian cities.

KEYWORDS

Environmental sustainability; Climate change; New comprehension approach; Adaptation strategies.

1 A NEW APPROACH FOR THE RESILIENT CITY

The population growth living in urban areas reaches 50% of the total, causing congestion, traffic, polluting air, noise and energy consumption, also due to the high density of urban activities. From the reading of the main world-wide reports (IPCC 2012; EEA 2012), it is clear that the core of the problem of emissions that affect the climate conditions is mainly concentrated on medium and large cities, where temperature is higher at least two degrees compared to less densely urbanized territory.

Cities play simultaneously actions of opposite sign: on the one hand they represent one of the principal source of pollution and global warming, and on the other hand they try to develop strategies of mitigation and adaptation to help combat the effects due to climate change.

Regarding these strategies is evident the essential role played by land use policy (mixed use, compact settlements) both towards mitigation and adaptation actions; the first are aimed at changing lifestyles mainly related to mobility and energy production and consumption in urban areas, while the second are aimed at anticipating the possible negative effects of climate change and at preparing plans, actions and measures for the construction of settlements that is able to conform to the consequences of climate change (IPCC 2001). Therefore it is clear that the declinations of the effects of climate change enhance the hard task of policy-makers and planners who have to work under conditions of increasing uncertainty in the attempt to outline future scenarios in systems characterized by high complexity and dynamism.

Most recent researches and documents regarding this issue strongly reveals the urgency to afford the problem in a multi-sectorial and systemic perspective, that has always characterized the planning theory. The European Commission, henceforth, has pointed out as seventh thematic strategy the urban environment (COM(2004)60), where it is necessary to integrate environmental policy with other actions. In this context it is required to develop new comprehension and methodological approaches, and to update tools and operational techniques of managing territorial transformation that «should adapt to the dynamism and diversity of the city» subjected to climate changes (Papa and Gargiulo 1995). In this perspective, the concept of resilience can be used as a guiding principle for the future growth of the city, integrating a systemic approach, which currently seems to provide good guarantees of connection with the studying systems. There are many authors and institutions that have formulated a definition of the concept of resilience in urban and regional sciences (Alberti et al. 2003; ONU 2009; IPCC 2012), describing it as «the ability of a socio-economic region, to absorb the endogenous or exogenous disturbances by change processes, so that the main functions, structures and relationships being essential for the well-being and sustainability of the region remain intact» (Lukesch, Payer and Winkler-Rieder 2010).

The definition given above underlines the connection between the concept of resilience and that one of sustainability; some authors emphasize that: «resilience is to the 2000s and 2010s what sustainability was to the 1980s and 1990s» (Foster 2010) and also that «a development strategy is not sustainable if it is not resilient» (Perrings 2006). But if the concept of sustainability considers the evolution of urban systems as mainly related to endogenous factors, in the attempt to achieve a stable equilibrium state when the present generation meets his own needs «without compromising the ability of future generations to meet their own needs» (WCED 1987), the concept of resilience looks at urban development as a process that evolves as a result of both endogenous and exogenous events, unexpected and unpredictable, involving the reorganization of the urban system towards a new dynamic equilibrium state. In summary, it is necessary that the tools and techniques of territorial transformation government «are no longer static projection tools and slow and bureaucratic techniques of formal control, but they must adapt to the dynamism and diversity of the city» (Papa and Gargiulo 1995). It is essentially to rethink the development model, and, in particular, settlement and urban development, identifying the ways by which to reduce energy consumption maintaining sustainable economic growth rates and untying the link between economic growth and increasing energy consumption.

This consideration is confirmed by the fact that the weight of energy production from renewable sources out of the total production in Europe but especially in Italy, continues to be very low, and doesn't respect emission reduction targets. Furthermore the cost of the Kilovattora produced with the cheapest renewable sources available today (windpower) is even more triple than the one produced with traditional methods, such as from a coal-powered plant. This heavy gap doesn't allow the immediate solution to the problem but highlights how major benefits can be reached quickly with the lowest investment costs and how they are related to saving energy. Also in the transport sector, which is considered a major contributor to CO2 emissions and air pollutants (COM (2007) 551), the goal of greater efficiency in transport sector doesn't depend only on technological innovation, but mostly on an effective reorganization of urban trips discouraging private cars. In this regard, ENEA in 2009 estimated that the doubling the current demand of alternative modes to private road transport, determines a total saving of approximately 2.7 Mtoe proving so that modal shift policies are as effective as those promoting energy efficiency through technological innovation.

Therefore an energy policy environmentally sustainable, characterized by an integration between energy, mobility and urban system, should be quickly adopted. Adopting a systemic and operative approach with a precise set of priorities and specific actions means to address the environmental challenges, impacting significantly on climate change and on urban mobility, two aspects that are strategic for the construction of future resilient cities.

A great deal of studies and researches on energy and environment have showed the lack of a systemic approach, that involves the various actions and initiatives of the territorial settlement. More and more the traditional division between city and countryside has determined a higher soil consumption causing the inevitable growth of road transport demand and worsening the territorial, environmental and energy unsustainability. Moreover, the transformations that took place in the city to meet the growing road private transport demand, have led to intolerable profiles of energy and environmental unsustainability, such as to exclude that policies oriented to improve energy efficiency of existing buildings, although essential, can be produce effects comparable to the scale of the problem. The research lines that afford the energy consumption reduction have been developing their field action only recently within the Relevant National Interest Research Programs (PRIN) and National Operational Programs (PON).

The integration among territorial transformations, planning mobility and environmental sustainability opens interesting perspectives for the definition of new intervention strategies that tie together, into a new model of governance of the territory, different aspects such as: the reorganization of urban system, rail transport, social housing, urban regeneration and the implementation of energy policies and climate adaptation

2 PLANNING AND PROGRAMMING RESILIENT CITY IN EUROPE AT NATIONAL LEVEL

In 1992, 28 European nations signed the United Nations Framework Convention on Climate Change (UNFCCC), which states that parties are committed to «formulate, implement, publish and regularly update National and, when appropriate, regional programmes containing measures to facilitate adequate adaptation to climate change» (UNFCC 1994).

Also the European Union (EU) has made the fight against climate change a priority in its program of action and it set up the European Climate Change Programme (ECCP) as the key vehicle for identifying and developing, with Member State, policies and measures that can be taken at EU level to reduce greenhouse gas emissions. The second phase of this program was initiated in 2005 containing, in addition to the identification of further mitigation options, a work program on impacts and adaptation to climate change on certain topics of interest. One of them concerns the development of national adaptation strategies.

The European countries involved are at different stages in forecasting, formulating and implementing adaptation and mitigation strategies at national level. Starting from Finland who was the first European country to implement an adaptation strategy in 2005 with the FINADAPT, 23 other European nations including France, Spain, Netherlands, United Kingdom have adopted national strategies in the field of climate adaptation and some countries, such as Denmark, have already released the third update of its national action plan.

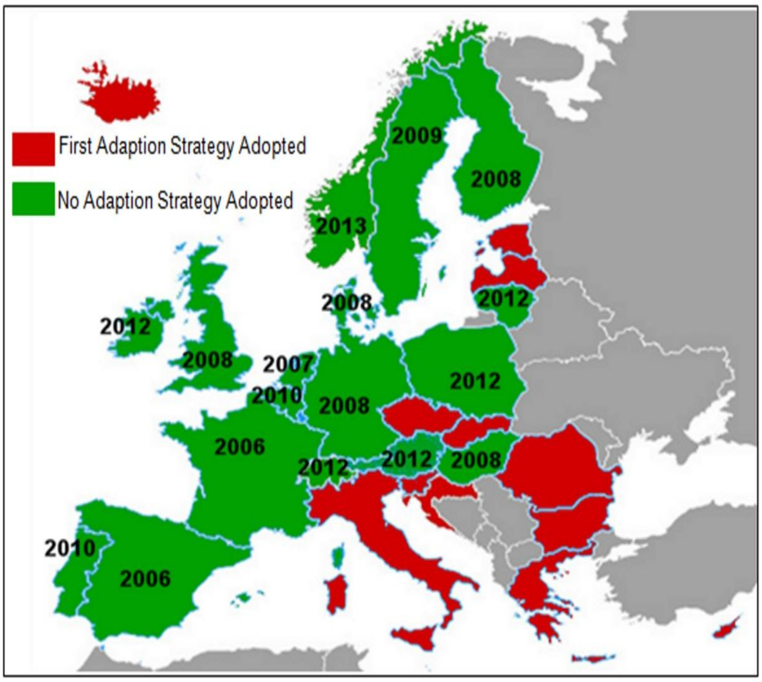

Fig. 1 The status of adaptation strategy developed in Europe: Italy is one of the few European countries that have not developed a unified plan of action at national level

France, for the development of the "Strategie nationale d'adaptation au changement climatique" (2006) set up a special authority called ONERC (Observatoire National sur les effets du réchauffement climatique). The strategy is merged in the "Plan national d'adaptation" (2011) which identified 80 measures to be implemented at different levels of decision in the period 2011-2015, adopting a multidisciplinary approach to the issue of adaptation that takes into account the strategic sectors such as: water, risk prevention, health, energy and industry, transport, construction, etc.

Spain has also entrusted to a special administrative body the OECC (Oficina Española de Cambio Climático) the development of the "Plan Nacional de Adaptaciòn al Cambio Climatico", approved in March 2006. The innovative aspect that characterizes Spain is the presence of two national coordinating bodies of the measures and policies on climate change: the Interministerial Group on Climate Change and the Commission's policy on climate change that coordinates and monitors the actions implemented at different administrative levels. The national adaptation plan represents the general framework to address the assessment of impacts, vulnerability and adaptation to climate change to which the administrations and organizations, both public and private, must refer in order to assess the impacts of climate change in their areas of interest.

In the Netherlands, the government has developed and adopted in 2008 the national strategy for adaptation to climate change "Make Space for Climate!".This document was preceded by the implementation of two major research projects funded in 2005 to fill the gap between theory and practice in the field of climate change: "Climate changes Spatial Planning" and "Knowledge for Climate" that link the coordination between the different stakeholders: government, business and research institutes, assuming climate change and climate variability as guiding principles for spatial planning.

The UK has started to pursue policies on climate change since the late eighties with the "The Non Fossil Fuel Obligation" (1989) and today is the only European country to have a law to reduce emissions carbon by 2050 (Climate Change Act 2008). This document contains both mitigation and adaptation legislative measures that require careful and constant monitoring program to recalibrate objectives, policies and interventions every five years in order to address the risks of climate change. In October 2008 the UK Government created the Department of Energy and Climate Change (DECC). This new department brings together the responsibilities for energy policy (previously with BERR –the Department for Business, Enterprise and Regulatory Reform), and the climate change mitigation policy (previously with Defra - the Department for Environment, Food and Rural Affairs).

Italy, Cyprus, Luxembourg, Poland and Slovenia are the only countries in Europe that have not yet developed a national adaptation strategy. In particular, Italy presents a very fragmented situation: in addition to not having taken any national strategy is in trouble even in the so-called downscaling, the transition from general strategy to the practical application at a local scale (Eco dalle Città 2013).

From the energy efficiency point of view, the European Union has already adopted several legislative measures to increase energy efficiency in various sectors - buildings, generation of heat and electricity, domestic appliances etc. The European Commission started a broad debate in 2006 with a Green Paper on Energy Efficiency which has been realized in the publication of the Action Plan for Energy Efficiency adopted on 8th March 2011. The Directive sets an indicative energy saving target of 9% by 2016 and establishes that the Member States have to submit three National Energy Efficiency Action Plans (NEEAPs), scheduled for 2007, 2011 and 2014.

Energy efficiency is also at the heart of the EU strategy "Europe 2020" for smart, sustainable and inclusive growth. The EU’s energy priorities are set out in the Communication “Energy Roadmap 2050”, adopted on 15th December 2011, in which the EU committed itself to reducing greenhouse gas emissions to 80-95% below 1990 levels by 2050.

Up to this day, almost all member states have already adopted the second National Action Plan and the results achieved are monitored by relevant experts as provided by the European project "Energy-Efficiency-Watch" that has finalized 27 reports for every EU Member State which provide a qualitative overview of the specific national energy efficiency policies and their implementation.

France has adopted a participatory decision-making approach to prepare its Action Plan for Energy Efficiency (National Energy Efficiency Action Plan), bringing together in a series of meetings (Environment Round Table) State, regional and local administrators; the guiding principle of this decision was to «define a roadmap for sustainable energy development, through drawing up concrete and quantifiable measures with as much agreement as possible from the participants». Two are the main challenges that France energy policy aims at engaging: a more efficient management of energy demand and the improvement of the energy supply to meet the needs of consumption. In particular, in order to support the actions for challenging energy sustainability, is crucial the role played by “Agence de l'Environnement et de la Maîtrise de l'Energie" (ADEME) which is engaged both in promoting the use of renewable sources, and in making more informed citizens and private entities in the field of energy saving.

Since 2005, Spain has begun to develop a sustainable energy policy aimed at improving energy efficiency and at widespreading the use of renewable energy (IEA report 2009). Because of these objectives two tools that contain the priorities for energy policy for the horizon 2020 have been developed: the Energy Efficiency and Saving Energy Action Plan and the Renewable Energy Plan. The process of development of both plans was carried out simultaneously (the plans were approved in July and November 2011), in order to be able to realize in a concrete way a sustainable energy model.

The Netherlands has approved in 2011 the second National Energy Efficiency Action Plan, which sets an energy savings of 2% per year of energy savings by 2020. To achieve the targets for reducing CO_2 emissions and the production of electricity from renewable sources the Dutch government has also promoted the Green Deals, that are agreements between the business community and the local governments to promote the industry adaptation to emission standards and to stimulate new projects of green energy production. However, in the Netherlands there is a lack of ambition and enthusiasm of energy efficiency policies, of stable investment climate due to frequent changes and of funding programmes for building renovation are among the reported critical issues. Positive developments include an increase in fuel taxes which creates better economies for energy savings as well as more private initiatives for energy efficiency, also on regional level (EU 2012).

The UK, in line with the European Directive Energy Roadmap, established in December 2011 a reduction of 80% of greenhouse gas emissions by 2050 with the Carbon Plan, and identified four possible scenarios for 2050, relative to 1990, which imply a per capita demand reduction of energy consumption between 31% and 54% relative to 2007. On 18th October 2011 the UK approved the Energy Act 2011 that provides for a step change in the provision of energy efficiency measures for homes and businesses. The Government has already made progress through radical initiatives such as the Green Deal, a new financing framework to enable the provision of fixed improvements to the energy efficiency of households and non-domestic properties, funded by a charge on energy bills that avoids the need for consumers to pay upfront costs.

Italy has placed the promotion of energy efficiency among the priorities of its national energy policy, elaborating two National Action Plans; the first Energy Efficency Action Plan (EEAP), which was presented in July 2007, identified the guidelines that the Italian Government has intended to pursue to achieve the objectives of improving energy efficiency and energy services. In July 2011, the second EEAP was approved and, retaining the quantitative target for reducing consumption to 2016 amounted to 9% (126,540 GWh / year), it aims to relate renewable policies with energy efficiency policies. At the same time the National Action Plan for Renewable Energy (PAN) was issued by the Ministry of Economic Development and the Ministry of the Environment, and this Plan provides further guidance for energy efficiency, as a prerequisite for achieving objectives in the field of renewable energy and reducing CO_2 emissions.

3 ENVIRONMENT AND ENERGY STRATEGIES IN EUROPE AT LOCAL LEVEL

In this section the current strategies implemented in some European cities for adapting them to climate change will be discussed. The reading of the strategies has been carried out in function of three sectors which may influence or which may be affected by climate change in urban areas: energy, transportation and planning.

In addition to individual initiatives adopted in each of these three sectors, in recent years many European cities have joined the Covenant of Mayors (Covenant of Mayors) on a voluntary basis; it was promoted by the European Commission on 29th January 2008, during the second edition of the EU Sustainable Energy Week, aimed at involving the local governments towards energy and environmental sustainability. The main actions of signatory cities of the Covenant to reduce emissions of harmful greenhouse gases by 20% by 2020 are: green mobility, energy efficiency of public and private buildings and public awareness. This formal commitment is to be achieved by the implementation of sustainable energy action plans (SEAP), that many cities have already adopted, to demonstrate how the council intends to achieve the goals of reducing CO_2 emissions by 2020.

The starting point for the drafting is the emission inventory (Baseline Emission Inventory-BEI) which constitutes a snapshot of municipal energy situation with reference to the year since then the reduction of carbon dioxide emissions shall be assessed. In fact, on the basis of the data collected and processed in BEI the municipal administration will be able to identify areas of priority action plan and energy saving measures in the public and private sectors.

London was among the first cities to join the Pact, and to submit, in 2011, the SEAP developing its own action strategies for saving on three pillars: retrofitting green London (retrofitting existing buildings in order to reduce the energy consumed to heat environments and produce hot water), greening London (increase the arboreal soil of 5% by 2025 for a report of a tree for every Londoner and create a network of green areas) cleaner air for London (improving air quality by focusing on the use of non-fossil fuels). A careful identification of direction of intervention allowed the London Government to act jointly and synergically on multiple themes (energy, environment, sustainability and air pollution) to ensure that it becomes «the best big city in the world» (Mayor’s Energy Strategy 2011), characterized by low levels of carbon dioxide in the atmosphere and a high quality of life. The action strategies outlined in the several planning tools of the UK capital (Mayor's Air Quality Strategy, Mayor's Transport Strategy, The plug-in vehicle infrastructure Strategy, Hydrogen Action Plan) fully comply with the guidelines and objectives contained in the higher level plans.

As London also Amsterdam has developed and implemented integrated policies in the field of transport, energy and environment thanks to the planning model adopted at national level, the Polder Model, which ensures a sustainable future. To encourage change in the use of energy and reduce carbon emissions, Amsterdam has developed two strategic documents: the New Amsterdam Climate and the Amsterdam Smart City; the last one appears as a great opportunity for a collaboration between the government agencies, the community and the entrepreneurship to design and implement projects in the fields of labour, housing, mobility and production of renewable energy, in order to demonstrate «how energy can be saved, now and in the future» (Amsterdam Smart City 2011). Amsterdam has joined the Covenant of Mayors in early 2009, with the goal of 40% reduction in CO_2 emissions compared to 1990. Actually, on the website of the Covenant of Mayors, where it is possible to consult all information relating to the signatories and their membership status, rather than the actual plan document Amsterdam has published its action strategy that provides only a summary of the real situation and of the main measures that the Administration wants to take. In this document the key actions for a radical change are: the total use of renewable sources and the uptake of electric vehicles articulated with respect to short, medium and long term (up to 2015, 2015-2025-2025, 2040).

Among the European cities that have integrated transport policies with environmental ones, assigning to the energy and environmental sustainability a key role, there is Paris which puts as its main objective of planning strategies the improvement of accessibility and quality of life. In 2006, after consultation of citizens and local communities, the “Plan de la Protection de l’Atmosphere” (PPA) has been approved for the entire region of Ile-de-France, aiming at respecting the limit values for air quality based on 16 measures articulated in four categories: regulatory measures, to be implemented permanently or in case of strong pollution; contractual measures, based on voluntary participation of transport companies; further measures for the development of transport; recommendations to citizens and enterprises. The environmental plan for reducing greenhouse gas emissions (Plan de lotte contre le dereglement climatique) constitutes the SEAP which, unlike the other cities analyzed, concerns with a metropolitan area such as Ile-de-France. This plan aims at achieving goals far more ambitious than those of European strategy: not 20-20-20, but 25-25-25. The determination of the French Government to reduce air pollution and emissions of CO_2 and other toxic agents related to urban transport has led to a further update of SEAP in 2011 that aims mainly at electrical and even more at cycling mode. To confirm this, Paris government has implemented different initiatives oriented to make favorable the road electric traction transport (Autolib) and the use of alternative transport systems to the private car when the underground trains and buses are no longer in service (Velib).

To drive, manage and monitor Barcelona's energy plans it has been created a public consortium named "Barcelona Local Energy Agency". The first Plan oriented to sustainable energy was approved in 2002 (the Barcelona Energy Improvement Plan (PMEB)) that is an innovative document provided the frame of reference for the city's energy policy between 2002 and 2010. This plan forms the general framework for the work of the Barcelona City Council in matters of energy policy and its environmental impact on the city and establishes a set of local action measures addressed to the achievement of a more sustainable city model. As a continuation of the PMEB, the Barcelona Energy Agency (AEB) has drawn up a new plan called "Energy, Climate Change and Air Quality Plan of Barcelona 2011-2020 (PECQ)". More extensive than the PMEB, the PECQ deals with the current circumstances not just in terms of energy but also in terms of the climatic situation and the air pollution that affects the city. The plan also needs to ensure that the public administration is provided with strategic instruments that lead to improvements in the health of the general public by reducing polluting emissions, promoting the efficient use of energy resources, and reducing greenhouse gas emissions. In order to achieve this objectives several actions and projects have been promoted such as the "Solar ordinance" that regulates the incorporation of solar thermal energy and its use for the production of hot tap water in the new, restored and fully refurbished city's buildings and the pilot project "Live Barcelona" which is the platform that is promoting the electric vehicle in the city by creating a network of electric cars charging public points.

In Italy the issue of climate change is engaged just in some of the planning tools at provincial level (such as the ones of Venice and Syracuse); on the contrary the energy saving theme involved several regions and provinces in the development of appropriate energy plans that define the objectives to which the policies of local governments should tend towards.

At the local level, compared to the 800 cities that have ratified their volunteer commitment in the Covenant of Mayors, only 44 municipalities have a Municipal Energy Plan by 2010 despite the existence of a national law (L. 10/91) which states that «the municipal planning tools, in the city with more than fifty thousand inhabitants, must include a specific plan regarding the use of renewable sources of energy».

From the analysis of some of the Municipal Energy Plans and their associated Action Plans (City of Bergamo 2011; City of Udine 2009; City of Reggio Emilia 2008) it is interesting to observe that the actions for the mobility sector would lead back to:

- promote sustainable transport modes, encouraging a greater use of public transport;
- rationalize and enhance the public transport system, both through direct actions on the physical system (upgrading the transport system) and through actions to improve livability of urban areas (institution of low emission zones, pedestrian island, etc..).

These actions result substantially in individual initiatives promoted by the municipalities and, even if they represent good examples, they are not integrated in an unitary point of view. The measures to reduce emissions and to increase renewable energy are effective “only in theory”, rather than in reality. For example, Italy according to the EC Directive 77/2011 has to reach the goal 22% of renewable energy production by 2010, but, in recent years, the effective percentage of renewable sources for electrical uses has remained largely steady on the level of 16%. In addition, the transport sector is second only to the civil one for total energy consumption and 95% of the energy used comes from oil source. Currently, in Italy, energy policy refers to the Regulations regarding to real estate already existing or just built are more detailed and are mainly focused on improving the efficiency of buildings; however they reveal little effective because of the complexity of energy problem. These interventions occur with a very wide temporal frequency (30-40 years or more), and it makes the response produced by it inadequate both for the number of interventions that occurs and for the transformation rate compatible with the needs to reduce energy consumption, both globally and locally.

4 CONCLUSIONS

From the analysis of the experiences it can be seen a gap between the current situation of the policies aimed at engaging climate change and those aimed at energy saving. In the first case a gap stands out between the approaches provided by scientific literature as well as by institutional documents and the consequent implementation at local level. In fact, while at European level there is unitarity in the directives and addresses provided, at the lower administrative levels the rate of fragmentation of documents and plans increases.

There are only few European cities, such as London, that have drawn up rules of national planning (planning policy statement) establishing a direct link between planning tools, policies for energy planning and climate protection. The approval of a specific planning rule at the national level has in fact forced local governments to adopt plans oriented to the protection of the climate.

On the contrary, in Italy, through the analysis of urban planning tools and of mobility governance as well as the ones referred to the energy issue, results a strong awareness of the need to adopt strategies oriented toward the reduction of polluting emissions to the implementation of natural mechanisms of uptake (mitigation) and new strategies aimed at contrasting the possible adverse effects of climate change and at drawing up dedicated plans. On the other hand, it’s evident also that a national unified reference framework causes heavy restrictions on the implementation of concrete actions.

From climate change point of view the European countries, that have not yet done it (Italy), should develop an action plan at the national level that establishes guidelines for the preparation of mitigation and adaptation actions; secondly these guidelines should be followed up by the preparation of plans and regulations at the local level in order to contextualize the mitigation and adaptation actions referring to the main socio-economic variables that characterize the territory to which they relate, in order to “think globally and act locally”. The aspects that affect the energy efficiency especially at the building level, result deeper and more effective. Currently in Europe, most energy policies now cover the existing or new construction housing stock.

Unlike what happens with the issue of climate change, in which it becomes necessary to shift from the national to the local scale, for energy efficiency it is hoped that the measures and regulations prepared should focus not on the individual building but widen the range action to urban settlements. Therefore the effort that European cities need to take is the passage from the buildings energy efficiency to the settlements energy efficiency as most the energy consumption in urban areas is linked to the city working and its services (IPCC 2012).

Another topic related to the energy issue concerns the transport sector that in Europe has the highest consumption of fossil fuels and is the sector with the fastest growth rate in terms of energy use (EU, 2007). As most international organizations and research institutions believe, the goal of greater efficiency in transport sector doesn't depend only on technological innovation, but also on an effective reorganization of urban trips discouraging private cars. Therefore in order to bring the experimental initiatives into effects (such as car sharing, bike sharing etc.,) an energy policy environmentally sustainable, characterized by an integration between energy, mobility and urban system, should be quickly adopted.

Henceforth initiatives such as the Covenant of Mayors might provide a valuable contribution, as SEAP is based on interrelationship between these areas. Anyway the implementation of the SEAP has some points in common with various cities, though each city show its own characteristics and therefore needs specific solutions for transport problems they suffer. In all the proposed European cases an integrated planning process has been developed, focusing on shared decisions among the various stakeholders and particularly with the community.

An open participation is the fundamental element to achieve prearranged objectives as energy sustainability begins mainly with a radical lifestyle change. Italy is making progress too in the definition of integrated policies; however, the integration between urban and transport plans analyzed often remains a theoretical aspect and the description of the objectives to be achieved in the field of urban mobility is almost always in reference to the reduction of greenhouse gas emissions and not to energy saving too.

Energy saving should therefore be regarded as a consequence of the reduction of polluting emissions and not as a goal. All the examples referred to Italy have considered SEAP as an important opportunity in order to identify the best solutions for their own problems about energy efficiency and urban transport. In fact these elements represent both a challenge and an opportunity to rethink the future of cities, to transform and improve life conditions. The definition of a national strategy, however, seems increasingly remote because during the last Conference of the Parties COP17 held in Durban, South Africa in December 2011, the nations who attended the conference have agreed to enter only by 2015 a formal and legally pact that legally bind the different country to reduce greenhouse gas emissions by 2020. This means that until 2020 the signatory countries of the IPCC should only respect the voluntarily commitments made in past years. Summarizing, despite the large efforts currently underway, policies at city level are still fragmented and effective tools to support decision-making processes are still lacking (Corfee-Morlot *et al.* 2011).

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Fig. 1: Rielaboration of the authors, on the basis of PEER (Partnership for European Environmental Research) Report: Europe Adapts to Climate Change – Comparing national adaptation strategies, www.peer.eu.

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BIO-ENERGY CONNECTIVITY AND ECOSYSTEM SERVICES

AN ASSESSMENT BY PANDORA 3.0 MODEL FOR LAND USE DECISION MAKING

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ABSTRACT

Landscape connectivity is one of the major issues related to biodiversity conservation and to the delivery of Ecosystem Services (ES). Several models were developed to assess landscape connectivity but lack of data and mismatching scale of analysis often represent insurmountable constraints for the correct evaluation and integration of ecological connectivity into plans and assessment procedures. In this paper a procedure for ES assessment related with Habitat and Bio-Energy Landscape Connectivity (BELC) is proposed. The method is based on the connectivity measure furnished by the last version of PANDORA model and uses a modified formulation of current ES evaluation. The implementation of the model in a real case has highlighted its potential multi-scale workability. The spatial approach of the model aims at furnishing a further tool for the spread of ES and landscape ecology concepts into procedures of assessment (e.g. EIA, SEA) and land use planning at different administrative scales.

KEYWORDS

Landscape connectivity, Urban planning , Environmental Assessment, Environmental modeling

1 INTRODUCTION

As reported in the Charter of European Planning (ECPT- CEU 2013), a sustainable development requires the maintainance, enhancement and creation of natural resources that are within towns and cities or that provide services for them including the protection of cities from pollution and degradation, high levels of efficiency in energy production and the wise use of resources (e.g. water, air, soil).

Indeed, every land use change can induce either negative consequences or positive repercussions. Man, more than other living species, plays a fundamental role in the global health of the environment as his ability to strongly modify the landscape structure, and consequently its functionality, to reach his objectives. Examples of this capacity are the huge land cover and land use changes realized, above all in these last centuries (Foley et al., 2005; Pelorosso, Leone, & Boccia, 2009) thanks to the technology advances and the use of stoked carbon fossil sources of energy, to acquire even more goods and services from ecosystems and landscapes, generally named Ecosystem Services (ES) (Hermann, Schleifer, & Wrbka, 2011; Termorshuizen & Opdam, 2009). Among these ESs we can find provisioning services such as food, wood and water, as well as energy used by citizen and urban systems, or cultural services such as social, recreational, and touristic benefits. However, the exploitation of natural resources affects the delivery of other ESs as regulating services, such as flood and CO2 control, or supporting services, such as oxygen production, that maintain the conditions for life on Earth (MEA, 2003). In particular, urbanized areas seal soils determining several environmental consequences, e.g.: increasing of water runoff and relative pollutants transport, deterioration of ecosystems functionality, rising of green house gases, fragmentation of habitats and biodiversity reduction. These impacts and consequences can be assessed in the ES framework since it can provide “a new way to approach environmental management and to connect nature and society in research and appraisals” (Karjalainen, Marttunen, Sarkki, & Rytkönen, 2013). Indeed, policies and plans are gradually directed to supply and reinforce desired ecosystem/landscape services (Gulickx, Verburg, Stoorvogel, Kok, & Veldkamp, 2013).

Ecological landscape connectivity is an important issue often erroneously considered only in extra urban or/and protected areas planning context (Pelorosso, Gobattoni, Lauro, Monaco, & Leone, 2012). Landscape connectivity can be defined as the ability of landscape to facilitate or impede movement among habitat patches, support fluxes of energy, organisms and materials (e.g seeds, biomass, pollen, nutrients, sediments) and long-term persistence of biodiversity (Foltête, Clauzel, & Vuidel, 2012; Ng, Xie, & Yu, 2013; Saura & Pascual-Hortal, 2007). Landscape connectivity is therefore one of the major issues related to animal dispersal, population persistence and ecological functions maintenance. In particular, biodiversity represents a fundamental ecosystem property: estimations reports that a 1% change in biodiversity results in a 0.5% change in the value of all ecosystem services (Bastian, 2013).

In this view, landscape connectivity covers an important role in the definition of ecosystem services value of a single patch of the landscape mosaic; indeed, habitat patches, with the same size and characteristics at different locations, may provide different ecosystem services due to their different connectivity within the landscape. Moreover, a well connected landscape increases the resilience of the social ecological systems allowing them to overcome sudden changes (e.g climate changes, wildfires) by persistence, adaptation and transformation processes (Zurlini et al., 2014). Indeed, several methods, indices, approaches and models have been developed regarding landscape connectivity and fragmentation issues (e.g. Luque, Saura, & Fortin, 2012; Saura & Pascual-Hortal, 2007). Moreover, recent papers have focused on the importance of the integration of landscape connectivity measures into the Ecosystem Services (ES) assessment (Ng et al., 2013), Urban Planning (Ahern, 2012; Tannier, Foltête, & Girardet, 2012), and into Environmental Impact

Assessment (EIA) and Strategic Environmental Assessment (SEA) (Girardet, Foltête, & Clauzel, 2013; Mancebo Quintana, Martín Ramos, Casermeiro Martínez, & Otero Pastor, 2010; Scolozzi & Geneletti, 2012a).
Connectivity assessment in the context of land use decision making processes and landscape and urban planning is still challenging (Scolozzi & Geneletti, 2012b). Lack of data and mismatching scale of analysis can represent insurmountable constraints for the correct evaluation and integration of ecological connectivity into plans and assessment procedures. Moreover, complex models can be hard to manage when scenario comparison is requested or the localization and extension of the area change. Thus, several examples of structural connectivity assessment (not species specific approach) and simplified models were presented to adequately face these issues in the planning and assessment practice at different spatial scales (Mancebo Quintana et al., 2010; Marulli & Mallarach, 2005; Ng et al., 2013). An assessment of structural landscape connectivity in terms of energy, based on landscape graphs approach, was presented in an innovative model named PANDORA (Gobattoni, Lauro, Monaco, & Pelorosso, 2012; Gobattoni, Pelorosso, Lauro, Leone, & Monaco, 2011). The energy considered by the model is linked with vegetation metabolism by BTC index, thus it assesses the biological energetic state of the landscape and bio-energy exchanges among landscape components (Bio-Energy Landscape Connectivity, BELC). The model was developed to meet the needs of planners and practitioners involved in the environmental assessment procedure and it was proposed as operative Decision Support System to assess the impact of different scenarios of land use change. The last version of the model (Gobattoni, Groppi, Monaco, & Pelorosso, 2014) analyzes the contribute of each patch of land mosaic to global BELC and, consequently to functionality and resilience of the whole system.
In the current methods to assess landscape connectivity in terms of ecosystem services, there are two main limitations: 1) connectivity is calculated within the same land use category of habitat patches; 2) the evaluation of ecosystem services mainly relies on patch size without considering other variables, e.g. water, soil and climatic characteristics, that could strongly affect the final ecosystem services value (Ng et al., 2013). A model fully integrating ES into landscape connectivity assessment has not been presented yet.
In this work, to face those limits, we propose the last version of model PANDORA with the new module, presented here for the first time, for the evaluation of the ecological value (Ecosystem Services) of single patches of landscape mosaic in terms of Habitat (e.g. land cover) and BELC. The multi-scale workability and the spatial approach of the model aim at furnishing a further tool for the spread of ecosystem services and landscape ecology concepts into procedures of assessment (e.g. EIA, SEA) and land planning at different administrative scales.

2 METHODOLOGY

The proposed method for bio-energy landscape connectivity (BELC) assessment is here synthetically reported. A deep description is out of the aims of this paper and it can be found in other publications. The ES evaluation is then reported in a specific paragraph.
Numerical integration of the Ordinal Differential Equations (ODEs) system, on which the model PANDORA is founded, can be rather heavy because of the high number of equations, specially to produce a friendly user system. Thus, an approximated solution is proposed in order to substitute the above set of ODEs with an algebraic hierarchy which may be implemented easily (Gobattoni et al., 2014). The Bio-Energy (B) is the state variable related to the metabolism of vegetation characterizing each land cover patch. The parameters regulating the B evolution (e.i. evolution to mature forest with highest biodiversity level) are derived by vegetational, morphological, climatic and soil characteristics of the landscape units. Most important human-made barriers to energy fluxes (e.g. large and high traffic roads) define the borders of each landscape unit

(LU). Other human-made barriers (e.g. minor roads, edified areas, urban sprawl, no photosynthetic surfaces) in each LU are considered as limiting factors to energy fluxes and consequently to the evolution of biotopes energy level inside them. Fluxes of bio-energy among LUs are continuously recalculated with the evolution of the patches and they define the connectivity index of each LU. High connectivity level defined by such an index is considered by the model as a positive factor for the increase of the Bio-Energy of the patch. The solution of the algebraic hierarchy until asymptotic values gives the final values of B^{as} for each patch and the Generalized Biological Energy of the overall system (M^{as}tot).

The ES assessment has been realized by considering both the land cover typology (e.i. habitat) and the importance of the patch for the global landscape connectivity expressed by the asymptotic value of M^{as}tot. The importance of each patch in terms of its contribution to the maintenance of M^{as}tot level has been calculated by comparing the M^{as}tot difference before and after changing the patch into an urban area (e.i. impervious and no photosynthetic surface). Such an index is defined as dMtot. Ecosystem Services Value for Biodiversity protection (ESV_B) for a unit area of different land cover categories (€/ha/year) has been updated and modified to Italian case from Ng, Xie, & Yu (2013). The model has been developed in open source environment and applied in a portion of the municipality of Viterbo (Central Italy) considering the actual land use and urban development.

2.1 ECOSYSTEM SERVICES ASSESSMENT

ES value (ESV) can be evaluated for each patch taking in consideration only the type of habitat (e.g. land Cover) and the area of a patch by the following conventional formula (Ng *et al.* 2013):

$$ESV_{kj} = VC_k \cdot A_{k\_j} \qquad (1)$$

where ESV_{kj} is the estimated Ecosystem Services Value of patch *j* of land cover category *k*, VC_k is the value coefficient for landcover category *k*, A_{k_j} is the area of the patch *j* and land cover category *k*. VC_k is the economic value of each macro land cover typology and it was used to evaluate different ESs in China (Ng et al., 2013; Tianhong, Wenkai, and Zhenghan, 2010; Xie, Lu, C. X., Leng, Zhang, and Li, 2003). Based on a seminal work of Costanza et al. (1997) and Xie et al. (2003), Tianhong et al. (2010) report the procedure to obtain the contribute of each land cover class in the delivery of a range of ES starting from equivalent weight factors of ESs for several terrestrial ecosystem (see table 1).

ECOSYSTEM SERVICES	FOREST	GRASSLAND	CROPLAND	WETLAND	WATER BODY	BARREN LAND
Gas regulation	3.5	0.80	0.50	1.80	0	0
Climate regulation	2.70	0.90	0.89	17.10	0.46	0
Water supply	3.20	0.80	0.60	15.50	20.40	0.03
Soil formation and retention	3.90	1.95	1.46	1.71	0.01	0.02
Waste treatment	1.31	1.31	1.64	18.18	18.20	0.01
Biodiversity protection	3.26	1.09	0.71	2.50	2.49	0.34
Food	0.10	0.30	**1.0**	0.30	0.10	0.01
Raw material	2.60	0.05	0.10	0.07	0.01	0
Recreation and culture	1.28	0.04	0.01	5.55	4.34	0.01
Total	21.85	7.24	6.91	62.71	46.01	0.42

Tab. 1 Equivalent weight factor of ESs per hectare of terrestrial ecosystems in China (Tianhong *et al.* 2010)

The economic value of average natural food production of cropland per hectare per year (ANFPC) was assigned to the weight factor one (bold character in table 1). Thus, to obtain the delivered ESs for unit area of different terrestrial ecosystem it is necessary to multiply the economic value of ANFPC for each weight of the table 1. ES value of one unit area of each land use\land cover category can be then assigned based on the nearest equivalent ecosystems. ANFPC can be calculated considering a mean price for hectare of most common crops (e.g. wheat) and that, generally, the natural food production is 1/7 of the actual food production. The weights were estimated for China context so for other Regions possible variations are expected. In this work, for the applicability of the method and the aims of the paper, the proposed weights were unchanged, while, the economic value of ANFPC was recalculated for Italian study case and update to nowadays. Different types of land cover in the study area were finally estimated.
The method proposed by Ng et al. (2013), to calculate biodiversity Ecosystem Services Value (ESV_B) considering ecological connectivity measures, introduces a connectivity index as followings:

$$ESV\_B_{kj} = VC_k \cdot \left(\frac{dPC_{k\_j}}{dPC_{k\_\max}} \right) \cdot A_{k\_\max} \tag{2}$$

$$dPC_{k\_j} = \left(\frac{PC_{k\_j} - PC'_{k\_j}}{PC_{k\_j}} \right) \cdot 100 \tag{3}$$

where ESV_B$_{kj}$ is the estimated biodiversity Ecosystem Services Value of patch *j* of land cover category *k*, A$_{k_max}$ refers to the largest area of patches among the land cover category *k*. PC (possibility of connectivity) is a well known area-based functional connectivity index (Saura and Pascual-Hortal 2007). dPC$_{k_j}$ indicates the importance of each patch in terms of its contribution to the maintenance of overall connectivity by comparing the overall connectivity difference before (i.e. PC$_{k_j}$) and after (i.e. PC'$_{k\_j}$) moving the patch (Saura and Pascual-Hortal, 2007). dPC$_{k_j}$ is the dPC value of patch *j* of land cover category *k*, and dPC$_{k_max}$ indicates the maximum value of dPC among land cover category *k*. The method standardizes values of connectivity within the same land cover category and takes in consideration the largest patch as reference.
The proposed new method to calculate ESV_B$_{kj}$ is a modification of the formula (2) and (3) and it aims to overcome above cited constrictions by introducing a connectivity index linked with bio-energy level of the landscape and the actual patch area:

$$ESV\_B_{kj} = VC_k \cdot \left(1 + \frac{dMtot_{kj}}{dMtot_{j\_\max}} \right) \cdot A_j \tag{4}$$

$$dMtot_{kj} = \left(\frac{M^{as}tot_j - M^{as}tot'_j}{M^{as}tot_j} \right) \cdot 100 \tag{5}$$

where ESV_B$_{kj}$ is the estimated biodiversity ecosystem services value of patch *j* of land cover category *k* with bio-energy connectivity evaluation, VC$_k$ is the value coefficient for land cover category *k* updated for Italian study case, A$_j$ refers to the area of the patch *j* without considering land cover type membership. $M^{as}tot_j$ is the Generalized Biological Energy of the overall system; it derives by Pandora 3.0 model e.i. by the solution of the algebraic hierarchy until asymptotic values of all the patches: it is the index of overall BELC and it considers the Bioenergy evolution of all the landscape patches under the actual barriers to energy fluxes, climatic, morphological and soil conditions. $dMtot_{kj}$ indicates the importance of each patch *j* and land cover category *k* in terms of its contribution to the maintenance of overall BELC by comparing the overall connectivity difference before (i.e. $M^{as}tot_j$) and after (i.e. $M^{as}tot'_j$) changing the patch into an urban area. $dMtot_{j\_max}$ indicates the maximum value of dMtot among all the patches *j* of the landscape without considering land cover type difference.

In this work a comparison between ESV_B evaluation without and with BELC assessment is proposed on the basis of formulas (1) and (4) respectively, moreover aggregated ESV_B assessments are pointed out at:

a) Land cover type scale

$$ESV\_B_k = \sum_{j=1}^{z_k} ESV\_B_{kj} \tag{6}$$

Where z_k is the number of patches with land cover category *k*.

b) Landscape Unit scale

$$ESV\_B_i = \sum_{r=1}^{m_i} ESV\_B_{ir} \tag{7}$$

Where m_i is the number of patches inside the landscape unit *i*.

c) Landscape scale

$$ESV\_B_{tot} = \sum_{i=1}^{n} ESV\_B_i \tag{8}$$

Where *n* is the number of landscape units.

3 RESULTS

The commodity exchange of Bologna for 2013 reports a mean price of 200 €/ton for soft wheat and 270 €/ton for durum wheat. Thus, considering a value of 250 €/ton and a mean production of 6 ton/ha per year, the economic value of ANFPC for Italy was estimated as 214 €/ha per year. Table 2 reports the final VC_k for the main land cover typology of the study area for Biodiversity protection.

	FOREST	GRASSLAND	ORCHARD	CROPLAND	WETLAND	WATER BODY	BARREN LAND	BUILD UP
Biodiversity protection	697,64	233,26	189,92	151,94	535,00	532,86	72,76	0,00

Tab. 2 Value Coefficient (VC_k) for land cover category *k* of unit area for Biodiversity protection (€/ha*year). Note that orchards are calculated as 25% more of cropland

The index $dMtot_j$ representation (Fig. 1) allows to highlight the importance of each patch in terms of its contribution to the maintenance of the overall bio-energy level and consequently to BELC. The results show also the capabilities of the model to spatially discriminate the ES value of each patch on land mosaic (Fig. 2), the ES at level of land cover typology (Fig. 3) and at level of LU (Fig. 4). The ES value at landscape scale without and with connectivity measure is therefore 7.134.357,90 €/year and 10.192.959,80 €/year, respectively, with an increase of 42.8% considering the BELC.

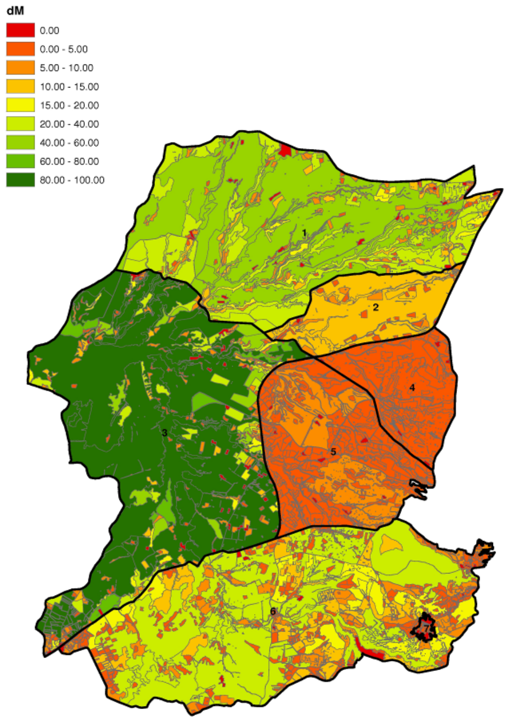

Fig. 1 dMtotkj index representation: the value ranges between 0 and 100 and defines the percentage decrease of overall generalized bio-energy Mastot consequent to the conversion of the patch into an urban area (e.i. impervious and no photosynthetic surface)

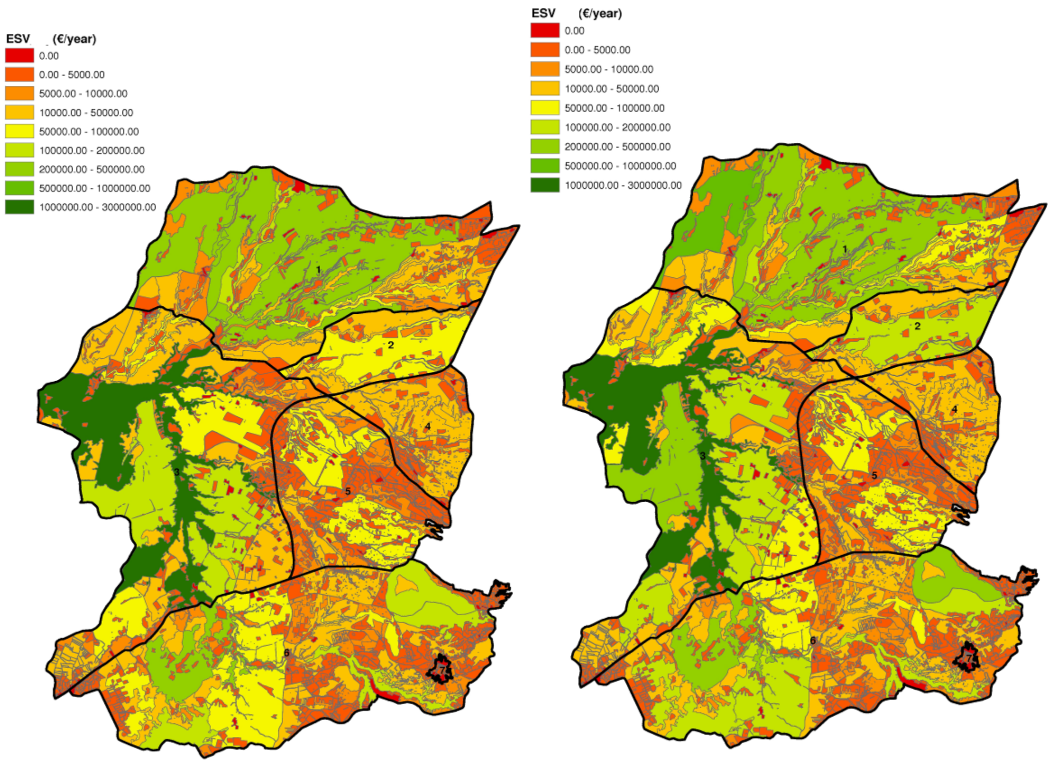

Fig. 2 ESV_B$_{kj}$ for each land cover patch of study area. a) Without considering BELC; b) with BELC

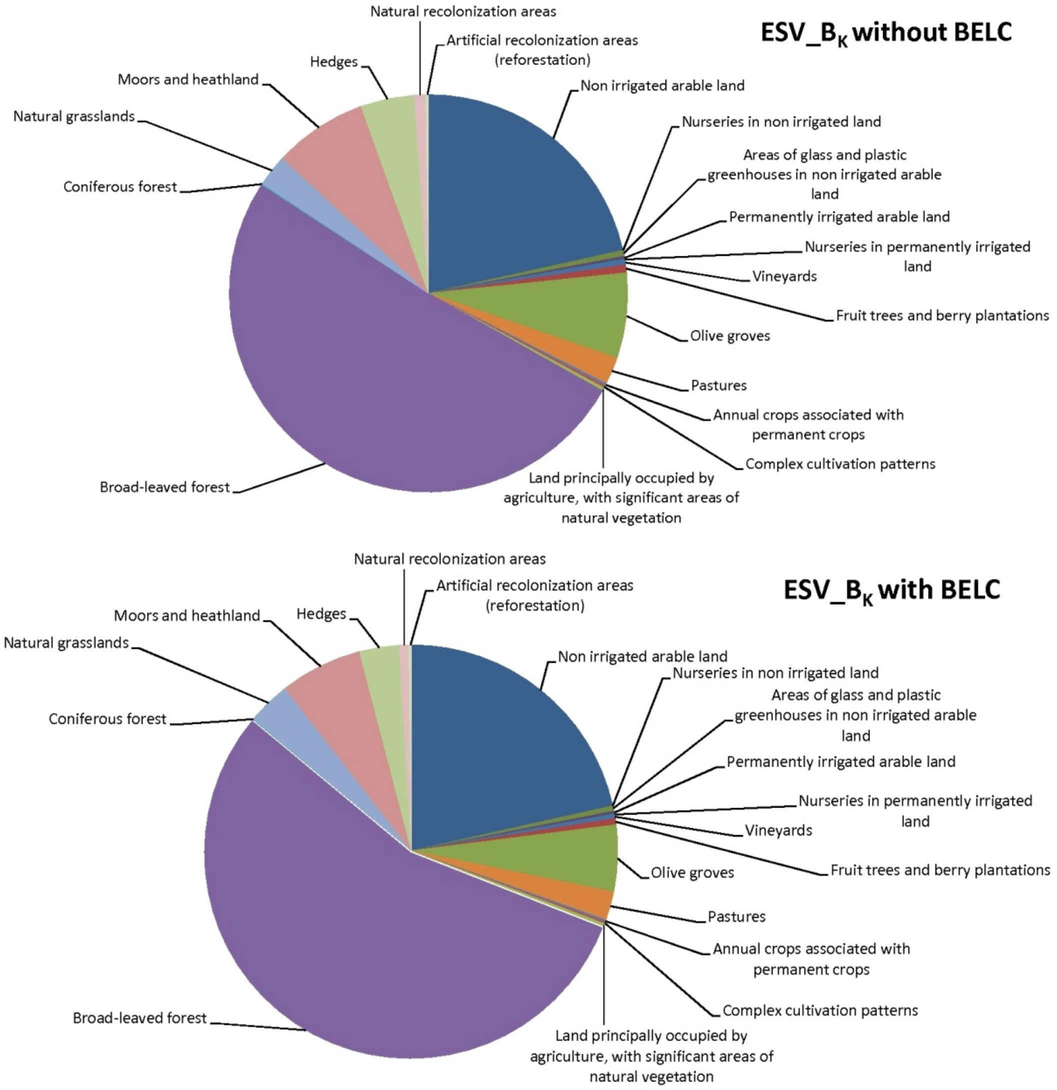

Fig. 3 ES Value for each land cover typology without and with BELC, respectively

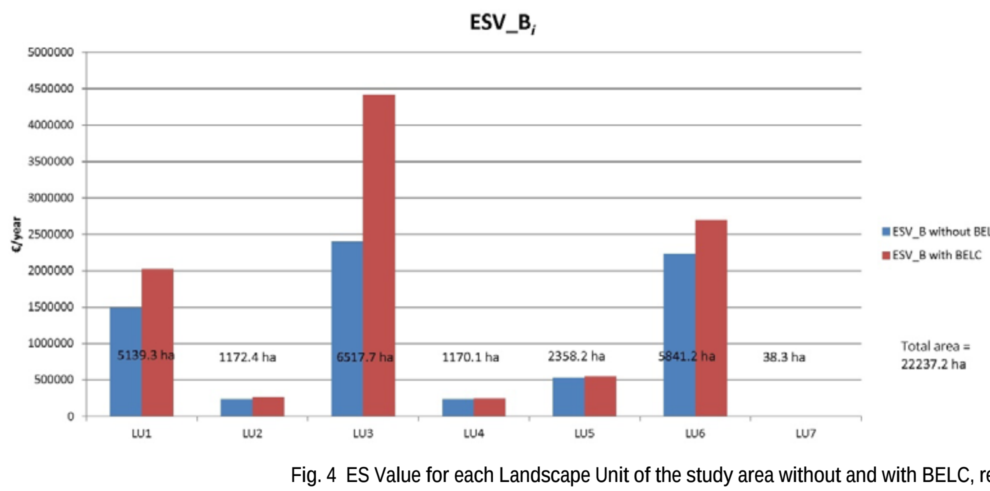

Fig. 4 ES Value for each Landscape Unit of the study area without and with BELC, respectively

4 DISCUSSION

The concept of landscape embraces all the components of human environment: cultural identity, natural resources, economy and society. Landscape is, therefore, an expression of the diversity of shared mutli-cultural and natural heritage (ECTP-CEU, 2013).

Spatial planning science and praxis has to provide cohesion among these different aspects and, consequently, it has to be applied to all the various contexts: residential, commercial and industrial areas; infrastructures; tourist and leisure locations; urban green areas and parks; rural areas. The challenge for effective planning consists in integrating these needs, starting from the protection and management of biodiversity and lndscapes. To pursue this aim, it's necessary to assess the interactions between human settlements, infrastructures and natural areas, i.e. examining landscape connectivity, which is a theme stressed since long time ago by landscape ecology (e.g. Forman, 1995).

Starting from Landscape Ecology assumptions, it's necessary to extrapolate the role for spatial planning. Namely, landscape connectivity was considered in the evaluation of ES only recently (Ng et al., 2013). The current methods to assess landscape connectivity in terms of ES, show two main general limitations: 1) connectivity is calculated within the same land use category of habitat patches; 2) the evaluation of ES mainly relies on patch size without considering other variables, e.g. water, soil and climatic characteristics, that could strongly affect the final ES value. Moreover, a model fully integrating ES into landscape connectivity assessment has not been presented yet.

In this work, we propose an innovative approach to face these limitations. The new index dMtot points out the importance of each patch in terms of its contribution to the maintenance of BELC (Fig. 1). It considers soil, climatic and morphological aspects of the LUs and, moreover, is related to the connectivity of all the patches with respect to a bio-energy measure making the dMtot index no-dependent from habitat typology, indeed all the patches contribute to BELC.

The calculation of ES values of the patch considers a measure of a structural landscape connectivity founded on thermodynamic laws that lie behind all the environmental processes and dynamics of landscape, as well as animal movements and vegetation/ecosystem evolution. Consequently, such a connectivity is strictly linked to the functionality and resilience of the landscape.

Indeed, ES values as well as dMtot index can be used to individuate suitable areas for urban development or conservation measures both at level of patch (Fig. 1, Fig. 2) and at level of LUs (Fig. 4). Such a latter zoning, based on recognizable barriers (e.g. roads) on landscape, may facilitate the integration of connectivity information in different territorial plans e.g. supporting the characterization of urbanized and non-urbanized areas into municipality plans, or of rural areas for provincial or regional plans. Finally, the data required by the model are usually available by land manager making the implementation of the procedure feasible also into contexts of scarce resources and low financial availability.

In this way, it's possible to carry out the usual planning praxis giving it an effective, low cost and scientifically sound analysis. Moreover, it's possible to quickly compare scenarios and make maps and graphics generated by PANDORA model accessible to stakeholders thus supporting, in a more transparent way, both planners' choices and people participation. The proposed approach can therefore allow decision makers, but also communities, to have a clear picture of the ecological impacts of planned order and, as a consequence, to contribute to build healthy landscapes.

5 CONCLUSIONS

The final aim of this research consists in developing methods and tools to include the ES thinking in planning practice since it can allow to assign an objective value to natural resources: biodiversity, air, soil, water and energy.

At the present step, in this paper, the new version of model PANDORA 3.0 is presented: through the application to a real case, it has pointed out its capability to assess the landscape in terms of BELC and ES. The model allows to support the decision making process by the assessment of different land use scenarios. The multi-scale workability and the spatial approach of the model aim at furnishing a further tool for the spread of ES and landscape ecology concepts into procedures of assessment (e.g. EIA, SEA) and land planning at different administrative scales.

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ENTROPY AND THE CITY.

GHG EMISSIONS INVENTORY: A COMMON BASELINE FOR THE DESIGN OF URBAN AND INDUSTRIAL ECOLOGIES.

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ABSTRACT

From a thermodynamic point of view, the attribution of the adjective *sustainable* to an open system like the city is, at least, very problematic. The biosphere is a closed system, kept far from the thermodynamic equilibrium by the flow of energy coming from the sun. The biosphere maintains and increases its internal order dispersing entropy, generated by all the internal processes, as thermal infrared radiation. But then, the elegant picture of sustainability given by thermodynamics can not be applied to open systems, and notably to the city, without raising both theoretical and practical problems.

The city is almost by definition a place of consumption and of degradation of potentials, kept in local equilibrium by external flows of matter and energy, but at the same time plays a key role in shaping and maintaining the global flows of matter, energy, and information, and this role must be taken into account when interpreting thermodynamic-based descriptions.

The urban capital probably represents the greatest investment made by mankind. Materials have been harvested from the earth crust and from the natural systems, and have been concentrated and ordered in the city. But the "city" is not the infrastructure: it's concept of a different logical type. The city is a further level of organization that produces services of higher level. The urban infrastructure is necessary, but not sufficient to produce the city services.

The city is the most important social and health "device". A proper accounting must consider the city-performance of the urban infrastructure, beyond the mere, local energy and carbon efficiency.

In this context, local GHG accounting is proposed as a rather simple and useful basis to ground process-wise studies and projects, including the creation of effective local industrial ecologies, in a continuous city-making effort toward higher sustainability.

KEYWORDS

City, People wellbeing, urban capital, GHG accounting, carbon footprint, industrial ecology.

1 ENTROPY: WHY DO THINGS GET IN A MUDDLE?[1]

The most general, generic, and at the same time the most implacable sight that human knowledge can project over complex systems is given by the second law of thermodynamics. The general tendency toward disorder can be found in disparate classes of phenomena, always tracing the ultimate limit between what is possible, and what is not.

The very problem of sustainability rises from the existence of limits that are thermodynamic in their nature: if there is no potential for work, no exergy (i.e. available energy), natural or artificial systems cannot work (Wall and Gong 2001). From a thermodynamic point of view the entire, astonishing complexity of the biosphere, including the artificial systems, can be described as a closed system that maintains its internal order due to the flow of high quality energy coming form the surface of the sun (and due to the heat coming from the nucleus of the earth). The dynamic internal order of the biosphere, the homeostasis of its ecosystems, is maintained without violating the second law of thermodynamics because a continuous flow of disorder, of greater magnitude, is expelled as heat to the cold sink of outer space.

The history of the biosphere is indeed the evolutionary path of a closed system that, thanks to this perennial flows of exergy, have actually increased its internal order and complexity, from the establishment of global material cycles to the rise of biodiversity in an incredible variety of organisms, organized and mutually connected in ecosystems.

1.1 EXERGY, EMERGY AND OTHER “PROXY” DESCRIPTIONS

The most direct attempt of modeling and describing the thermodynamic behavior of ecosystems, including artificial ones like the city, has been conducted analyzing exergy2 flows.

Ecological modelers have tried to quantitatively describe the flows of energy and materials within ecosystems since decades. H.T. Odum, in particular, has pioneered the modeling of energy flows, extending progressively the sight from aquatic ecosystems to larger complexes and to the entire biosphere, including men’s activities, urban systems and cities.

H.T. Odum haven’t tackled entropy measures directly, but conscious of the intrinsic limits of an energy-based modeling, i.e. the necessity of including “quality” parameters beside energy quantities, has introduced the concept of Emergy. Emergy (or energy-memory) represents the amount of solar energy necessary to sustain a unit of a certain product, or flow. The solar input is the base value that is “concentrated” by natural systems in flows of higher value. Each material in a natural ecosystem has hence a different intensity or transformity, because higher quantities of solar input are necessary to produce it. For example: 1 joule of energy embedded in the acacia biomass is equivalent to 5540 sej (solar energy joules).

[1] “Why do things get in a muddle?” is the title of a Gregory Bateson’s *metalogue*, one of the most successful attempts to describe entropy in intuitive terms.

[2] In thermodynamics, Exergy is the energy that is available to be used. Exergy accounts for the irreversibility of a process due to increase in entropy and is always destroyed when a process involves a temperature change. This destruction is proportional to the entropy increase of the system together with its surroundings. Exergy analysis is performed in the industrial field to use energy more efficiently. In ecological modeling exergy is generally is represented as a sum of potentials, i.e. the existing distance from a reference state.

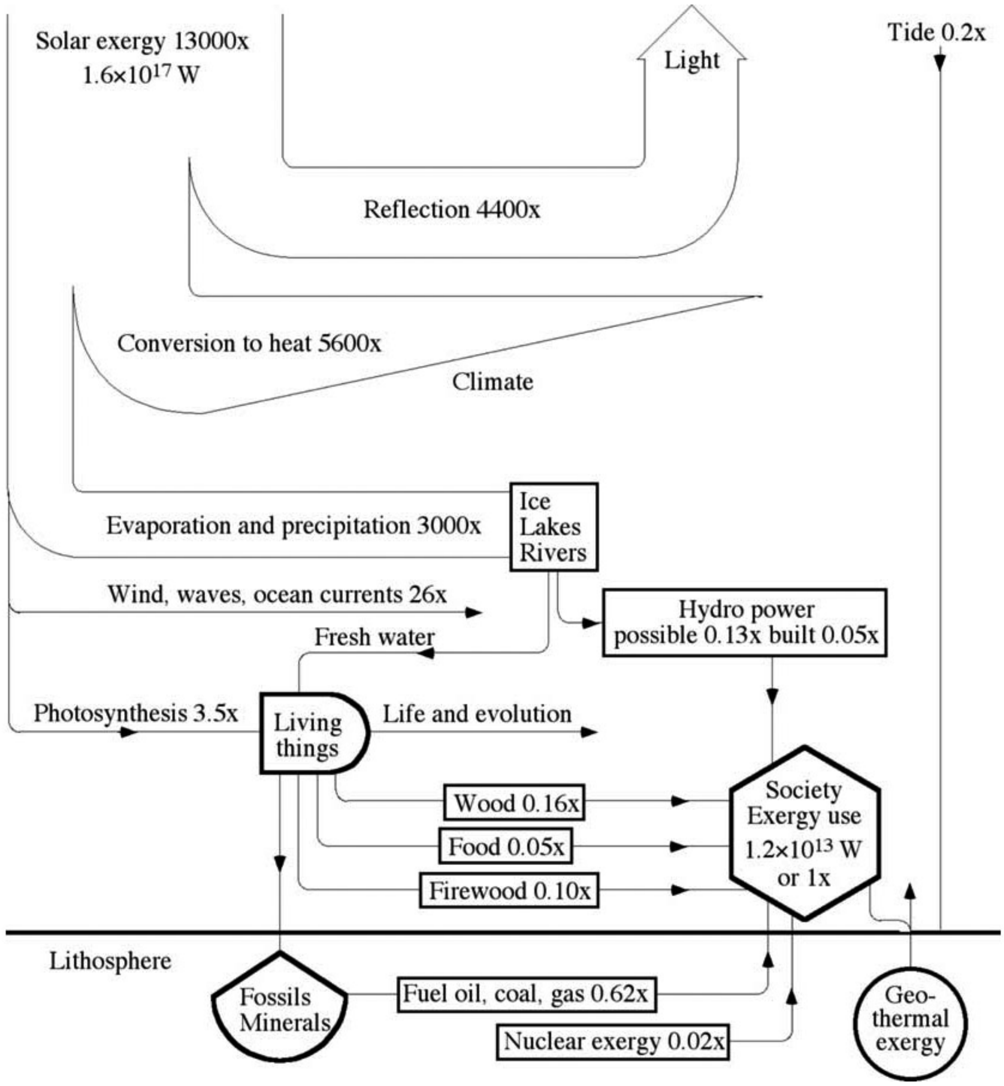

Fig. 1 Exergy flows on the earth, indicated with relation to the exergy flow input to the society -12 Terawatts - that is indicated 1 x. (Wall, Gong, 2001)

Emergy is a great concept for analyzing and understanding natural ecosystems, and has been applied also to the urban systems, specifically to quantify the Urban Capital, a concept of central importance for the topic here at stake. But for his foundational idea, i.e. that everything depends on solar input, the presence of relevant flows of materials from the geosphere, i.e. of substances structurally independent from sunlight, its accuracy and significance is severely limited in artificial systems.

The global quantitative scenario has been described in explicit terms of exergy only later (Wall and Gong 2001). A reference environment have been established to quantify the chemical potential of material flows in the biosphere (Szargut et al., 2005) and exergy has been applied for the ecological modeling introducing the genetic information potential, producing exergy conversion factors to be applied to living biomass (Jørgensen, 1992, 2004). Exergy modeling is very used worldwide in the field of ecological modeling for natural systems (cfr. Silow and Mokry, 2010) and a thoroughly comparison between the behavior and the meaning of exergy in technological and ecological systems has been proposed by the modeling school of Siena (Susani, 2006).

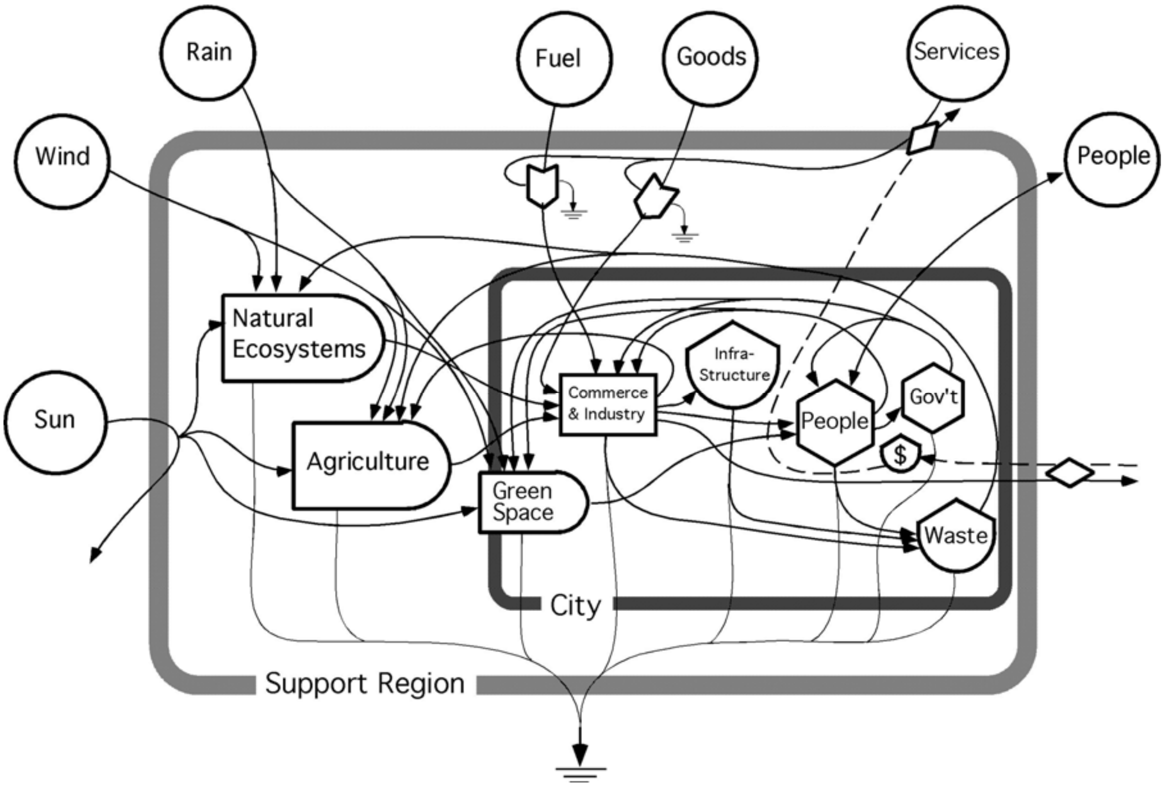

Fig. 2 A simplified, qualitative diagram of energy flows in the city and in the surrounding support region. The diagram uses the H.T Odum symbols to distinguish between sources, production, consumption, transformation and sinks. Money (dotted lines) typically flows in the opposite direction with respect to energy and materials flows. (Image created by Mark T. Brown, from Odum, 1996)

From the point of view of ecological disciplines exergy-based modeling of anthropic systems is of great interest, but it should be underlined that when applied to specific systems such as cities or metropolis also involves severe technical and practical issues, and that the resulting values must be always be considered with care and properly interpreted.

In measuring urbanized areas (i.e. cities, metropolis, megalopolis, etc.), besides exergy, other values and indicators seem to have a sufficient degree of generality to better figure – and therefore to be used as significant - useful proxies of the global thermodynamic picture of sustainability, e.g. emergy modeling (with the limits described above), but also other approaches like the ecological footprint and, more interestingly, the carbon footprint and greenhouse gases (GHG) inventories.

The relative relationships between exergy, emergy and CO2(e) accounting have been inquired and debated, and each indicator or approach has manifested both theoretical and practical limits, providing specific insights, while producing typical biases and errors, but it is interesting to observe that all these approaches share a common nature.

1.2 GREENHOUSE GASES, NATURAL CAPITAL AND URBAN CAPITAL

In the very general, thermodynamic picture of the biosphere sustainability, greenhouse gases (GHG) play a special role.

Sequestering carbon dioxide from the original atmosphere into the ground, the biosphere has dramatically incremented its thermodynamic efficiency. On the reverse path, putting back methane and carbon dioxide in the atmosphere, manmade emissions are making the earth more adiabatic, reducing the capability of the planet of expelling entropy, hence reducing the global carrying capacity.

The different level of organization between the original, primordial earth in its early stages, with its insulating atmosphere and radical simplicity, and the actual biosphere, represents the Natural Capital.
The generation of Natural Capital can be seen as the creation of order, of potentials that can be well described as exergy or emergy stocks, but the creation of higher complexity during the biological evolution is also reflected in the concentrations of GHG in the atmosphere.
GHG emissions inventories have become more and more central in the scientific community with the increasing evidence of manmade global warming and of climate change threats. The most important, massive effort in ecological modeling is today represented by the series of world-scale models presented in the IPCC assessment reports (FAR, 1990; SAR 1995; TAR 2001; AR4, 2007 and AR5, 2013). National GHG inventories have been established as well as standardized procedures for quantification and monitoring (e.g. the UNI-14064 standard). Each day new data are collected worldwide, and the pipelines for the harvest and management of GHG data are continuously enforced, with an increasing influence on the monetary economy through the establishment of carbon markets.
This global, enormous effort in establishing a control mechanism for the global thermodynamic balance, i.e. a feedback from GHG emissions into the economy, represents a very important opportunity also for urban planners, if (and only if) adequately understood and interpreted in the context of the city.
What is important to bear in mind is that GHG inventories represent a particular vision of a general, thermodynamic problem: the radiative forcing determined by GHG emissions represent a reduction of the capacity of the atmosphere to expel entropy, *hence influencing the efficiency of all the underlying processes*.

2 SUSTAINABILITY OF OPEN SYSTEMS: THE URBAN CAPITAL AND THE ROLE OF THE CITY

A tendency in using the GHG or carbon dioxide emissions as a “proxy” for measuring sustainability is already emerging. In a recent paper (Rybski et al, 2014) that made the headlines in some popular media, researchers from the Potsdam Institute for Climate Impact Research have analyzed emission inventories of 256 cities from 33 countries, looking for power-law correlations between emissions and size of the cities. The results apparently show that larger cities perform better than smaller in developing countries, in terms of emissions per-capita, while the opposite happens in developed countries. The results are quite interesting, but the approach and the same title of the study: “cities as nuclei of sustainability”, suggest the immediate opportunity of a very important, general caveat.
While the earth can be considered a closed system, exchanging only energy with the external sinks, cities are open systems, exchanging with the outer world flows of matter, energy, information, and this is more and more relevant in the contemporary, hyper-connected economy.
Thermodynamic-based approaches (i.e the GHG accounting and the entire family of proxy indicators described above) do represent a necessary, but radically not sufficient instrument to assess the sustainability of open systems. It is hence clear that the adjective “sustainable” can not and must not be applied to the city without adopting very special care: by definition the city is an open system, relying on energy flows coming from outside and not capable of dispersing the entropy generated by its internal processes without affecting the external ecosystems and the biosphere.

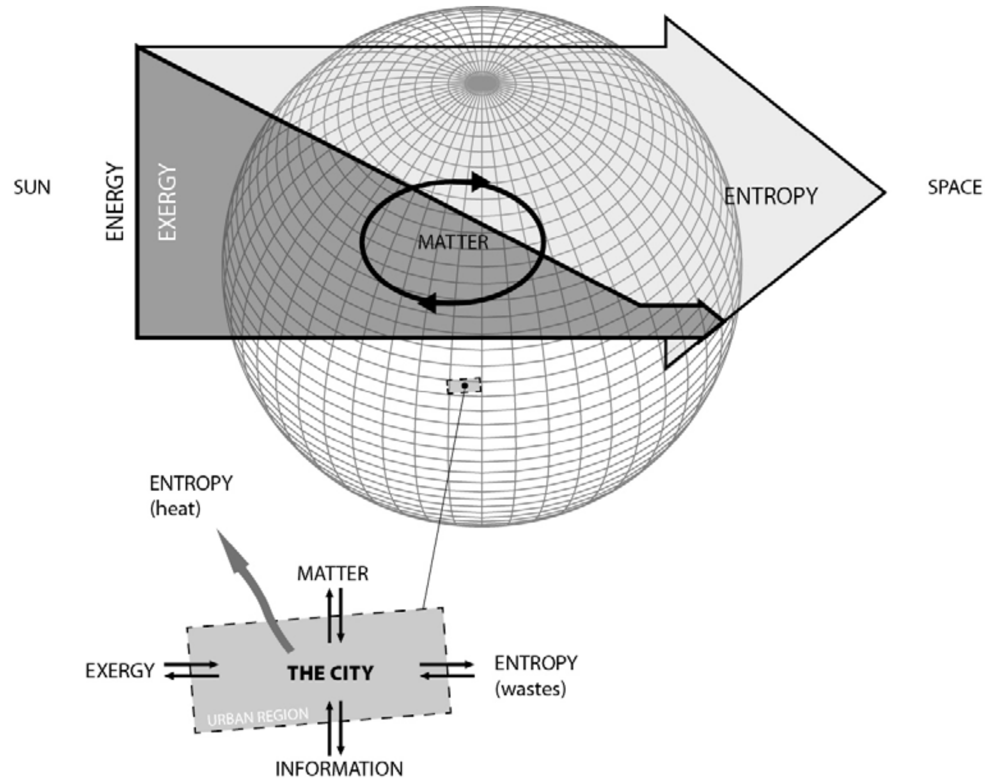

Fig. 3. The global energy balance and the local systems: energy is used to sustain the material cycles within the biosphere in a quasi/steady-state condition, but the sustainability of open systems cannot be univocally assessed. (Concept adapted from Wall, Gong, 2001)

This is a pretty simple observation, but we must consider that urban planners often use adjectives in a specific fashion, in their attempt to define, qualify, bound the object of their attention and their research. Using adjectives the city can be effectively characterized, in synthetic and meaningful expressions: the modern city, the medieval city, the ancient city and so on, immediately representing precise forms, complex morphologic characteristics or recurrent solutions. The deriving image can be considered stable and univocally defined in the literature. But it's not always so: adjectives of disparate nature have been used by urban planners and architects to characterize the city, the ideas becoming more and more vague and faint. The city has been defined as 'liquid', 'adopted'… and at the same time technical terms, with a well-defined pregnancy, suffer of a kind of abuse that makes them weak, if not quickly useless.

Talking about energy, ecology and climate change, the most abused adjectives are probably 'sustainable' and 'resilient', but many more have to be considered at risk.

It is of utmost importance, for the sake of the research and to permit real advancement in urban studies, to preserve the pregnancy of this words and concepts, avoiding misuse and misunderstandings.

In order to use and interpret GHG accounting results to produce real benefits in terms of knowledge and sustainability it is important to be aware of their nature. Hence, as first, it must be clear that GHG accounting, or energy efficiency measures of the kind, must not be 'sold' and marketed as measures of sustainability with an independent value. A zero emission profile is positive signal in general, but not sufficient per-se to assess sustainability.

A local system can have a local zero emissions profile simply importing goods from outside and exporting outside its wastes. Or, going in the even more subtle world of controls and informative feedbacks, a speculation capable to destroy an entire ecosystem, or economic sector, can be launched from a clean looking, green-washed, zero emissions company.

This doesn't mean that local emissions balances are irrelevant, and that it's impossible to talk about, or improve the sustainability of the city. On the contrary, it is possible and extremely important, especially in a more and more urbanized world, but ingenuities can produce dangerous diversions.

We suggest here some preliminary consideration, to be taken in account when dealing with cities' sustainability, with regard to energy, entropy and global sustainability.

- From materials accounting studies we know that the urban infrastructure represents the greatest investment made by mankind. Hence, a proper attention on the subject is of paramount importance. We must never forget the giant expenses we have already done to build the urban infrastructure and the city, namely: the urban capital we own.
- The "city" is not the infrastructure: it's a concept of different logical type. The city is a further level of organization that produces services of higher level. The urban infrastructure is necessary, but not sufficient to produce the city services.
- The city is the most important social and health "device". A proper accounting must consider the city-performance of the urban infrastructure, beyond the mere, local energy efficiency.
- In the rush of mankind to urbanization, in the fast growing giants like China, India, Brazil, as well as in the developing countries, an enormous quantity of entropy (in simpler terms, of carbon emissions) is being spent on building the urban infrastructure. But the city-effect is often poor.
- Looking at the European cities that are entering in a (more or less) steady state from a material flows perspective, we must properly consider the investment made in concentrating materials. The distribution of materials in the city is far more ordered than in the baseline of the earth crust (This means, for example, that urban-mining practices could be a fundamental path in the inner evolution of the city toward sustainability).

Indeed, the city effect achieved by the investments, i.e. the organizational quality of the urban infrastructure, the capacity of proper nurturing its citizens in all their human and social needs, appears a concept of paramount importance in the perspective of sustainability, also in the specific perspective of energy efficiency. Considering for example that has been calculated (Chung and Meltzer, 2007) that the health care accounts for 8% of US carbon footprint, it is clear that a city capable to suppress the demand, i.e. to reduce the need of hospitalization giving a healthier and stimulating environment, can make a huge difference in global emissions, that will never be apparent dealing with GHG inventories unless a specific reasoning, interpretation and project is put on the table.

On the other side, looking at the relationships of the city with the external region and the rest of the world, the role played by the city must always be considered. This means that it is always necessary to dig into the meaning of the quantities and the flows we are measuring, in order to understand if and how the expenses, i.e. the emissions intensity of a city, are justified by the role played by the city in the regional and general context.

Like for the entire class of thermodynamically based indicators, the main interest of the GHG emissions inventory lies in its generality, in the capability of being relatively independent from a great number of underlying processes. For this reason it represents an extremely useful sight that is necessary, even if never sufficient for assessing sustainability.

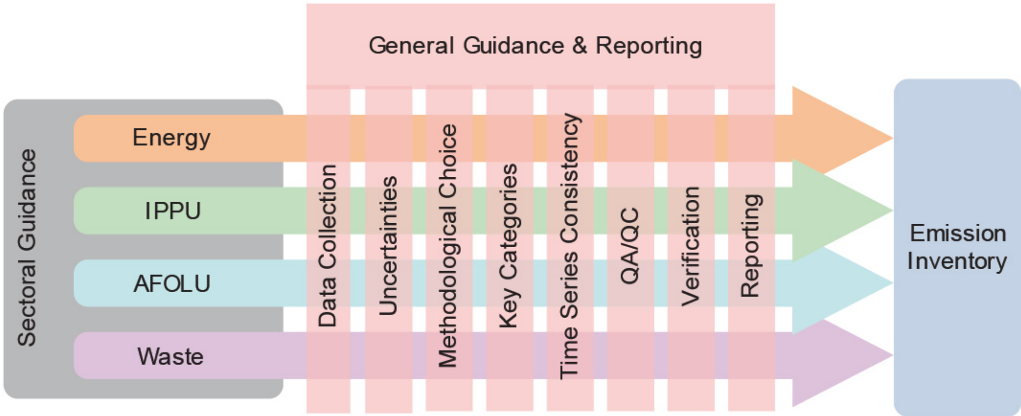

Fig. 4: a general diagram of the IPCC guidelines for GHG inventories. Four main sectors are considered: Energy, Industrial Process and Product Use (IPPU), Agriculture, Forestry and Other Land Use (AFOLU), and waste. The acronym QA/QC is used for quality assurance, quality control and verification. (IPCC, 2006)

3 DEALING WITH THE CITY: GHG ACCOUNTING IN SUPPORT OF URBAN PLANNING AND POLICIES

The International Panel for Climate Change (IPCC) has defined the methodology and the guidelines for the creation of GHG inventories (IPCC, 2006), while the ISO 14064 standards provide governments, businesses, regions and other organizations with an integrated set of tools for programs aimed at measuring, quantifying and reducing greenhouse gas emissions.

Greenhouse Gas Inventories are conceived as complete estimates of the anthropogenic *annual* emissions and removals of greenhouse gases from a specific territory, developed source-by-source and sink-by-sink. Special care is devoted to the creation of consistent time series, in order to produce comparable results, and it is worth noting that the IPCC guidelines (including the emission factor database and the IPCC inventory software) have been originally prepared in support to the creation of national-level inventories.

At such a large scale, with strong external boundaries, the geographic principle (or production principle, i.e. the accounting of all the emissions related to the activities within the boundary) can be adopted as the main criterion, but the smaller the area under study, the more the intensity of the exchanges with the external area increase. For this reason the responsibility principle (or consumption principle, i.e the accounting of emissions generated outside the system, but related to the internal activities) can be considered.

One of the most recent experiences of the application of the methodology on sub-regional level, the REGES project of the Province of Siena (Ecodynamics Group, 2014), has for example adopted a mixed approach, creating two different scenarios for the attribution of the emissions generated by the forest products, while adopting a geographic approach for the attribution of emissions related to power consumption (considering at first the total use of local power production, and then the national mix).

The technical and methodological implications of the creation of GHG inventories at the urban scale have still to be examined in depth, and with regard to the different contexts: cities of different scale and with a different structure, with different densities etc. Particular attention should be given in defining the object of the study: as a matter of fact, from the planner perspective cities are often bigger than their administrative boundaries. In some cases they can be figured as megalopolis or metropolis (Gottman, 1970 OECD, 1997, OECD Territorial reviews, 2006) and others - such as Randstad-Holland, Öresund Regionen, United States Northeast Megaregion, Padanian LiMeS) - are Linear Metropolitan Systems (Soria y Mata's, 1970, Busi, 2007).

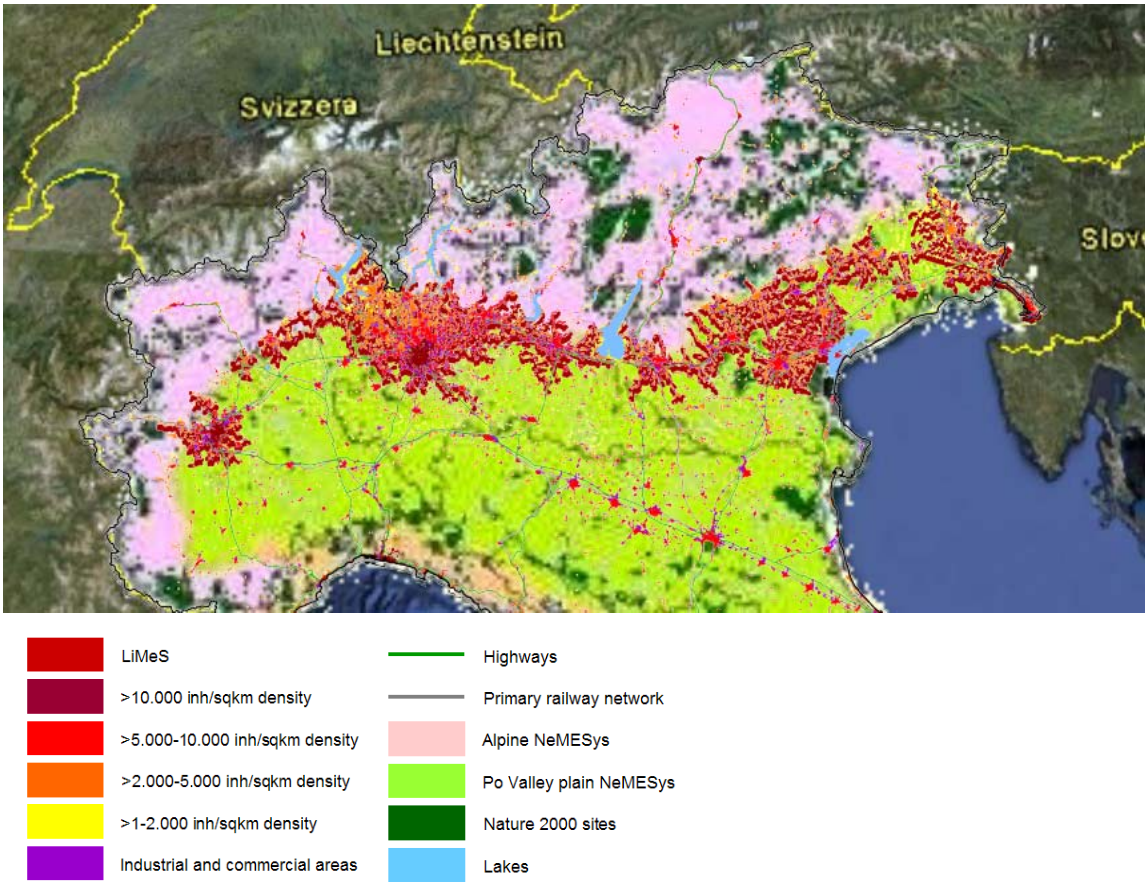

Fig. 5 : Po Valley LiMeS (i.e. Padanian LiMeS) has an approximately extension of 500km and a population of 16 million people: polycentric areas, which are characterised by the aggregation of a series of centres with partial non-specific dominance (Pezzagno, Docchio, 2010).

The perspectives, considering the results achievable at the *proper level* (mega-regional, regional or sub-regional) appear very promising.

GHG inventories permit a deep sight in the "metabolism" of the "local" system, maintaining a basis that is soundly consistent with global, national and regional inventories. Hence, not only local results are comparable, but just like the global balance is composed by national values, national inventories can be significantly mapped through the regional and local level, adding detail and resolving the granularity of smaller elements in the picture.

With the extensive adoption of the methodology, we can easily imagine each city, with its metabolism and its role, being consistently described in the general scenario, participating to the single, world-scale equation of GHG emissions[3].

In the case of linear metropolitan systems must be underlined that these polycentric conurbations are usually distinguished by a clear-cut morphological identity regarding the spatial distribution of activities (city-network) accompanied by flows of socio-economic integration of the main growth factors (employment, services, knowledge and social capital). In other words, they are urban centres and areas with intense demographic and productive activity, aligned along a specific axis, with a metropolitan system of relations.

This urban area constitutes the limit (*limes* means limit in Latin language) between two macro-areas characterized by specific environmental systems. These systems called NeMESys (Neighbouring Mega Ecological Systems) generally result to be deeply different from the LiMeS areas from a morphological,

[3] Because – let us pay tribute to the Naples famous De Curtis prince – «it's the sum that makes the total».

environmental and landscape point of view and are different one from each other. In the Po Valley reality for example the first one is constituted by “the alpine and prealpine system”; the second one is constituted by “the Po Valley irrigated plain system”. As environmental areas, very low-anthropogenic-pressure levels characterize the lands that constitute NeMESys territories. In these territories we can find the majority of the minor deprived urban communities of Northern Italy. These communities are essentially rural and suffer from the lack of investments, infrastructures and facilities that are allocated/located in the high-anthropogenic-pressure areas which enormous and constant growth functions as a catalyst for the financial resources of administrative regions and provinces. The lack of resources especially occurs whenever one rural community does not have, within its territory, any specificity (i.e. special protected area or natural reservoir, etc.) that requires financing from national or regional administrations. In this case rural municipalities does not have the chance to plan their territories towards a sustainable growth and tend to loose population for the lack of features and resources and work that they offer. On the counterpart, if properly addressed, the push towards the sustainable development of these minor communities could be an opportunity for the preservation and the valorisation of a huge ecological system that could maintain the entire system balanced (LiMeS and NeMESys). This can be faced only with an appropriate knowledge level of the dynamics underlying the complexity of the system. At the same time the creation of consistent time series of GHG emissions annual inventories permits to define a sound baseline to monitor both the evolution of the city (LiMeS) under business-as-usual conditions and with respect to the introduction of specific policies or planning decisions (useful also for the NeMESys). A baseline that can be used both for the assessment of policies and actions in the “local” context and for the establishment of best practices to be adopted at the “global” (LiMeS and NeMESys) level.

Of course, not every action can produce a signal strong or clear enough to be read in GHG inventories, but this represents an interesting effect in the priority-setting, shifting the attention to the global context even when dealing with local choices.

In this perspective establishing an effective basis for a local *industrial ecology*, like in the decennial experience of Kalundborg Symbiosis and of many other recent experiences worldwide, will appear more appealing and visible. Creating the premises for a more efficient exchange of by-products and wastes between local enterprises can contribute at hugely reducing the emissions per GDP unit.

Using GHG emissions inventories at local level appears extremely promising in order to evaluate and monitor the effectiveness of instruments like the LEED certification, both at building scale and for neighborhood development policies, or to confront the results measured in the CASABEE-City experiences as BEE (Built Environment Efficiency) values[4].

Large capacity-building projects in the field of sustainable energy solution like the SPECIAL-EU could monitor the effectiveness of the adoption of policies by town planners on the basis of GHG inventories, but indeed, each significant intervention on the city: a new traffic line, a new logistic platform, a new class of transport vehicles, etc. could be read and properly *understood in its order of magnitude* with respect to the local context in terms of effects on the GHG inventory.

4 CASBEE-City is developed by JSBC (Japan Sustainable Building Consortium) with the cooperation of the PCLCC (Promotion Council of Low Carbon Cities) as a comprehensive assessment tool on built environmental efficiency for city-wide scale that allows users to identify the performance of their city. As with other tools in the CASBEE family, CASBEE-City is also measured by BEE (Built Environment Efficiency) value. The performance of a city is calculated as BEE value.

4 CONCLUSION

The urban infrastructure represents the greatest investment made by mankind so far. Materials have been harvested from the earth crust and from the natural systems, and have been concentrated and ordered in the city. This creation of order has come at a cost: the generation of a flow of entropy, in part dispersed as thermal irradiation, in part absorbed by the biosphere itself, often at the cost of a dangerous degradation of local ecosystems, and depleting the fundamental chemical potential represented by the GHG gases sequestered from the atmosphere into the crust during billions of years.

Several thermodynamic-based approaches have been proposed to assess the weight of the urban infrastructure in the biosphere: exergy and emergy flows have been quantified, while materials accounting studies have produced significant pictures of the behavior and weight of material flows in the urban systems. Today, in the class of general, "thermodynamic" descriptions, the most affordable, concrete opportunity to define a significant baseline to represent and monitor the general performance of an urban system is probably represented by the mapping and inventory of GHG emissions.

Dealing with a complex, open system like the city, GHG mapping represent a necessary, but not sufficient instrument to assess sustainability.

At the same time, thermodynamic-based approaches and proxy indicators are extremely important for the study and the management of the city toward higher levels of sustainability. Just for their generality, their capability of producing values that are independent by the underlying processes, this kind of studies (and, specifically, the GHG accounting) represent the common ground necessary for an effective interdisciplinary discussion.

GHG accounting approaches do produce values that are not sufficient to determine the local system sustainability, and should never be interpreted as self-significant. This means also that a better performance of a local system in terms of reduction of carbon impact is generally desirable and while must never be considered as a strict goal function, can orient and give a common horizon to a vast class of policies and approaches in town planning and management practices.

Urban studies have to arise from the general picture defined by thermodynamic values and GHG accounting, and must then interpret the values in in a process-specific and evolutionary perspective.

Dealing with a necessarily trans-disciplinary sight, urban planners must in particular be aware of the "second level" services produced by the city, that can rise from the urban infrastructure only if the quality of the urban system is sufficient. This kind of services do span from social inclusion, to health, to the capability of producing a vibrant cultural environment (Consonni, 2008): they are indeed of key importance and a specific effort must be spent in order to quantify their role in the global equation of sustainability.

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IMAGES SOURCES

Fig. 1: Wall and Gong, 2001

Fig. 2: Image created by Mark T. Brown, from Odum, 1996. Distributed in Wikimedia.

Fig. 3: original picture, concept adapted by Wall, Gong 2001

Fig. 4: IPCC, 2006

Fig. 5: Docchio, Pezzagno, 2011

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URBAN PLANNING AND CLIMATE CHANGE:

ADAPTATION AND MITIGATION STRATEGIES

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ABSTRACT

Climate change is a current phenomenon: the temperatures rise, rainfall patterns are changing, glaciers melt and the average global sea level is rising. It is expected that these changes will continue and that the extreme weather events, such as floods and droughts, will become more frequent and intense. The impact and vulnerability factors for nature, for the economy and for our health are different, depending on the territorial, social and economic aspects.

The current scientific debate is focused on the need to formulate effective policies for adaptation and mitigation to climate change.

The city plays an important role in this issue: it emits the most greenhouse gas emissions (more than 60% of the world population currently lives in urban areas) and the city is more exposed and vulnerable to the impacts of climate change.

Urban planning and territorial governance play a crucial role in this context: the international debate on the sustainability of urban areas is increasing. It's necessary to adapt the tools of building regulations to increase the quality of energy - environment of the cities.

KEYWORDS:

Urban planning, Climate change, Mitigation strategies, Adaptation strategies

1 INTRODUCTION

As a result of climate change in urban areas, more and more frequently unpredictable and adverse consequences occur: devastating weather events, weather sealing of the rains, strong instability of soils, hot summers, falling water tables, changes in the quality of air, bubbles urban heat, reduced water supply, desertification, coastal erosion, etc.
Urban planning and territorial governance play an important role in preventing these effects. In Western countries, in recent decades, the degradation of the natural environment, air pollution, climate change have resulted in the demand for socio-economic models with a connotation of "green" and "sustainable." Many climate adaptation measures have been gradually implemented at different scales. However, some questions remain open: how to adapt the urban dynamics to make the city less vulnerable to climatic changes and generating less pollution and greenhouse gases? How to implement the coordination between mitigation and adaptation in a coherent and integrated approach? It is necessary first to identify the factors that determine the responsiveness of urban societies to global environmental risks such as those related to climate change.
The responsiveness also depends on the perception of the risks and their social acceptability. These elements vary in relation to stakeholders, the interests represented and the territorial scale of reference. It is necessary to formulate mitigation and adaptation strategies to increase urban resilience. Local policies for sustainable development that have managed to have the actual effects are very rare. Some cities have achieved good results, for example, reducing CO_2 emissions by more than 20% in ten years as Malmo, Heidelberg, Stockholm, Vaxjo, etc. These cities have built neighborhoods where the energy supply is made entirely by renewable energy. These experiences will respond to strong local policies, in the context of decentralization advanced, but most of the city defines only partial feeds because they cannot coordinate the multiple policies in the area. Sustainable policies tested in the city have focused on four main areas: climate strategies, eco-building, sustainable mobility and urban planning, which is the more complex target. The community that systematically adopt these four lines of action are rare. The initiatives will change depending on opportunities, and suffer from a great political fragmentation. The choices and mitigation measures are determined according to the circumstances of social, political and economic conditions of each city. these mitigation policies are guided by the importance given locally to issues related to climate change.

2 CITIES AND CLIMATE CHANGES

The Fifth Assessment Report (AR5), produced by the Intergovernmental Panel on Climate Change[1] in 2013, confirms the ongoing climate change, through observations, models, and research into the causes. "Since 1950 changes were observed in all segments of the Earth's climate system" (Cacciamani 2013), in fact:

- since the beginning of the global thermometer measurements (1850), the temperature of the thirty years from 1980 to 2010 is the highest ever recorded in the last 1400 years, including the last decade turned out to be the warmest ever;
- rainfall has increased since 1951, both in frequency and intensity
- has reported an increased frequency of extreme events in the 50s of the last century.
- the number of cold days and nights has decreased since 1950;

1 The Intergovernmental Panel on Climate Change (IPCC) is a scientific intergovernmental body under the auspices of the United Nations, set up at the request of member governments. It was first established in 1988 by two United Nations organizations, the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP), and later endorsed by the United Nations General Assembly. Currently 195 countries are members of the IPCC.

- the ocean surface temperature has increased in the last four decades;
- the extension of the cryosphere has been reduced across the planet, especially in recent years, the Northern Hemisphere snow cover has decreased by half of the last century;
- Global average sea level has risen by 0.19 m in the last century;
- CO2 emissions have increased by about 40% since 1750, mainly caused by burning fossil fuels and deforestation[2]

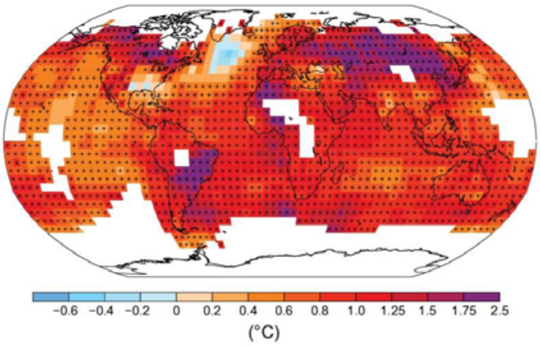

Fig. 1 Change of surface temperature from 1901 to 2012

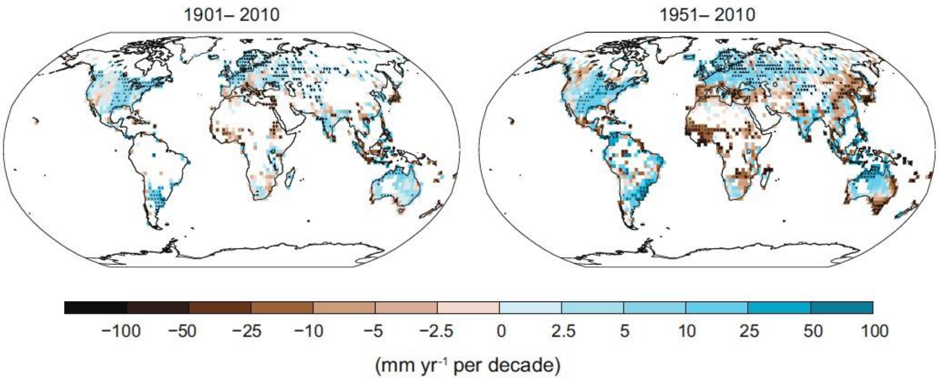

Fig. 2 Trend of annual rainfall

The climate changes have tangible effects in every part of the planet, but their effects vary greatly amplified in highly built areas due to human activity, which over the last few centuries has been concentrated in these territories located – often by changing the morphology and original conformation depending on your needs, not respecting the real nature of places and inevitably compromising the ability to respond to external stimuli. Recent estimates attest to the positive trend of growth of the world's urban population, of which approximately 10% live in megacities, but the largest share of the increase in urban settlements is being observed especially in medium and small sizes. The urban areas play a crucial role: they produce the majority of greenhouse gas emissions, and they themselves are more exposed and vulnerable to the impacts of climate change.

2.1 URBANIZATION AND URBAN HEAT ISLAND

Population growth and urbanization have resulted in a substantial transformation of the land by man. One of the main effects caused by this change is the change of the microclimate in the places where the

[2] Data taken from the Summary for Policymakers (SPM) published in October 2013 by the IPCC on all'AR5.

environment has suffered main transformations, ie urban areas. Despite the heat island[3] effect has been found for the first time by the British meteorologist Luke Howard in 1818, the term appears in the literature only in 1958 in an article by Gordon Manley in the Quarterly Journal of the Royal Meteorology Society.

The association of the term "island" to increasing temperature results from a similarity: air temperatures, being mapped through isotherms, make the city look like an island surrounded by the surrounding rural areas are characterized by lower temperatures, and urban areas characterized by greater intensity are those with an high building density. The extent of the problem varies greatly from city to city, and depending on the geographical location, the weather, the season and time of day. This alteration can be easily understood by considering: "the annual mean air temperature of a city with one million people or blackberries can be 1.8 to 5.4°F (1 to 3°C) warmer than the ITS surroundings and on a clear, calm night, this temperature difference can be as much as 22° F (12° C). Even smaller cities and towns will produce heat islands, though the effect Often decreases as city size decreases" (Oke 1997).

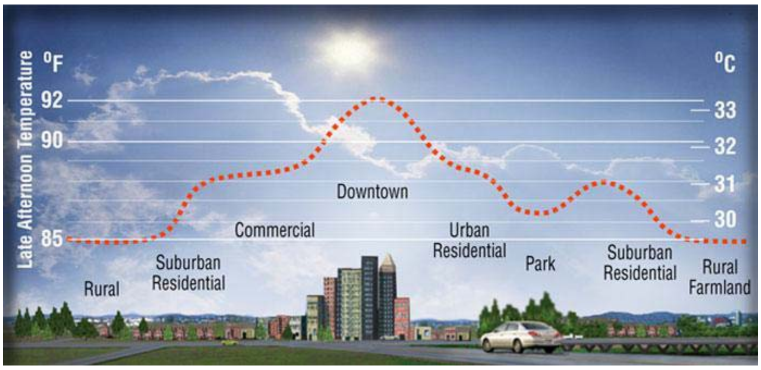

Fig. 3 Urban Heat Island

The growing urbanization of recent years and the resulting morphological structure of the city, have contributed significantly to the formation of heat island. Despite the elements that influence are obvious, their contribution to the UHI effect can not be defined uniquely, as the specific features of each city play a significant role.

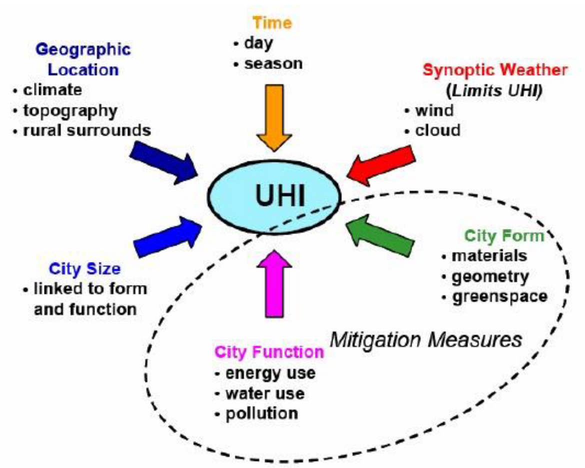

Fig. 4 Factors that influence the UHI effect

3 An urban heat island (UHI) is a phenomenon where the temperatures in the urban space are higher than those of the suburban rural areas.

The origin of the effect UHI consists of altering by the man of the characteristics of the land, through the process of human settlement. The intensity of the phenomenon is influenced by the geographical location, the time horizon and the meteorological variables. These elements contribute to alter the environmental comfort. In particular, the wind speed and the cloudiness have the greatest impact on the intensity of the phenomenon, by modifying respectively the atmospheric turbulence and the solar irradiation.

In addition, it was found that the UHI effect is amplified at certain times of year and day: during the summer and at night. In addition to these uncontrollable variables, there are causes due to anthropogenic modification of the area: the use of materials that retain heat and do not allow the evaporation, the reduction of vegetation and green areas, the energy processes that satisfy the needs of the population and the urban and architectural geometry, the presence of so-called urban canyons and widespread overbuilding.

Fig. 5 Example of street canyon

Urban planning play an important role, because it affects directly the environment, often favoring the reduction of the agricultural areas resulting in increased anthropization places, pollution and alteration of the natural environment. The urban fabric, especially in metropolitan areas, is often made up of narrow streets than the height of the buildings facing on them, the street canyon differ from undeveloped surface because they capture a greater amount of solar radiation that remains trapped by the many reflections on the surfaces of buildings. This solar radiation and infrared residual is directly proportional to the height of the buildings, to equal the width of the road. The geometry of the urban context also affects the wind flow inside: buildings – especially impressive and close to each other – act as aerodynamic barriers, reducing heat dissipation compared to non-built area in which the wind speed grows with the logarithm of the height of the soil.

2.2 TERRITORIAL VULNERABILITY AND URBAN RESILIENCE

The effects of climate change cause considerably different consequences depending on the specificity of the context to which it refers, in this context fits the concept of vulnerability[4]. The degree of susceptibility is an intrinsic factor in human nature and in the community and it is a function of the sensitivity of the biophysical

[4] Vulnerability is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity. (IPCC 2007).

system against the effects of climate change and the social system, or the ability to absorb impacts and adapt to change. At the global level[5] has been evaluated, in order to better assess the current situation, the index of vulnerability to climate change, which considers, in general, three indicators:

- the level of exposure of the areas to extreme events,
- the degree of sensitivity of the population to external events,
- the regions' ability to adapt to climate change.

The parameters are closely related to social, economic, political and geographical. A careful study of the vulnerability of the area is of paramount importance to promote and develop effective intervention strategies, policies and actions for adaptation and mitigation of risks. "Cities are the places where most people in Europe will experience climate change impacts first, they accommodate around three quarters of the population, to share Which is expected to INCREASE further" (EEA 2012). The socio-economic factors, then, are a determining factor in the assessment of climate vulnerability of the territories, because they influence the degree of risk. In urban areas, the union of the conditions of heightened vulnerability associated with the effects of global warming can lead to very significant consequences in terms of human lives and economic costs. These impacts could be greatly reduced with proper prevention in terms of planning and management of the system and the consequent risks. The risk is directly proportional to the degree of vulnerability of the system under consideration. The climate vulnerability and the interventions aimed at increasing the capacity of adaptation, affect sectoral policies, defining the future trajectory of development of territories. The concept of vulnerability is so closely linked, in addition to the human factor and social, the micro cities, understood as the possibility of the urban fabric to respond to external stimuli.

Currently, a critical specification of urban areas is the rigidity of its structure. The city is often unable to readily adapt to abnormal stress, such as climate change. Moreover, some features of the city - for example, the low percentage of permeable surfaces or the morphology of the city, further inhibit its ability to react.

In this context, urban planning plays a fundamental role to guide the city towards a more sustainable and resilient way. “An adaptive and resilient community on disaster risks and climate change related hazards becomes a more progressive and productive community” (Golez 2012). In recent years the term resilience has expanded the paradigm of sustainable development, especially when applied to the sphere of urban planning. Resilience is a concept that involves different areas with a multiplicity of meanings: it refers to ecology, anthropology, the social sciences, and finally to urban planning. Resilience has two main definitions that involve different approaches related to the concept of stability. The most widely used definition has origins from engineering: the resilience is the property that enables a material to regain its original shape after a deformation. The second meaning – or eco – systemic resilience – is special, typical of complex systems, to combat the phenomena of stress, triggering solution strategies of adaptation in order to restore proper operation. The resilient systems, subjected to external impulses, respond renewing, preserving the functionality and recognition of the systems themselves. Resilience does not therefore imply the restoration of the status quo, but the reactivation of functionality through the change and adaptation. The decrease in resources for the renewal and functional diversity compromises the system, increasing the vulnerability. Throughout history, communities have always tried to adapt to climatic and historical changes. In some areas, the change has been so rapid and violent, forcing the man to abandon the settlements. Through slower processes, communities have been able, in some cases, adapt to change. A resilient city is an urban system that not only adapt to climate change, but it is also able to plan and manage a long-term strategy that will guarantee social stability through a shared governance, building conditions for a low-carbon

[5] Analysis performed by Maplecroft, specialists in risk analysis, which in 2008 published an index of vulnerability to climate changes.

civilization. The city needs to programmatic and operational instruments aimed at ensuring an adequate level of homeland security, managing risk prevention, through a multidisciplinary approach. We need to create an effective synergy of knowledge, capable of varying responses depending on the specific evidence and the needs of the territory, gaining thus a flexible adaptation strategy. The uncertainty of scientific knowledge can not be a valid reason for postponing action on mitigation and adaptation. When there is a risk of harm – although not quantified exactly – it is necessary to provide the appropriate countermeasures to prevent their effects. Scientific knowledge must, therefore, be on the basis of guidelines highlighting the vulnerability of the area to extreme events and indicating the path planning for a coherent, effective and efficient, and resilient. Knowing the risk areas it is possible to implement a series of measures of a structural nature, aiming to reduce the frequency and the severity of a hazard, through consolidation and maintenance actions, trying to reduce the impact, through the preparation of action plans to inform and assist the population in case of need.

3 ADAPTATION AND MITIGATION STRATEGIES FOR CITIES

The vulnerability of cities to climate change is determined by many factors (Red-Cross 2010). The location certainly affects risk exposure, but most accidents are those socio-economic factors and the ability of administrators to develop appropriate strategies for adaptation and mitigation. In recent years, the concepts of adaptation and mitigation have become the basis of climate policy, identifying several strategic options in order to manage these issues. First we have to define the meaning of the terms mitigation and adaptation: the first is a global business that requires the interest intervention of the State – which participates through international agreements – while adaptation is an activity mainly on a local scale, which, therefore, requires the commitment of local governments.

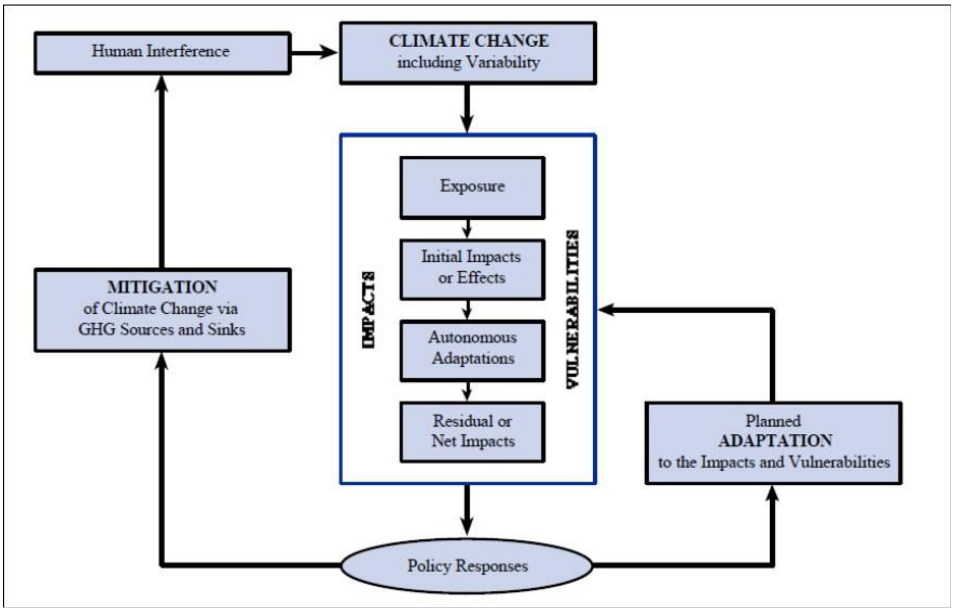

Fig. 6 Framework for the assessment of the effects of climate change

Furthermore, we must distinguish between adaptive measures and mitigative measures of the phenomenon (Solecki 2005). When we talk about adaptation we refer to those actions that tend to minimize the effects of climate change. Mitigation strategies are aimed instead to reduce the intensity of the phenomena. The adaptation seeks to manage the consequences of climate change. However, it is not intended to address the causes of the problems, but it tries to make it more tolerable coexistence with the phenomena, until subsequent deterioration require no further adjustments. In particular, these processes, which, on the one hand, seek to minimize the negative effects of the disturbance and on the other hand, tend to take advantage of the positive opportunities that this event can offer. The adaptability of the system are larger the greater its resilience – or the smaller is its vulnerability – and the lower the sensitivity of the system to the perturbation suffered or variations of pre-existing conditions.

As a consequence, increase the adaptation of the system means first reducing the vulnerability to climate change, increasing the risk threshold, reducing the potential negative impacts, increasing the positive ones, and promoting more sustainable development. The capacity to adapt varies considerably depending on the countries, regions and socio-economic groups. The ability to adapt is a function of different factors such as: economic power, technology, information, institutions and equity. Generally, the planning and development of adaptation strategies are considered necessary actions, complementary to mitigation.

3.1 COMFORT IN URBAN SPACES

It has been repeatedly demonstrated that the physical structure of the city affects the climate and weather, leading to various discomforts during certain times of the year. The conditions of well-being are therefore affected and often worsened because of physique and suspension geometry of the urban and architectural surfaces. In this sense the construction sector, accompanied and guided by a good city planning, plays a crucial role, as it has an inevitable impact on the environment, for example in terms of erosion of natural areas or agricultural, human settlement of places, pollution and degradation of the natural environment.

The complex urban structure of a city can be of fundamental importance for the mitigation of the phenomenon dell'UHI. This is the case of so-called urban canyons, ie narrow streets surrounded by buildings high. Unlike a flat surface undeveloped, urban canyons capture a greater amount of solar radiation that is trapped by multiple reflections. For this phenomenon (called the canyon effect) in some parts of the city heat island is preserved even at night. The cooling air that remains in the canyon is much slower than all other areas (eg rural areas), because the infrared energy radiated from the surfaces in the environment that surround the road corridor, rather than disperse freely in space, is largely captured and reflected several times on the part of the buildings that face on the opposite sides of the road. The trapping of solar and infrared radiation is much stronger than most buildings are taller than the width of the street. Another factor directly related to the geometry of the city is the wind profile within the urban context. The breezes and the wind in general are very important, especially at night, when the surfaces release the heat accumulated during the day and warm air stagnation causes discomfort for the citizens. The morphology of the city influence the wind profile: the buildings are in fact the aerodynamic obstacles that reduce the export of heat, especially if they are particularly large and close together. In the absence of an urban center (for example, in a rural area) in the surface layer wind speed increases approximately with the logarithm of the share. In the presence of an urban center, the structure of the boundary layer (called "urban boundary layer") will be unchanged. This layer is characterized by the presence of obstacles (buildings, trees, etc.) it is not common in rural areas. The role of cities within the mitigation strategies is crucial. Today more than ever necessary mitigation strategies to limit emissions of CO_2, produced by the city. Mitigation strategies can be seen as the best option for reducing the risk of disasters related to extreme weather events exacerbated by global climate change (Red-Cross 2010). The global CO_2 emissions come largely from human activity in cities and urbanization processes. The urban traffic, deforestation, industrial activities and energy consumption are among the main factors of greenhouse gas emissions in an urban setting. The role of urban planning is crucial in the challenge posed by climate change, both in terms of adaptation and mitigation.

In particular, the heat island phenomenon is developing more and more in different urban contexts, and especially in Italy, there are still few initiatives taken towards planning policies that can address the problem and mitigate the dangerous effect. Often the planning is developed on too many levels of decision and there is no interaction between them. It is necessary to make a good planning and a policy of control of environmental conditions, in order to define strategies and implement practical measures for the monitoring and mitigation of heat island. The current challenge for the city is to implement policies and projects aimed at both reducing emissions from urban areas to increase their resilience. The city will have to contribute to "mitigate" climate change and at the same time "adapt" to climate change. The most common strategies are:

- increase in areas with reflectivity (albedo);
- creation of green areas in the urban context;
- reduction of anthropogenic loads;
- use of specific materials.

The spread of surface reflectivity is very important. The albedo of a surface is the fraction of light, or more in general, of the incident radiation that is reflected back in all directions. Thus it indicates the reflecting power of a surface. Greater is the albedo and greater and the amount of radiation that urban surfaces reflect in space. Conversely objects that absorb solar energy have a low albedo value and contribute to the warming of the city. In urban areas it is very important to implement the ability of the surfaces to reflect solar radiation into space to avoid the storage of heat in the urban fabric, especially in the canyons, in cities with a high rate housing. For example the light surfaces reflect a greater percentage of solar radiation compared to conventional surfaces as they are characterized by a high albedo, and therefore entail a cooling of the surrounding air (Solecki 2005). Furthermore, it is very important to increase the green areas. Unfortunately, human activity in recent years is not developing in this direction: the vegetation of the urban environment is slowly disappearing because they are often made of low- density housing schemes that reduce the distinction between town and country.

The urban green has a value of albedo and thermal inertia different from other materials, and also has a large concentration of water. The presence of green is particularly important in the summer season, when the temperatures are higher due to evapotranspiration and the air temperature is lowered. Furthermore, the green, with its shading function, prevents the radiation directly affect artificial materials: these are less heated and consequently the energy re-emitted into the environment in the form of heat is reduced.

The green areas located in urban areas add quality to the urban landscape and the urban microclimate can be adjusted. The experimental data show that, thanks to the combined effect of the shadow and evapotranspiration, the presence of vegetation results in a significant reduction of the temperature (Robitu 2005). The functions of the green are emphasized in combination with the presence of elements of water because evaporation and evapotranspiration are always associated with the transfer of heat between water, vegetation and air (Robitu 2005). Another effective urban strategy is the reduction of anthropogenic loads. The city produces energy, with the loads generated by the traffic, from air conditioning or heating and industrial installations. Moreover, it is very important the choice of materials, which particularly affect the surface energy balance. The materials can be divided according to their intended use: flooring materials, building materials and structural materials. As for the roofs and pavements, we refer to cool roofs, green roofs and cool pavements. The roofs occupy about 20-25% of the urban area, therefore a reduction of the surface temperatures of roofs can bring direct benefits to individual buildings and indirect to the whole urban territory. To achieve this purpose materials are used in roofing and they reflect a greater proportion of radiation and high emissivity, eg cool roofs. A normal roof (black-roofs) can reach temperatures close to 85°

C and reflects only 5% of the radiation, the cool roof has a surface temperature lower than traditional materials, with high values of albedo and emissivity. A cool roof allows a lower heat transfer from the roof, then it has a more comfortable temperature inside the building, thus it limits the need for a cooling of the mechanical type. In those situations where the buildings are many and particularly close together and the realization of green areas is difficult, are used the green roofs. The best idea is to take advantage of the large area occupied by urban roofs for the realization of the so called green roofs, roofs covered by a layer of vegetation. The extensive use of green roofs leads to a reduction of the albedo and an increase of the processes of evapotranspiration that allow to limit the surface temperature of the roofs, reducing the flow of the incoming heat and heating the air.

Urban pavements can reach high surface temperatures, creating problems of microclimate and well-being.

The majority of the urban area is in fact made up of different types of flooring and the behavior is almost similar to other materials: during the day they absorb and store energy during the night, through the processes of radiative and convective cooling, dispose of the energy absorbed.

As for the roofs action can be taken on the properties of the floors to try to mitigate the heat island effect, unlike the budget shell (influenced by albedo and emissivity), the flooring is more complex: you have to consider factors such as the permeability, the thermal inertia and the convection.

All of these factors act on the surface temperature. To try to reduce this temperature may be used unconventional materials in order to reduce also the amount of heat stored. The cool pavements. reflect a greater proportion of the solar radiation and may be permeable. The cool pavements do not act on emissivity but on impermeability of the surfaces. This feature allows the descent of the water towards the ground, fundamental for the evaporative cooling. In contrast, porous pavements limit the transfer of heat to the subsurface because of their structure: the surface temperature will be greater but the advantage is that a lower thermal storage. Compared to the benefits produced by cool roofs and green roofs the benefits of cool pavements are indirect: for example with a good spread of permeable surfaces rainwater runoff may be reduced by up to 90% going to affect the costs of pumping.

4 CONCLUSIONS - THE ROLE OF URBAN PLANNING IN CLIMATE CHANGE

Planning is able to influence the way in which the density and the soil is used, but at the same time is able to connect the macro scale (cities and districts), at the micro (individual buildings) in a single perspective.

The planner often acts within the limits of political and economic factors, it is nevertheless an essential figure and plays a key role in the adoption of measures for improvement of the urban microclimate. In fact, the success of projects and mitigation plans also depends on the ability of the planner in developing awareness of the possible future changes in microclimate induced by modification of the urban fabric (De Schiller and Evans 1994). The planner must be able to understand and incorporate the principles and techniques that can be applied to achieve the objective of reducing the impact of the transformations of the territory urban climate. To facilitate this integration is a fundamental understanding of the two-way relationship between the built environment and the environmental thermal conditions: the planners change the environment through the building and on the other hand the buildings suffer from environmental changes around it. The future buildings should be designed in view of the reduction of impacts on environmental thermal conditions and at the same time control the negative effect of changes in these conditions over the users of urban spaces (De Schiller and Evans 1994). It is also necessary to evaluate the climatic variations at different scales: from the building, the neighborhood, to the city. It is necessary to concentrate their efforts on three areas with synergies between adaptation and mitigation: urban planning, building design and decentralized energy production. It follows the central role of local governments and local adaptation to climate change at the same time developing integrated strategies between mitigation and adaptation. Many actions have been taken in this direction. After the adoption of the European climate change package in 2008, the European Commission has proposed the "Covenant of Mayors" to support the efforts made by local authorities in the implementation of policies in the field of sustainable energy. To meet and exceed EU targets for energy and climate, the signatories of the "Covenant of Mayors" are committed to develop a Sustainable Energy Action Plan (SEAP). The SEAP is a document that defines the energy policies that administration must take to reach the EU target of reducing CO2 emissions by 2020. This objective is pursued through actions to reduce energy consumption in the city and to increase the production of energy from renewable sources. Many European cities have adopted their own Sustainable Energy Action Plan. Recently, the Institute for Environmental Protection and Research, ISPRA, has drawn up a strategy of local adaptation to reduce the risks caused by climate change, urging the development of the resilience of the community. The institute has set some Guidelines for Climate Change Adaptation Plans at Local level (PAL).

The aim of the Guidelines is not only to provide the basic theoretical concepts on the key issues of adaptation to climate change but also to propose a practical and operational support to local governments that are interested in starting a process of adaptation and to develop Climate Change Adaptation Plans at Local level (PAL). Furthermore, there are many opportunities for local governments to use the process of urban planning for the reduction of greenhouse gas emissions. A general urban consolidation and a more varied use of local centers of activity near public transport nodes help to reduce the amount of land used for construction and tend to reduce travel and emissions of transportation. However, the policy of adaptation to climate change require spaces inside and around buildings. An average density of settlements, along with a differentiated use and green areas, tends to lead to a reduction of greenhouse gases and contribute to adaptation. The integration of functions – residential, manufacturing, recreation, infrastructure – in urban areas causes additional benefits of adaptation. Innovative air-conditioning help to limit emissions. The orientation and organization of buildings and covered areas allow for the replacement of the conventional air conditioning system with solar and district heating. The planning of green areas around the buildings and green roofs to reduce the temperature leads to a substantial reduction in energy consumption. In conclusion, a sustainable territorial development must consider the impacts of climate change. A combination of mitigation and adaptation strategies can lead to optimal results in terms of resilience, environment and local economy. Such an approach needs to be developed consciously by government as a strategy of anticipation and opportunity that is based on the vision of a region resilient to climate change that takes the pulse to go down the route of a new model of development ”low carbon". The objective is to develop and prepare the implementation of strategies to address local and regional climate change in a comprehensive and integrated manner thereby broadening the effectiveness of climate policy through optimal combinations of measures, both short and long term, precautionary response and thereby establishing a kind of local planning and land that minimizes the risk for the development of the territory.

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Fig. 3: www.heatisland.lbl.gov

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Fig. 6: IPCC. (2007), *Climate change 2007: The physical science basis*.

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URBAN GAMING SIMULATION FOR ENHANCING DISASTER RESILIENCE

A SOCIAL LEARNING TOOL FOR MODERN DISASTER RISK MANAGEMENT

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ABSTRACT

An emergence of the disaster resilience concept broadens the idea of urban risk management and, at the same time, enhances a theoretical aspect in a way in which we can develop our cities without making it more vulnerable to natural disasters. Nevertheless, this theoretical plausibility is hardly translated into a practical implication for urban planning, as the concept of resilience remain limited to some scholars' debate. One of substantial factors that limit the understanding of people about disaster risk an resilience is a lack of risk awareness and risk preparedness, which can be solved by restructuring social learning process that enable a process of mutual learning between experts and the public. This study, therefore, focuses on providing insights into the difficulties of disaster risk communication we face, and how gaming simulation can be taken as a communication technique in enhancing social learning, which is regarded as a fundamental step of disaster risk management prior the mitigation process takes place. The study argues that the gaming simulation can facilitate planners in acquiring risk information from the community, conceiving the multitude of complex urban physical and socio-economic components, and conceptualizing innovative solutions to cope with disaster risks mutually with the public.

KEYWORDS

Gaming Simulation, Risk Communication, Social Learning, Urban Resilience

1 DISASTER RESILIENCE IN THE MODERN URBAN PLANNING

While cities around the world have been developing and transforming their built environment and socio-economic characteristics, the consequences of these urban development efforts bring about changes of built and natural environment. Those development and transformation chance the cities from agricultural-based to industrial and commercial-based development in such a way that leads to increased complexities of urban metabolism. Besides, the pressure of capturing globalization stimulates huge investments in the city creating more dense urbanized areas, especially in the disaster-prone zone.

In fact, the vulnerability in terms of environmental chances and natural disasters is not just emerged, but it has been a major threat to the urban fabric of our society since rapid urbanization changed the urban landscapes and socio-economic characteristics (Mitchell, 2010). Dating back to the industrialization era in the the 1970s, the economy of the capitals of major countries in the world had depended on a large-scale production of middle and heavy industries, which was central to the urbanization. Nevertheless, the economy prospered through the industrialization brought about other negative impacts in where factories were located. The industrial development without proper urban management - allowing factories to build in a residential area - led to several urban problems related to the environmental degradation and social inequality, which had considerable side effects on the sanitation service provision with decent housing and the quality of life of the inhabitants. After that, the late 1970s and 1980s many old industrial cities – especially in England – experienced the urban crisis in terms of accelerating declines in their traditional manufacturing industries (Bramwell & Rawding, 1996; Xiao, 2007), corresponding with a stepping increase in the substantial concern on urban revitalization.

As a result, in the 1980s and early 1990s, the process of urban revival responding to economic recession were initiated and considered as "the wave of worldwide economic recovery", which aimed to restructure cities' economy towards services and consumption (Xiao, 2007). Recently, thousands of cities have shifted their place marking from the promotion of industrial estates to city-image building and to strategic tourism planning (Lim, 1993). Even through this placement brings about the economic prosperity, the flux of tourists and tourism causes a sharp rise in waste production as well as the demands of urban facility and utility beyond the carrying capacity.

Since the future catastrophe of man-made and natural disaster tends to be more severe than the past, human beings have been forced to seek for a suitable strategy in which it enables us to protect our lives against the perceived risks, and to respond these risks through detecting vulnerable spatial, social and economic attributes that can lead to the catastrophe. Such a kind of that strategy has been developed over time, corresponding to the shift of human understanding of the interactive relations between human society and nature (Table 1).

After the experiences from a variety of destructive disasters in 1980s, we have been aware that natural disasters are not amenable to technological quick fixes alone. The attention of risk management strategies has increasingly been paid to behavior changes and disaster risk awareness that follow upon the environmental sustainability campaign. The increase of risk awareness of world leaders association has shifted the role of human society in dealing with disaster impacts from re-active to inter-active. Besides, it has also stimulated human thinking and cognition about social-natural relations. Correspondingly, the risk response approaches have been innovated. This innovative thinking leads to a series of shifts from adaption, via sustainability, to resilience, which is regarded as a core approach defining the way we enhance our capability and aptness to cope with natural disasters.

THEME	PRE-1980'S	1980'S	1990'S
Urbanization trend	Industrialization	Garden City	Globalization, Commercialization, and Tourismization
The exist of nature and culture	Culture is nature	Nature is culture	Nature and culture have a reciprocal relationship between
Risk response approaches	Adaption	Sustainability	Resilience
Human-environment relationship	Human is re-active to the environment	Human is pro-active to the environment	Human is inter-active with the environment
Human centric perception	Environmental crises hit human	Environmental crises are caused by human	Environmental crises are caused by socio-natural interaction
The perceived risks	Environment is dangerous for human	Human is dangerous for the environment	Neither is dangerous if handled carefully, both if that is not the case
Applied tools and strategies	Apply technofixes	No new technology	Minimalist balanced use of technology

Tab.1. The shift of human cognition toward social-natural relations

2 DISASTER RESILIENCE IN THE MODERN URBAN PLANNING

Even the concept of disaster resilience has been proposed since a couple of decades, there is still no unique understanding of this term. Its definition depends on how scholars apply the resilience concept to achieve their goals and objectives. Nevertheless, the practical use of this concept somehow shows remarkable insight into its theoretical plausibility and the difficulties that we face in defining this term.

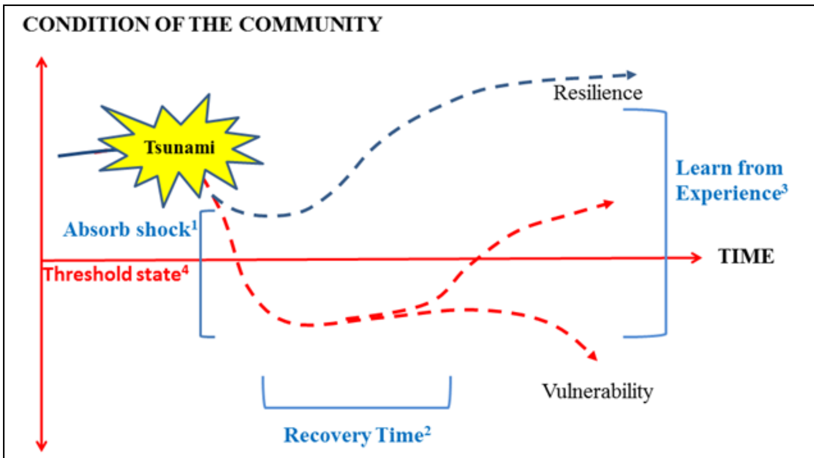
Focusing on the theoretical background of the term "resilience", a concept of resilience is developed from its predecessor term, "vulnerability". The term vulnerability based on the social sciences was proposed in order to respond to the pure hazard-oriented perception of disaster risk in 1970s (Schneiderbauer & Ehrlich, 2004). After that, this term has increasingly been taken as a starting point for risk reduction programs. For instance, it is heavily promoted in "Hyogo Framework for Action 2005-2015" (UNISDR: United Nations Office for Disaster Risk Reduction, 2007).

Vulnerability is broadly understood as the degree of or potential for loss, or as a predictive variable that can potentially be affected by external threats (Armas & Gavris, 2013; Bohle, 2001; Cutter, et al., 2008). Nevertheless, the conceptual framework of vulnerability proves its weaknesses, as it partially defines a group of people or systems exposed to risk without concerning the flexibility and adaptability of those to react and respond the external stressors. In fact, it is, undeniably, necessary to underline the distinction between exposures to external threats and the adaptive capability coping with the threats. The concept of vulnerability has, therefore, been developed and brought about a concept of resilience, which does not only focus on potential impacts on a defined system, but also the essential of coping capacities of the system under pressures from the external perturbation.

The concept of resilience was originally constructed as a concept referring to a system's capability to absorb shocks and persist in an equilibrium state that focuses on maintaining the basic function of the ecosystem. Resilience is to some extent understood as the opposite of vulnerability as if the flip side of a single coin, while some scholars view the relations between resilience and vulnerability differently. Based on the interdisciplinary approach, resilience and vulnerability can overlap each other as they shares a common ground referring to the susceptibility. Resilience generally refers to the adaptability and capability of the defined system that can resist and recover from changes either in terms of physical, social, or natural environment. However, when urban systems are not resilient, the status of the system does not automatically become vulnerable; its state is in a continuum between resilience and vulnerability in which this sliding state gradually changes into vulnerable. Hence, vulnerability and resilience are not a static state, but they are a dynamic process in which they were misleading in the measurement process that views them as a static state.

3 A SOCIAL LEARNING PROCESS AS A TOOL FOR ENHANCING DISASTER RESILIENCE OF CITIES

Based on the lens of urban planners, urban resilience to disaster mainly comprises of three adaptive capacities: 1) the stability, 2) the reactive responsibility, and 3) the innovative recoverability. The stability refers to a capability to absorb stress or destructive forces through resistance or adaptation, whereas the reactive responsibility determines a capability to manage or maintain some essential functions and structures during disastrous events. On the contrary, the term innovative recoverability is used to express complementarily a capability to recover or 'bounce back' quickly after disasters. To express how those three cover a great proportion of the different elements of resilience, we divide a city state into pre-, during-, and post-disaster time, and the characteristics of urban resilience can be identified by the overall state of city (Figure 1). However, this state based on a resilience approach may not reflect all practical situations as it merely presents the idea of reconstruction process rather than the restoration process that are more related to the theoretical resilience. The other weak points towards concepts of resilience are not represented through absolute terms, but the representation is simply compared with a status quo level of the defined system's functionality.



Notes:

1. Ability to absorb or avoid impacts of hazard events: Enhancing resilience decreases the magnitude of impacts of hazard events on the community.
2. Ability to recover from hazard events quickly: Enhancing resilience accelerates recovery time.
3. Ability to adapt to changing conditions: Enhancing resilience builds the capacity of communities to learn from experience.
4. The threshold state in which a community can qulitively maintain their basic structures and functions

Fig. 1 Role of Resilience in Determining the Urban System's Response to Hazard (adapted from Twigg, 2007 and UNISDR: United Nations Office for Disaster Risk Reduction, 2007)

Thousands of scholars and philosophers have been trying to re-define the concept of resilience and invent a variety of variables to describe an ideal resilient system. This concept is re-defined to amplify the principal capability and adaptability of the system - rather than the qualitative capacity - for processing self-renewal, self-organization, and the innovative development beyond its principle from the ecological discipline. Nowadays, a resilient system is measured by its unique characteristics instead of its dynamic state during the perturbation. To enhance the understanding of the resilience, Cutter and colleagues (2008) shed the light on resilience indicators that involves different aspects in the indicator development; those include ecological, social, economic, institutional, infrastructural, and competent aspects. Within this indicator development, the resilient system is surrounded by various elements and characteristics referring to, for example, the robustness, adaptability, and transformability of the defined system. Through integrating those constituents into a disaster cycle, a model of key dimensions of resilience was framed by Galderisi, Ceudech, Ferrara, & Profice (2012) (Figure 2).

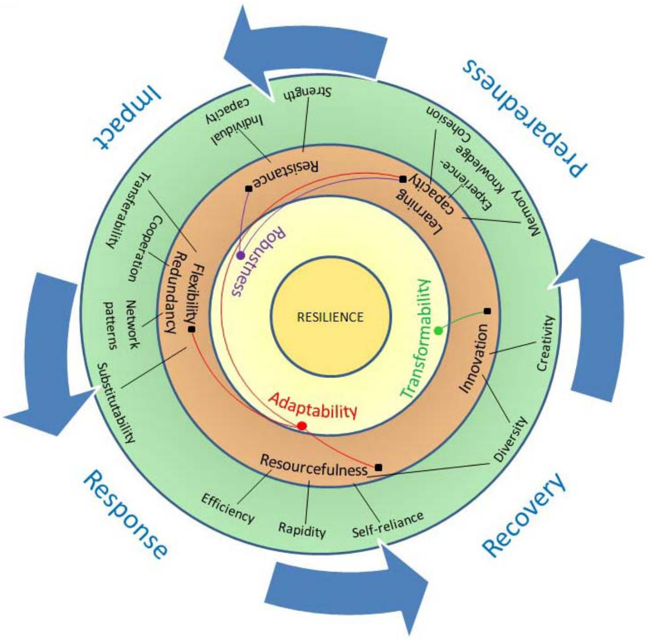


Fig. 2 The key dimensions of resilience in the disaster cycle (Galderisi, Ceudech, Ferrara, & Profice, 2012)

In sum, the resilience of a defined system is not only the sum of each component, but also a dynamic interaction of individual and collective processes at different levels, which contribute to the adaptability and capability to the system to withstand changes. Hence, components of each realm - such as socio-economic characteristics, built- and natural environment - contribute to the capability of the system to turn negative circumstances to opportunities. This dynamic interaction between the system and changes may eliminate or transform some components of the process in order to maintain the system's continuity and growth as an entity.

This study proposes a conceptual model of urban resilience to guard against disaster risk (Figure 3). Resilience in this model is interpreted as both an outcome and a process of disaster preparedness and recovery. This recovery after disaster should be considered as a restoration process rather than a regular reconstruction. Whereas urban resilience to natural disaster means that components of urban system - built and natural environment, human capital, and socio-economic activities - are able to withstand disaster impacts without qualitatively losing its basic functionalities and physical structures that are necessary to maintain livelihood of their users. Urban resilience here is the dynamic process that shifts the urban system from vulnerable, to resilient, and then advances to innovative urban transformations. Nevertheless, this active movement requires sufficient adaptive capacities and a better social learning process as a set of catalysts to a resilient urban transformation.

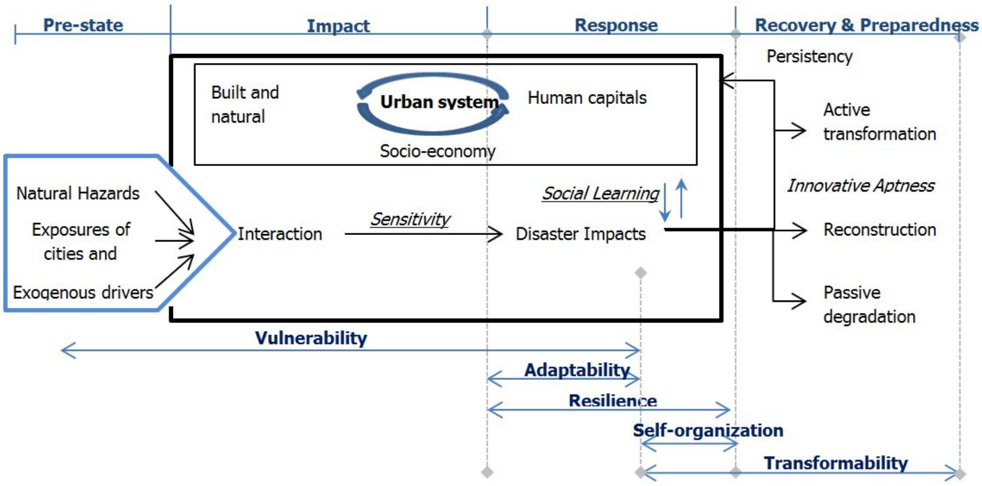


Fig. 3 The conceptual model of urban resilience to disaster (adapted from Twigg, 2007; U.S. Indian Ocean Tsunami Warning System Program, 2007; Chapin, 2009; and Galderisi et al., 2012)

4 IMPROVING A SOCIAL LEARNING PROCESS THROUGH UTILIZING THE URBAN GAMING SIMULATION

Under the aforementioned framework of urban resilience to disaster, risk information sharing and transfer has been recognized as one of the crucial problems of the social learning process. Theoretically, disaster risk management can be integrated into the urban planning field for achieving disaster resilience goals depending on how well the risk assessment is conducted by and conveyed to the public. We need to realize that the risk assessment cannot be a standalone tool of disaster risk management, and it is indispensable to take three board actions of risk analysis, communication, and management into account (Bendimerad, 2008). Based on the top-down approach of disaster risk management, a traditional goal of urban risk management aims at producing a hazard map and risk management policies, and after that bringing them into the locality's consideration. As a result, a delicate concept of risk zoning policy has been increasingly considered as the fundamental discipline for urban and infrastructure planning in Europe and North American continents in the mid-nineteenth century. However, the production of those hazard maps and its relevant policies, in many cases, ignores the essentials of public participation and implicit data arisen form the public, which results in increasing risk and vulnerability of the cities. We have experienced from thousands cases which those actual outcomes of the implementation of risk zoning policy are significantly different from the plans. In some cases, the vulnerability of cities and people living in those cities is continuity increasing instead of decreasing. Those situations can refer to a breakdown of administrative management or a failure of risk communication between experts and the public.

In fact, before a formal risk analysis is initiated, risk information related to both physical attributes and social vulnerability must be obtained from the public, whereas the outcome of risk analysis should also be transferred to the public in the way that can cultivate them the risk awareness. The study proposes, therefore, a new conceptual framework of disaster risk communication, which can contribute to the better result of disaster risk management and enhance the urban resilience. Figure 4 illustrates the role of risk communication as a means of overcoming the main problems of the contradictory risk perception and awareness between the public and risk managers, while retaining the advantages of sophisticated computer-based risk assessment. In order to enhance the public cooperation, results of dynamic modeling of risk assessment should be conveyed effectively to the public in a proper way that can raise public awareness of environmental hazards. Thereby, the disaster risk managers and planners are expected to develop their risk communication skills as well as to invent an innovative risk communication approach, which enables local community members to get involved collectively in risk communication and management processes.

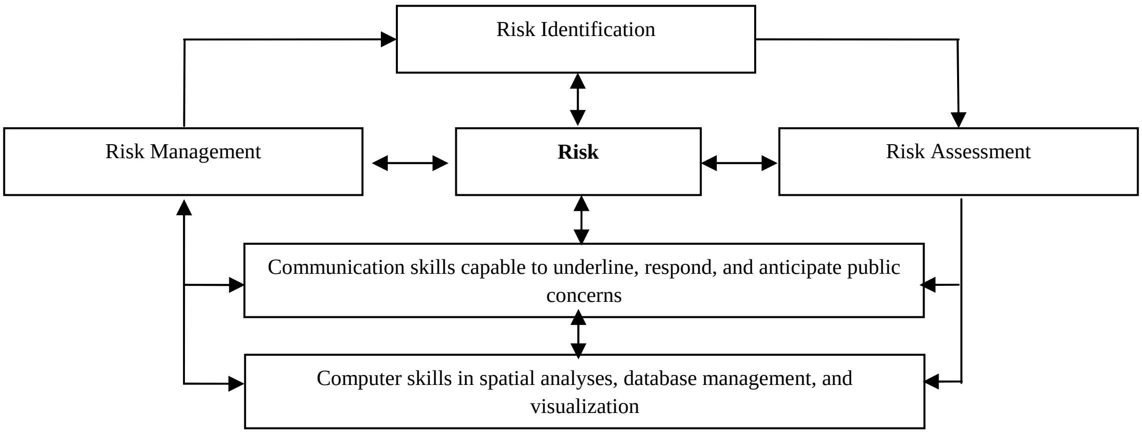


Fig. 4 The integration of risk communication with spatial risk management (adapted from Hatayama, 2007)

Risk communication plays an important role in an interactive exchange of risk information and opinions among risk assessors, risk managers, the public, and other stakeholders (World Health Organization: WHO, 2012). Applicable in the situations where either the qualitative information or precious consideration of hazards is undertaken, risk communication can be used for two different purposes: the data collection and information transfer. It is a useful action to obtain the risk information from different vulnerable groups for the increased effective risk analysis as well as to disseminate risk information among individuals, groups, and institutions in order to educate the public about possible effects of hazards (Ng & Hamby, 1997; Morrow, 2011). Therefore, the formation of risk communication should be taken into consideration as a common action in the disaster risk management. Decision makers have to receive little attention to the paradox in which the intricate risk modeling may provide qualities of risk assessment, but its outcome seems to be incomprehensible to the public (Figure 5). The remarkable issue is how far we can go along with sophisticated risk mapping techniques in visual risk communication, while the risk information and warning can be accessible and simply understandable for them.

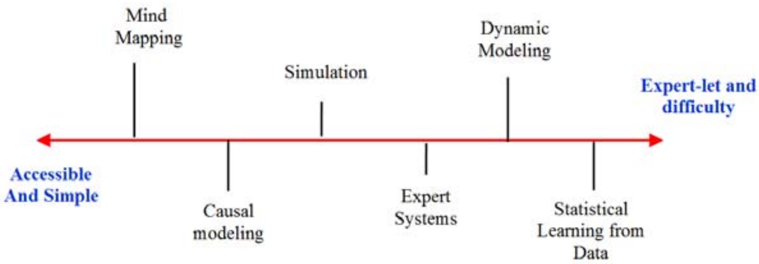


Fig. 5 The sophistication spectrum of risk mapping techniques to visually model and communicate risk (Neil, n.d.)

Among the risk communication techniques in the Figure 7, the simulation is respected as a communication technique, capable to convey a massage that falls in a middle range between the understandable simplicity for the public and the expert-let difficulty. Additionally, this simulation technique can be used as a communication tool of urban planning and design in which it can be transferred from a traditional computerized simulation into the gaming simulation. By this way, a sophisticated simulation that provides a complex context of the reality can be represented coherently by a pleasant and playful game, so-called "gaming simulation", that offers the players to play and make changes to a mock-up of the reality, in order to broaden and deepen understanding the reality that surrounds them. Besides, the gaming simulation offers representatives of stakeholders the opportunity to meet each other, discuss and exchange their different information and opinions on a specific issue, which enable a fruitful communication avoiding a risky judgment on wrong terms.

Additionally, the comparison between two different sciences of urban planning and that of gaming simulation can make better understanding on the differences and the overlapping parts between them. The science of urban design and planning deals with analysis and synthesis on the issues related to infrastructural engineering and social construction of the reality, while the science of urban gaming and simulation mainly emphasizes the importance of building metaphor of the reality under a specific purpose to pursue defined goals (Klabbers, 2006). In a process of producing the urban gaming simulation, the planner can take double vital roles as a designer and a facilitator. Those roles can help the planner in addressing questions that fit into the realm of resolving chronic policy problems related to, for example, a policy implementation issue of the difference between the public risk awareness and desirable behaviors. On the other hand, designing an urban gaming simulation and facilitating the play allow the planner to use this mechanic and its results for collectively representing tangible solutions to real-world controversial risk management, which often faces the conflict over the different interests as well as tricky interpersonal and institutional social issues.

It is clear that the sophisticated urban risk management strategy requires careful implementation and appropriate risk communication model integrating with the simulation technique. Thereby, the efforts of disaster risk communication leads to the emergence of Urban Gaming Simulation (UGS) and Disaster Imagination Game (DIG). To visually illustrate how UGS and DIG can transform today's individualism risk awareness that is limited to group of experts to the collectivism one, VADDI (vallo a dire ai dinosaur) designed by Rizzi and et al. (2010) can be taken as an example.

VADDI, a gaming simulation on urban planning and disaster risk management, shows how UGS and DIG work in exchanging information either between experts and the layman or among experts. This game characterizes as a role-playing game giving players a scenario that they were living in a coastal region where is enriched with environment resources such as mountains, forests, rivers, and the suitable land for pastures and cultivations. Players are given roles of government, planners, developers, and citizens who live in one of three neighboring cities: a metropolis, a seaside town, and a picturesque mountain village. This game simulates the reality where different stakeholders have different concerns on urban development according to an individual's role, which possibly bring about the conflict. Additionally, every player is given personal projects to carry out and to make decision under the consensus of community member whom the play lives and works with. During the play, the climate change scenarios - such as urban heat, overwhelming rainfall, summer fires, landslides, and floods will be given as a mark of the seasonal transition, whereas some areas are subject to prolonged periods of drought. Thereby, the players are put into the situation where environmental problems are no longer under control. During the last phase of the game, players will be motivated to think about their risk and city vulnerability, which let them express their ideas and options related to the future of regional development concerning on environmental risk. Remarkably, this game simulation can reach its ultimate usefulness when the political advocacy translates the messages from the discussions into risk management projects, strategies and law.

4 DISCUSSION

Decision-makers and planners nowadays know well how to apply their computer skills to obtain and analyze the urban physical attributes contributing to disaster risk and vulnerability, but they are rarely capable of bringing the risk analysis to the public consideration. As a result, this phenomenon manifests the failure of risk communication and a methodology used to identify the problems as well as to reveal a complexity of urban system and its social vulnerability. On the other hand, this reminds human beings that the successful efforts to render the adaptive capability to interact with disaster risk is not only limited to reducing the vulnerability of urban systems, but also alleviating the vulnerability of social structures.

The idea for risk communication, in the face of disaster, can make the urban planner and risk managers deepen their understanding about the reasons behind people's actions that either impede or motivate them to perform desirable protective measures corresponding with a risk zoning policy that is enacted. Similarly, improving urban risk communication through applying the gaming simulation provides the urban planners and practitioners a bridge between their viewpoints on urban risk management with the public risk awareness that actually exists. An integration of the gaming simulation and the urban risk management innovates a traditional simulation to a metaphor of complex urban and social systems, which is so-called "urban gaming simulation". This urban gaming simulation can enable a mutual social learning environment that is regarded as a fundamental principle of enhancing urban resilience against natural disaster.

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IMAGES SOURCES

Fig. 1: adapted from Twigg, 2007 and UNISDR: United Nations Office for Disaster Risk Reduction, 2007

Fig. 2: Galderisi, Ceudech, Ferrara, & Profice, 2012

Fig. 3: adapted from Twigg, 2007; U.S. Indian Ocean Tsunami Warning System Program, 2007; Chapin, 2009; and Galderisi et al., 2012

Fig. 4: adapted from Hatayama, 2007

Fig. 5: Neil, n.d.

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VISUALISATION AS A MODEL

OVERVIEW ON COMMUNICATION TECHNIQUES IN TRANSPORT AND URBAN PLANNING

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ABSTRACT

Information and Communication Technologies (ICT) changed the way planners present and operate with their projects. New visualisation tools have changed the ways projects and plans are presented and disseminated. However, the opportunities given by visualisation are not completely exploited in the professional practice. This is due to several bottlenecks which occur in the daily carrying out of activities.

The paper is organised in three sections. The first one explains how visualisation can be an added value to the planning practice if it is organised and designed as a framework of information; conceiving the visualisation as a model, data can be managed and represented in order to provide information at different levels of expertise, allowing city plans to be analysed and understood before their realisation. The second section resumes the changes caused by the introduction of ICT within the daily practice; a comparison between pre-digital and digital approaches highlights current opportunities for implementing the communication values of plans and projects. The third part illustrates some examples of innovative visualisations in the urban and transport planning practice, showing a number of uses of visualisation to fit different purposes. The paper concludes this insight formulating the necessity for integrating the studies on visualisation coming from different disciplines into a scientific method that can be proposed as a guideline in building the images of urban and transport plans. This would be particularly useful for obtaining a more scientific approach in the choices of representation and visualisation of urban aspects.

KEYWORDS

visualisation, urban models, ICT, representation.

1 INTRODUCTION

The use of technology in managing and processing different information has nowadays a strategic role in many fields of science. Latest Information and Communication Technologies (ICT) are increasing the possibilities to interact between users, to express and manipulate data, thus developing new perspectives and applications for experts.

ICT changed the way planners present and operate with their projects. In the last two decades, the daily practice framework has shifted from paper to computer screens, making visualisation a framework and technique for converting hand drawings into processed images. Nevertheless, visualisation is something more than a technical switching from manual to digital tools. Thanks to its visual properties which enable human intuition skills, visualisation can enhance the professional work in different ways. In particular, it can improve the process of knowledge building, thus making easier the communication between people.

However, the opportunities given by visualisation are not exploited in the daily professional practice. The reason is connected to several bottlenecks which range from personal skills in handling digital tools to the understanding of outcomes of these tools which are often not easily comprehensible (Couclelis 2005; Vonk, Geertman and Schot 2005; Geertman and Stillwell 2009). Furthermore, the use of visualisation is cross-disciplinary. This implies that the techniques related to its use are not defined by a systematic approach as it happens for other disciplines. In the transport and urban planning context, no common scientific standards have been defined in the visualisation field. Therefore, the building of images does not follow a pre-constituted scientific method, but it is often left to aesthetical preferences and personal choices.

This paper aims at bringing an overview on the use of new visual ICT within urban and transport planning contexts in order to analyse the relationships between the uses of visualisation and possible achievements in its application. It is organised in three sections.

The first one explains how visualisation can be an added value to the planning practice if it is organised and designed as a framework of information; conceiving the visualisation as a model, data can be managed and represented in order to provide information at different levels of expertise, allowing city plans to be analysed and understood before their realisation.

The second section resumes the changes caused by the introduction of ICT within the daily practice; a comparison between pre-digital and digital approaches highlights current opportunities for implementing the communication values of plans and projects.

The third part illustrates some examples of innovative visualisations in the urban and transport planning practice, showing a number of uses of visualisation to fit different planning purposes.

The paper concludes this insight formulating the necessity for integrating the studies on visualisation coming from different disciplines into a scientific method that can be proposed as a guideline in building the images concerning urban and transport plans. This would be particularly useful for obtaining a more scientific approach in the choices of representation and visualisation of urban aspects.

2 VISUALISATION AS A MODEL

Representation and visualisation are terms often used as synonymous, but a substantial difference exists between the two. To represent means to symbolise (Oxford dictionary) so that representation is a selection of the reality, which includes an intention and can be visually showed within a map or a shared system of signs. Meanwhile, visualisation is a term formed by the combination of the words action and visual: it is the action to make something visual. This gives to the visualisation the characteristic to communicate by visual language, which is recognised as a more intuitive and useful form of communication. In fact, it can enhance the process of knowledge building by the illustration of the hidden relationships which occur between different objects (MacEachren, Cai and Hardisty 2003; Dodge 2005). Therefore, visualisation contains the representation, but it is something more. Visualisation allows the data exploration and makes visible the connections between different elements, so that it can be considered as a framework for selecting, filtering and organising data (Masala, 2014). In this sense, visualisation can be defined as a model. Therefore, visualisation becomes a way for conveying knowledge by means of a classification of entities, reading processes and components of visualisation.

2.1 THE MODEL FRAMEWORK

The flow of information within spatial studies is based on the translation from a reality, perceived as rich and complex, to a representation of reality, which results limited and simplified but useful to illustrate an idea. This passage is the result of a modeling work that uses the brain as a filter and generates unique interpretation of the reality. For instance, a group of different people standing in front of a beautiful landscape may experience and perceive diverse aspects of the same reality, highlighting the several semantic richness of a landscape. On the contrary, a model of the same landscape, as it can be a map or whatever representation of that reality with arbitrarily chosen elements and fixed codes, returns a unique interpretation.

To build a visualisation, conceived as a visual data model, some considerations can be done.

- Firstly, it is essential to identify “physical” or sensible entities that can be objectively determined. These entities are the elements which can be assumed as variables in the model. The relationships between these entities are the information to be analysed.
- Secondly, the process of visualisation assumes that the model builds a unique relationship between data and goal. Thus, the goal is considered a guideline throughout the construction of any component of this process and cannot be considered as a separated object.

After that, the model can be structured to reach a goal trough a chain of relationships connecting different entities (fig. 1). Three entities have been identified:

- the *medium*, or device, which is the physical object that supports the message. It can be referred to a map as well as to a wood mock-up or a software image;
- the *message*, intended as information, which is limited to what is physically and objectively observable and countable;
- the *knowledge*, a target achieved by users at the end of the reading process as a determinable object, strictly related to the success and effectiveness of the visualisation.

To connect these entities each other, three relations have been recognised:

- The *reading process*, which constitutes the relationship between the medium and the message, physically observable and countable. It is determined by the visual grammar, made of signs, colours, shapes and order, and it is affected by the capacity of the human eye to read and catch different images. The visual grammar is lowly susceptible to interpretation.
- The *communication* is referred to a higher level of reading, in which the message is converted into knowledge. It is the relationship between the objects of the message and the knowledge that the receiver is supposed to achieve. It is susceptible to interpretation.
- The *fruition* is referred to the capability of the receiver to use the new knowledge acquired through a visualisation process. It strongly depends on personal skills of the receiver in using what has been learnt during the pursuing of the objective. It is highly susceptible to interpretation.

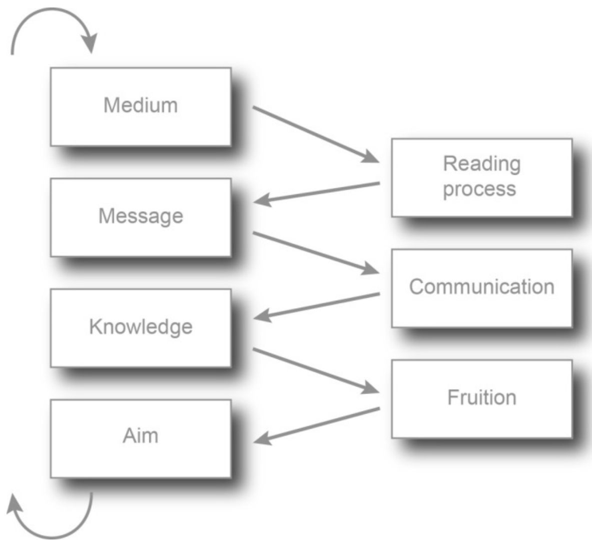

Fig. 1 Visualisation as a model: the structure of the model

However, in all cases, the process of knowledge deeply depends on two main elements: firstly, the personal skills of end-users of the visualisation and, secondly, the uniqueness of visual messages. Ambiguity on the representation, misleading information, cultural differences between actors are all factors which can affect the effectiveness of the visualisation and generate problems that can bring to a failed communication. For these reasons, the process of building a visualisation as a model requires a planned design which could organise the knowledge within a determined framework. Only through this designed framework, data can be managed to provide information at different users with different skills and backgrounds. Therefore, visualisation can be an effective support for implementing the urban and transport planning processes, allowing plans and projects to be explored before their accomplishment and evaluated by actors aware of their choices.

3 BRIEF OVERVIEW ON THE TRANSFORMATIONS INDUCED BY ICT

New Information and Communication Technologies (ICT) brought several changes on the methodologies and tools conceived for supporting the urban planners' practice. In the last two decades, all the aspects concerning the communication and acknowledgment of information have been strongly improved. The widespread use of websites and social networks has led to innovative possibilities to provide information for the general public. Meanwhile, important changes have occurred among the possibilities for the management of land use, of urban facilities, functions and morphology. In particular, ICT provide different devices for the planning and management of cities, offering instruments for modelling the cities (Batty 1976; Wegener 1994, 1995), for supporting planning and decision processes (Batty and Densham 1996; Geertman and Stillwell 2003, 2009; Klosterman and Pettit, 2005), or for structuring and evaluating the geo-graphical information within systematic frameworks (Malczewski 2006).

With regard to the past physical medium, ICT brought several innovations, which increased the number of applications and the accessibility to information. Table 1 resumes the main differences between traditional supports and digital tools for each part of the visualisation model.

For instance, an evident change is the acquired dynamism in rapidly modify the scale of a drawing or a map when needed it. This possibility may involve a greater manageability for the user and also provide the opportunity to represent different levels of detail at the same time. Furthermore, the use of a dynamic scale in time makes possible the representation of multiple dimensions and the visualisation of non-static and evolutionary phenomena, like the maps of traffic and parking availability.

	TRADITIONAL SUPPORTS	DIGITAL TOOLS
MEDIUM	Fixed scale Limited space Handy use	Dynamic scale Unlimited space Visual use Easy links to other documents
Reading process	Fixed codes Deterministic	No standard Undetermined and subjective
MESSAGE	Unique	Plural
Communication	Static and objective Not interactive	Dynamic and subjective Interactive
KNOWLEDGE	Rigorous method Limited accessibility Low ambiguity	User based Highly accessible Possible ambiguity
Fruition/use	Restricted Conveyed	Possible ambiguity Open to new applications
PURPOSE	Unique	Plural

Tab. 1 Visualisation as a model: differences between traditional paper-based supports and digital tools

In addition, the process of reading information on traditional supports is characterised by fixed codes which result more rigorous and scientific, such as the graphic elaborations of colours and backgrounds in the tables of urban master plans. Thus, users who are familiar with these codes are enabled to receive a clear, objective and unambiguous reading. On the contrary, new ICT are not yet subject to fixed codes or standards. The choice of colours, shapes, patterns is often left to the personal preferences of the technician who builds the image, so that, sometimes, the reader may be led into error because misunderstanding a subjective interpretation of the modeller.

Moreover, the use of new ICT allows a multiplicity of messages to be generated through the same graphical visualisation. This feature enables the representation of larger amount of data and consequently a richer and more detailed description of the phenomena represented. In particular, interesting possibilities are given by the use of data coming from new types of dynamics platforms, which constantly generates large amount of records known as “Big Data”. Social networks as Facebook, Twitter, Instagram, Flickr or Foursquare, telephone companies and data from User Generated Content (UGC) represent the new frontier for the analysis and design of future cities. Therefore, the plurality of data is not only a better source for gathering information, but it represents also a way for obtaining important input from different parts of the urban society, improving the bottom-up approach within the urban planning. Thus, ICT offer the opportunity to increase the social inclusiveness and participation in the urban design process, allowing new possibilities for cities to become socially smarter.

Visualisation in urban planning context can enforce knowledge, allowing the final user to be guided in understanding and becoming conscious about facts and projects concerning the planning issues. The message is carried through a virtual communication, that is no more static and objective as the traditional support, but subjective and dynamic. Visualisations through ICT can have a greater visual impact than traditional supports, so to provide more opportunities to caught decision makers' mind. Therefore, through the interaction with the information, the user becomes an active subject in the process of knowledge. As a consequence, the point of view becomes plural and connected to the perspective of every user.

As a conclusion, it is evident that the increased flexibility enables the possibility to produce more appealing and attractive visualisations, thus enhancing the capacity of communication of messages.

To be successful and provide a high level of knowledge to the final user, the construction of a visual support for decision makers with new ICT is strictly linked to the expertise of final audience. In fact, visualisation should be based on its users. Therefore, knowing the public is fundamental to resize the visualisation on audience's culture and level of experience. This is also essential to make the transmission the most efficient possible to avoid the problems of communication typical of traditional supports .

With regards to the process of fruition, intended as the use of knowledge for the achievement of the purpose, conventional supports are characterised by limited space and less flexibility than tools given by new technologies. For example, a traditional map is usually made only for one purpose limiting consequently its fruition, while new digital instruments can have a variety of purposes that extend their applicability.

In conclusion, the introduction of digital tools has increased the accessibility to information and the opportunities for implementing the communication values of plans and projects. Nevertheless, analysing the daily use of tools in planning practice shows that technicians and experts in spatial studies make a limited use of technologies. Therefore, more awareness is needed in the use of new ICT so that more opportunities can be properly exploited.

4 EXAMPLES OF USE OF VISUALISATION IN URBAN AND TRANSPORT PLANNING

To visualise the city, a process of selection and filtering of reality is needed. Therefore, a model of the city itself should be created. According to this concept, the city may be divided into three layers, by three different point of view in which urban planners take into account the complex urban fabric: the first level of the city, "*urbs*", regards the structural and physical aspect, representing buildings disposition, transport localisation, within technology network and energy resources. The second interpretation level of the city, is called "*civitas*" and comprehends the functional social and economic aspects, like the social and economic behaviour of the people living there, throughout their work place, the majors activities in town, public service lifestyle, ethnic groups and their different living places, and so on. The third and last point of view, looks at the city as a cultural aggregate, the "*polis*", expressed in its governance, in its ability to be renewed and bearing its quality of life.

As in the previous chapters visualisation has been discussed as a model for the organisation of data and information, in urban and transport planning the visualisation of a model may assume a threefold utility throughout different functions (Occelli and Rabino 2006):

- *communicating to other people* (visually expressing ideas)
- *operating policies* (evaluating projects with simulation)
- *learning problems* (showing the city dynamics and structure, points of strength and weakness).

These functions allow different levels of knowledge to be achieved by users. As discussed by MacEachren *et al.* (2003), the purpose of the visualisation can strongly affect the possibilities of knowledge building for actors involved in the planning processes. In the case visualisation aims at communicating with other people, users can just attend a presentation of data. In the second case, visualisation can support planners in operating policies by means of analysis and evaluations, providing useful information to understand the dynamics of a spatial system such as a city or a region. However, only in the case visualisation aims at learning problems, users can really achieve awareness of the city inner structure and take conscious decisions. Through the exploration of the information, users can reach a high level of knowledge about spatial issues and form a personal consciousness on questions to be solved. Then, a successful visualisation provides a support to the planners' job and helps users in visually acquiring knowledge, understanding different dynamics and strategies.

In approaching visualisation, two important issues has to be addressed: one regarding the use of the model, related to its final aim, and the other regarding the choice of the visualisation method, related to what is meant to be showed. Therefore, a matrix can be combined between city layers (urbs, civitas and polis) and visualisation purposes (presentation, analysis and exploration) (tab. 2).

	URBS	CIVITAS	POLIS
PRESENTATION	• Rendering • 3D morphological models		
ANALYSIS		• Dynamic maps • Tools for filtering GIS data	
EXPLORATION			• Semantic models • nD interactive visualisations

Tab. 2 Matrix between city layers and visualisation purposes

Analysing the physical object, that is the city as "urbs", even if ICT allow new possibilities, there are not so many innovations about information included in the model. 3D construction and maquettes are not too different from a 3d representation such as the mock-up built using CAD software (Fig.2).

Fig. 2 Physical city:3d visualisation of Milan

In this case, the visualisation operates just as a form of communication to other people, limiting its purpose to present data.

However, the difference is substantial when handling the mock-up. The classic three-dimensional maquette can be touched, moved and rotated by hands, but it is strictly connected to the physical presence. At the same time, a digital maquette can be anywhere and visualised worldwide, without needing to be in a particular physical place. It can be scaled in and out allowing free use of its form, but it can not be touched yet (gloves for virtual reality explorations have not reached yet the expected sensibility for users).

If visualisation is used to analyse the functional aspects of the city (the so called "civitas"), traditional supports present more difficulties. At this level, the information technologies can provide the maximum of support for creating visualisation models of the city. This is due to the complexity of data and the large amount of elements to be represented, which are better managed if using a calculator. For example, the analysis of specific aspects, such as the social behaviour or data streams, is better represented if the scale and the image are dynamic (Fig. 3).

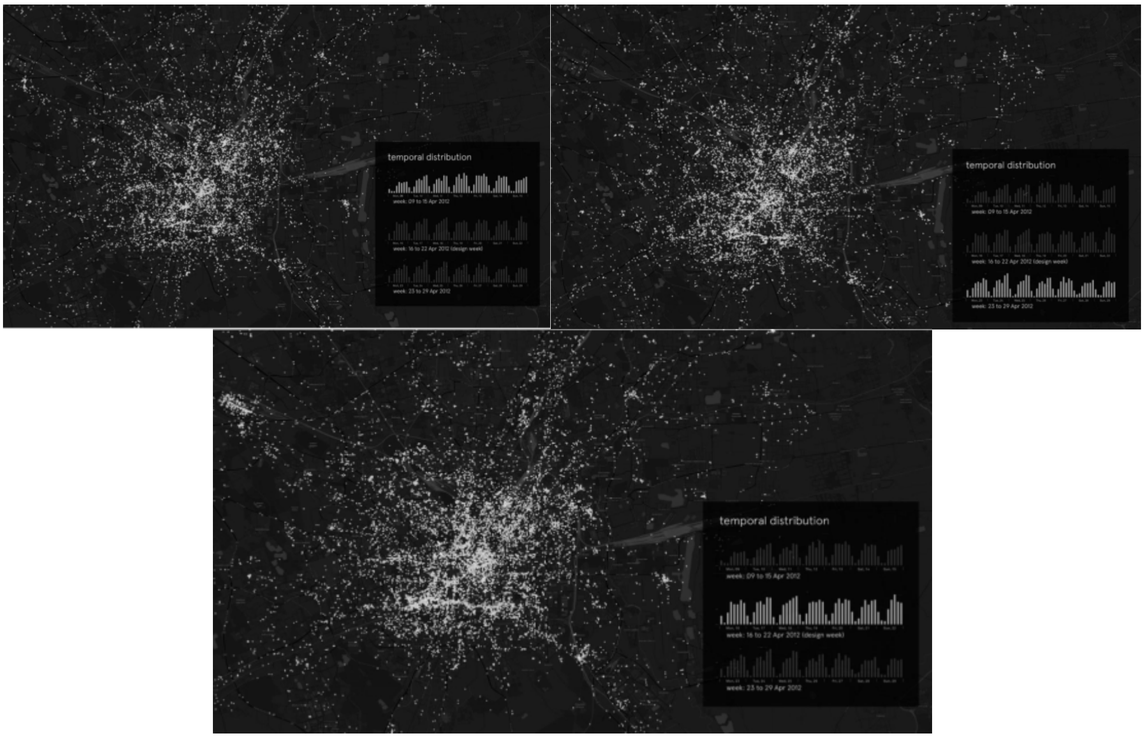

Fig. 3 Socio-economics city(maps of tweets in Milan during design week)

In this example, the use of “Big Data”, or data coming from user generated content (UGC) technologies can provide deep insights within the cities, which cannot be seen in other ways. The comparison with classic tools is practically non-existent. This kind of city model is an innovation which is possible only through a complex management of very large data base.

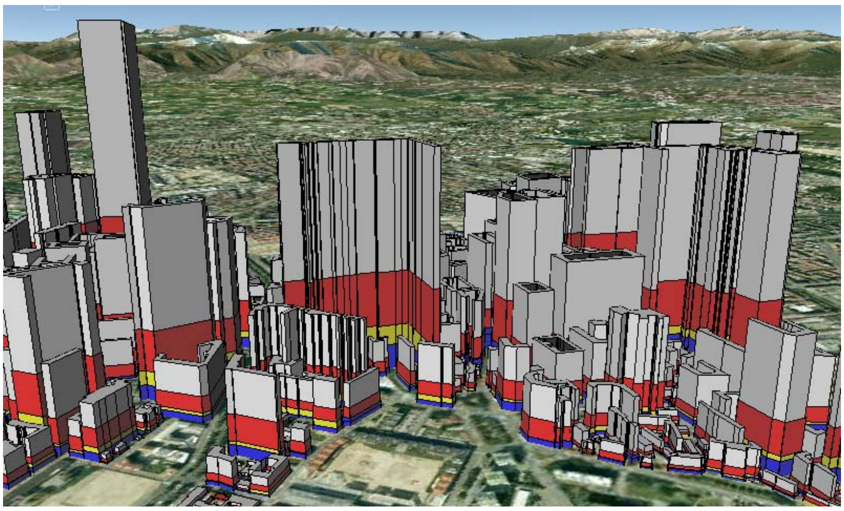

Fig. 4 Datascape for the exploration of form and function within the existing city

At the third level, the city is conceived in its ability to create a proper strategy for its own development. It is the polis, the brain of the city. In this case, visualisation can offer many advantages in creating shared visions and providing an imagery for producing common perspectives among citizens, stakeholders and policy-makers (fig. 4).

Datascapes, as well as other geo-referenced diagrams, generate information on the behaviour of the urban spaces, providing important information on the dynamics occurring within the city. This sort of images can provide leading guidelines for the construction of new visions and policies of the city, explaining which are the key elements that most affect its behaviour.

Visualisation can thus be used in different ways on the basis of pre-fixed purposes. Depending on the urban layer which has to be renewed, visualisation can assume different form and be adapted to satisfy specific tasks.

5 CONCLUSIONS

This paper introduces elements for investigating the potential of the use of visualisation within urban and transport planning. Analysing the different possible applications, it suggests the visualisation as a model to organise the process of knowledge of spatial systems. The paper proposes a method for conceiving the visual support as a framework for leading analysis, evaluations, communication, discussions and decision-making within planning processes. Nevertheless, this insights formulates the necessity for integrating the studies on visualisation in order to obtain a more scientific approach in the choices of representation and visualisation of urban aspects so to best fit the opportunities given by the use of ICT tools within the planning practice.

Additional developments from this work, that would require a more complex and deep investigation, are expected to be carried out within an International group of work, capable to link different competences and expertise such as: informatics, designers, city planners and urban engineers, who might increase knowledge and awareness on the use of visualisation within the planning practice.

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IMAGES SOURCES

Fig. 1: Authors' image.

Fig. 2: Rainer Schmidt Landschaftsarchitekten, 2010.

Fig. 3: GiorgiaLupi, 2012. https://giorgialupi.net/2012/07/01/design-week-tweets/.

Fig. 4: Stefano Pensa's image: Pensa, S. (2013). InViTo - Geovisualizzazione interattiva a supporto dei processi di decisione territoriale. PhD thesis. Torino: Politecnico di Torino.

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He is professor of Urban Planning at the School of Architecture and Building Engineering of Polytechnic of Milan. He is an acknowledged expert in urban studies, especially applying system theories and methods. His main contributions concern operational urban models, evolutionary theory applied to geographical structures and, recently, web technologies supporting multi-agents planning.

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ONTOLOGIES AND METHODS OF QUALITATIVE RESEARCH IN URBAN PLANNING

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ABSTRACT

Qualitative research can produce vast amounts of data and uses analytical categories to describe and explain social phenomena; several software packages are designed for qualitative data analysis and enable a complex organization of data. The study tests the capacity of new technology to build a formal ontology from qualitative data, in urban planning.

KEYWORDS

Formal ontology, Qualitative data, Urban planning.

1 INTRODUCTION

The last two decades have seen a notable growth in the use of qualitative methods to apply the planning rules because of the request in social fields to understand complex behaviors, needs and cultures.
From the 90s until now the concept of Planning Support System, PSS, has emerged in the scientific community. PSS studies the Information Technology and its impact on the urban planning referring to three main areas: the analytical methods and urban models to solve the complex problems at the base of the planning; the knowledge representation and the information management through the database to extrapolate specific information; the institutional aspects and the policy tools to improve the process of public participation (Rabino, Caglioni 2009a).
In this context qualitative data are a great amount. The qualitative data can be processed in many different ways (Rabino, Caglioni 2009b). The literature describes several tools that deal with the qualitative data as quantitative data to make it treatable, for instance the textual statics, the qualitative linear regression or the multi criteria analysis (HAMLET, TALTAC, LEXICO, ETC.). Also the visualization tools are suggested because they allow to represent the qualitative information using conceptual maps to show relationships between concepts graphically (IHMC Cmap Tools and its derivates). Besides these two types of instruments, recently have been proposed other software submitted as Qualitative Data Analysis Software, QDAS, for a more complex management of data using the procedures of archiving, coding and ex-ploration through queries (NVivo, ATLAS.ti, QDA Miner, Max QDA, Transana, etc.).
The aim of the paper is pointing out how this new type of technology seems to be actually tool to build formal ontology in terms of the conceptualization of the system. In fact QDA includes the two previous tools but increases the potential adding a social reflection about the data used, building formal ontologies of the qualitative objects, the PSS deals with.
In chapter 2 it is briefly illustrated the potential of the visualization, textual statistic and QDA. In chapter 3 are presented the ways in which QDAS create the formal ontology and how they include the other two previous tools. All this is put into practice in chapter 4 where, with reference to a specific case, it is shown how the ontological analysis enriches the results of textual analysis.

2 SHORT RECALL OF DIFFERENT METHODS FOR QUALITATIVE ANALYSIS

Qualitative data can be analyzed with different methods according to the specific case of work; below are exposed three of them.

- *Conceptual maps.* They are mainly graphic instruments composed by conceptual nodes (basic concepts) and logical links who connect them.

There are many software that create conceptual maps and allow the user to extrapolate, manually or using simple functions, the concepts by qualitative sources. Afterwards the user can create the conceptual map drawing the concepts and the link.
Conceptual maps are a strong method of visualization who can represent information and knowledge. The visualization of the issue is very useful because it clarifies the idea of the problem and allows a better understanding of the connection between the elements.
In addition, a conceptual map can be also used as a way of communication between different users, for example it could be adopted in a process of participation.

- *Text statistics.* They are quantitative instruments and use a statistic approach to explore the qualitative data. This method is used in text analysis and enable to find the frequency of the occurrences, the presences of a word or a group of words, and the co-occurrences, the presences of two or more close occurrences.

The frequency can be expressed as the number of times that a word appears in the source and the number of occurrences can be chosen by user or automatically by a software.

To analyze the text's content, the user can individuate the most frequent occurrences and co-occurrences in order to know the principals topics used in the sources, their relation and connection between the text itself and other topics. Another way to explore the content is the use of technics of classification that categorize the objects of the text by their difference from an ideal-object, considered as the point of reference. There are different software that use the text search method; in addiction other algorithms or methods can be also used to analyze the data statistically, one of the most knew is the cluster analysis.

- *Qualitative Data Analyses.* These methods are directed to a complex management of qualitative data, using classification, coding and exploration procedures (Coppola, 2011).

The classification procedure is a manual operation that permit to define and build a database such as an empty meta-model that could be filled after. It is usually composed of this elements: sources classification that allows to define different types of documents and stores bibliographical information about them; folders classification which provides to identify folders with their own attributes where concepts can be recorded; links classification that simply defines the nature of the relationships between folders.

After this phase, the data are filed in this database through the coding procedure: every document is tagged as specific source with its bibliographical information and every concept found by user is tagged in one or more folders and for each of them the attributes are filled in.

In this way the tables of the database, that are not other than every type of source and every folder, are gradually completed, so it’s possible to explore the whole set of data by queries. It’s often possible to produce a graphic representation of these analyses through charts, graphs, tree maps or conceptual maps.

3 QDA AS FORMAL ONTOLOGIES

In the computer science community has emerged the formal ontology, another way for processing the data to analyze the structure of a given reality in formulating a rigorous and clear vocabulary.

The main aim of these approaches is the information definition of single concepts to disambiguate all the possible misunderstandings or doubts due to different translations or interpretations in the same context of analysis.

A formal ontology represents knowledge as a set of concepts within a specific domain, using a shared vocabulary to denote the types, properties and interrelationships of those concepts. In recent years, formal ontologies have been adopted as a way to share, reuse and process domain knowledge, so they are now central to many applications such as scientific knowledge portals, information management and integration systems, electronic commerce, and semantic web services.

Now there are many informatics languages to encode ontologies (e.g., UML, Cyc, OWL) and different software that implement sets of know-ledge-modeling structures and actions to support the creation and the manipulation of formal ontologies: in this field is situated NVivo, even if this role of this software is not clear to its producers and users, that consider it just a data handling tool. The main contribution of this paper is to reveal this role, as explained in the following of the chapter.

NVivo is a Qualitative Data Analysis (QDA) computer software package produced in 1997 by QSR International, a software developer based in Melbourne, Australia (Bazeley, Jackson 2013). NVivo provides a sophisticated workspace to easily organize, classify and analyze unstructured information. Specifically, in the analysis of qualitative data NVivo helps the user to: manage the data organizing files from interviews, questionnaires and from other data formats such as audio files, videos, digital photos, Word, PDF and social media data; ask simple or complex questions of the data through different queries; show and display the concepts created and the relationships between them with a conceptual map or other visualization tools; report from the data.

Unlike quantitative software, NVivo doesn't have different types of model already incorporated as options but the researcher has to interpret the textual data and invent a model to explain the apparent relationships. In this way, the researcher's interpretations of the qualitative data are fundamental and irreplaceable.

An NVivo project is a single file that collects initial sources and nodes that are ideas or concepts linked to the data.

The nodes in NVivo enable you to extract some common themes from all the textual data stored in a specific project through the process called "coding": they can represent a specific idea/concept, a place where some interviewed live or are linked to, a single person, etc.

This process works in this way: the user catalogs the sources in nodes, each one is filled "tagging" the sentences or the words (information) from sources. The tag process not only copies the information in one or more nodes, but also connects them to their bibliographical information, the sources; it is evident that the node structure should be prepared in the researcher's mind already referring to the research questions. Accordingly, the user builds a database consisting of an empty matrix for each type of node and source and every typology has respective attributes that will be filled by the user.

This structure can be explored through different types of query, that can be based on the coding, text or attributes, and lets you examine the data using charts, models and other visualization techniques like tree map or cluster diagram to make sense of what is happening in the source materials.

It is clear, now, that NVivo includes the two main methods to analyze the qualitative data: textual statistics through queries and visualization tools through different techniques. About the textual statistics, it is possible to execute simple researches of words, sentences or concepts in all selected items, to find the most frequent words or sentences and to combine a textual research with a query based on the coding.

Regarding to the visualization tools, in NVivo there are specific functions that allow to create different diagrams to represent graphically the queries results, the similarity between concepts or directly the whole database structure like a conceptual map.

However the most important potentiality of this software is not an analysis method, but rather the previous process that try to define rigorously the treated system like a formal ontology. The codify in fact is first a conceptual process because it allows to define specific concepts whereby to provide a rigorous vocabulary that can be shared by the users. In addition, building the database, and so the tables of nodes, NVivo creates relationships between concepts through the attribute values in common.

It is evident, now, how NVivo is more complete than a simple textual statistic or visualization software because, if it is true that in NVivo the textual statistics and the visualization tools are not the main topic and have not an immense development, it is also true that a sufficient and basic smattering about them is present and that they are useful to support the user in the process of building of formal ontologies, searching hidden relationships between concepts.

4 CASE STUDY

The case study is an analysis made by Rabino and F. Scarlatti in 2006 (Rabino and Scarlatti 2006) about the "mental image" of a territory (namely Lecco and its province), obviously a highly qualitative and subjective information. The aim of the study was the identification of the image of Lecco in people's mind. It was conducted proposing to some people with different features (age, gender, work, qualification and residence) one open questionnaire about the feelings that Lecco and its province arouse to them.

The chose method to analyze these interviews was the textual statistic, executed through Hamlet software, thanks to which it was possible to find the most frequent words and consequently to create a vocabulary of nineteen concepts: beauty, city, decay, highway, industries, lake, landscape, Milan, mountain, no_parking, Politecnico, pollution, problems, province, territory, The Betrothed (i.e. I promessi Sposi), traffic, tourism, work.

After a simple statistical analysis, the most frequent concepts in the questionnaires resulted mountain, lake, traffic and highway, instead the most recurrent co-occurrences were lake-mountain, lake-tourism, mountain-traffic and city-mountain.

Moreover, Hamlet allowed to apply the cluster analysis and the multidimensional scaling to the vocabulary, therefore it was deduced that the most related concepts were lake-mountain, traffic-pollution, traffic-lake, pollution-no_parking and traffic-no_parking.

It will be presented now the application of NVivo to this case study to compare and extend the Hamlet's results: it must be remembered that this analysis was realized on summaries of the questionnaires because they were no more available: it explains in part the little dissimilarities that will be found between the two studies.

First of all, the summaries of the questionnaires were loaded in NVivo and was created a node for each of them, composing the database to be queried: for every node it was defined the attributes gender, age, profession, instruction and residence of the interviewee.

Later were built nodes of occurrences submitted above and of the most frequent co-occurrences found in the analysis with Hamlet: lake- mountain, town – work, no_parking – traffic, pollution – traffic, lake – tourism, lake – Politechnic, town – mountain, pollution – lake, work – tourism, mountain – Politecnico, lake – traffic, lake – town , mountain – traffic, lake – highway,highway – traffic, mountain –highway, mountain – tourism, traffic – no parking.

In the occurrences research it was used the vocabulary implemented in Hamlet, in which the single concept was defined through its synonymies, instead for the co-occurrences were researched the two occurrences which were away maximum seven words between them.

If in the occurrences research the results are the same, in the co-occurrences one there are some differences probably due to the lack of the entire questionnaires and to the different implemented function for the textual statistic.

Accordingly, were analyzed the main concepts through cluster analysis to show the relations between them.

In figure 1 is described the dendrogram of the occurrences showing the level of similarity of the different concepts: it proves the Hamlet's output, except for lake-traffic for which is not underlined the relation.

In the end it was interrogated the database through queries on the attributes values and the results were visualized with graphs. For example the figure 2 shows how the four most frequent co-occurrences are present in the questionnaires according to the values attribute provenience. It is clear that this software lets execute a more detailed and entire analysis regarding to the case study, providing a wider framework than a simple textual statistic.

The example of application exposed how implicitly NVivo, building nodes of occurrences and co-occurrences creates two formal ontologies; in fact, especially in the co-occurrences, the software forces the user to define rigorously what combination of words correspond to that co-occurrences. It is also clear now what is the potentiality of the database that links different concepts and that the graphs and the textual statistics are tools to analyze better the system defined by the formal ontology.

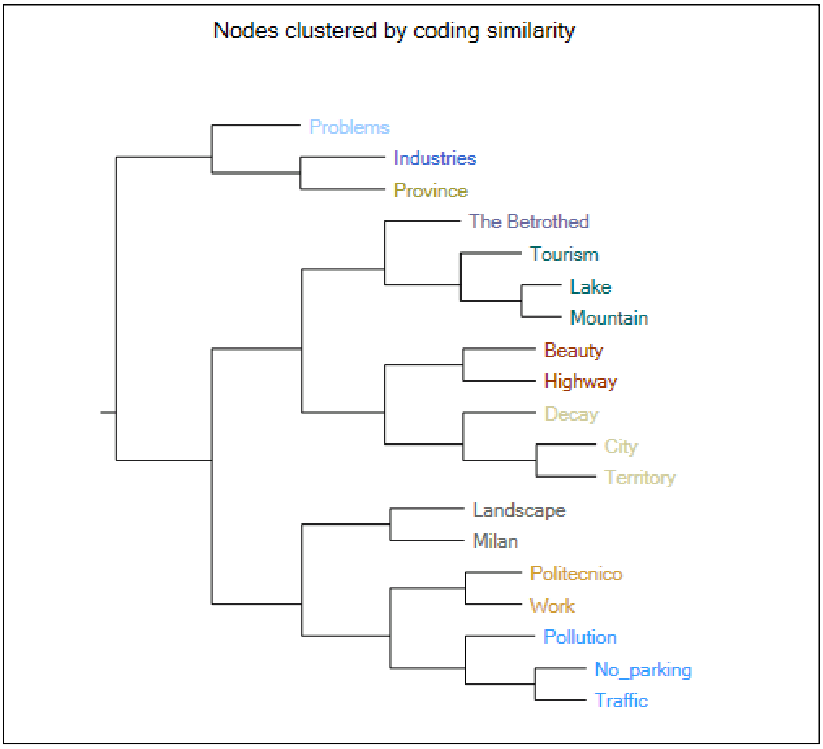

Fig. 1 The dendrogram of the occurrences

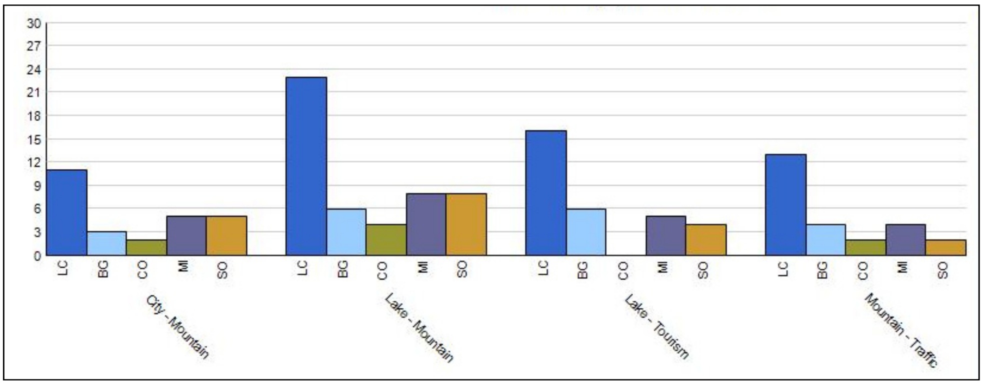

Fig. 2 Query that shows how the four most frequent co-occurrences are present in the questionnaires based on provenience

5 CONCLUSIONS AND FORESEEN DEVELOPMENTS

The discovery of intrinsically conceptualization implemented by QDA during the process of classification of data is of paramount importance. In fact, it allows to disambiguate doubts and different interpretations about concepts and to explore in great detail the information and their relationships, thanks to a comprehensive and structured storage of the material.

It would be useful making an entire application starting from the beginning, from the analysis of the sources. In this way it would be possible to confirm the thesis proposed in this paper, especially in a decisional participative process where there are some non-quantifiable questions and problems (in environmental, urban, cultural field) that require to put together different points of view.

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IMAGES SOURCES

Fig. 1: Authors' image.

Fig. 2: Authors' image.

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CITY/SEA SEARCHING FOR A NEW CONNECTION

REGENERATION PROPOSAL FOR NAPLES WATERFRONT LIKE AN HARBOURSCAPE: COMPARING THREE CASE STUDIES

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ABSTRACT

The port is a strategic area of transition, where it is possible to perceive the territory-landscape and the urban front. However it lost its urban character, gradually becoming an high specialized independent machines, a sectorial infrastructure divided from the city: this phenomenon has created increasingly socio-economical marginalization. Within a double view, lengthwise and transverse, we can describe the port as a space closed to the city and as an unfathomable barrier for the transverse flows that previously connected the waterfront to the city.

The paper examines the case study of Naples, where the port expansion continues to grow without any integration with other parts of the city, distorting its “urban area” role, establishing its independence and making urban system compatibility conditions even weaker. The functional and physical division increases the perception of the port as a barrier rather than a filter.

Turning the sense of these conditions aims at rethinking waterfront as a public space, a place where integration and specialization spaces become new open and accessible spatial devices. In some contemporary European and American cities (Aalborg, Oslo and Toronto) we could see the port as multifunctional system, an interdisciplinary project that creates urban spaces integrated to the city and that allows the coexistence of different uses. The project of a new public space between the sea and the hinterland could involve all these conflicting functions creating, with different strategies, a potential multifunctional landscape. In Naples as well, where the waterfront is still waiting to be re-connected with the story of the city itself.

KEYWORDS

Harbourscape, waterfront, regeneration

1 HARBOURSCAPE BETWEEN SPECIALIZATION AND PUBLIC SPACE

1.1 TWO KEY NOTIONS

Talking about urban waterfronts and port areas, landscape and public space is a key notion in a contemporary debate about cities.

The port is an area of transition, a strategic area where the city becomes landscape. The port infrastructure turns into an access device, a place where it is possible to perceive the territory-landscape, the shore line and the urban front, a line with different dimensions but, at the same time, an incredible depth.

In the past, port areas have represented an amazing public space for the city. However, in the course of time, they lost their urban character, gradually becoming high specialized independent machines and taking out every activity and every function not essentially related to their internal function.

Today the port area has become a sectorial infrastructure divided from the city, that creates marginalization and urban blight, not only in its proximity, but also next to the infrastructures that connect and, at the same time, divide the city from its waterfront.

In the contemporary[1] European city we could see the port as multifunctional system, an interdisciplinary project that creates urban spaces integrated to the city and that allows the coexistence of different uses. The project of a new public space between the sea and the hinterland could involve all these conflicting functions

Integration and cross-sectorial strategies are the keywords for a different concept of these areas as a landscape and a public space. We need to extend the *multifunctional landscape*[2] concept to the port's waterfront and reconfigure it working on any material that links, on a larger scale, its identity to a territorial government.

The port is, potentially, landscape and public space: its shape, its position, its history, its shore line connection, its nature of a public space as an extension of the city into the sea, define its social and urban character.

1.2 A DOUBLE NATURE AND A DOUBLE INTERPRETATION

We can think the port area as an *independent machine,* regulated by laws and rulings into his spatial and authority enclave, but also as a *part of the city*, as a natural extension of spaces and fabrics that characterize the urban morphology.

We can read the port of the contemporary city with a double view: lengthwise and transverse. The port's waterfront combines specialized areas that lost the characteristics of a place, sectorial but still relevant rationality remains and irregular zones, and contemporary city's critical and potential materials in need to be understood through a perceptive and functional interpretation of spaces.

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[1] From the 1980s a different integration to the existent city throughout the remodeling of port areas was really frequent. Examples like the Moll de la Fusta in Barcelona, the London Docklands, the Amsterdam Eastern Docklands, the Kop Van Zuid in Rotterdam and the Hafen City in Hamburg, prove the amazing urban potential of the waterfront as an opportunity of urban and social regeneration and of reconstruction of integrated parts of the city.

[2] Multifunctional landscape is a concept related to ecosystems, where sometimes the ecological function has to become compatible to different and usually incompatible uses. These type of studies are usually agricultural or – when working on the city – greenways oriented, especially in the US landscape, as structures "planned, designed and managed for multiple purposes including ecological, recreational, cultural aesthetic or other purposes compatible with the concept of sustainable land use". (Ahern J. F, 2002).

Lengthwise, because the port is a space closed to the city, between its enclosure and the sea. It is an unfathomable zone organized on the basis of connections between different parts, areas, elements, buildings, characterized by functional reasons often without any link to the urban context, except for the infrastructure that allow the access and the crossing of the internal space. The harbor enclosure has monitored access and imposed direction of travel that define – lengthwise – an inner organization of linear series of volumes, of enclosures and buildings, describing the urban waterfront as a composition of large buildings, linear infrastructure and functional centers.

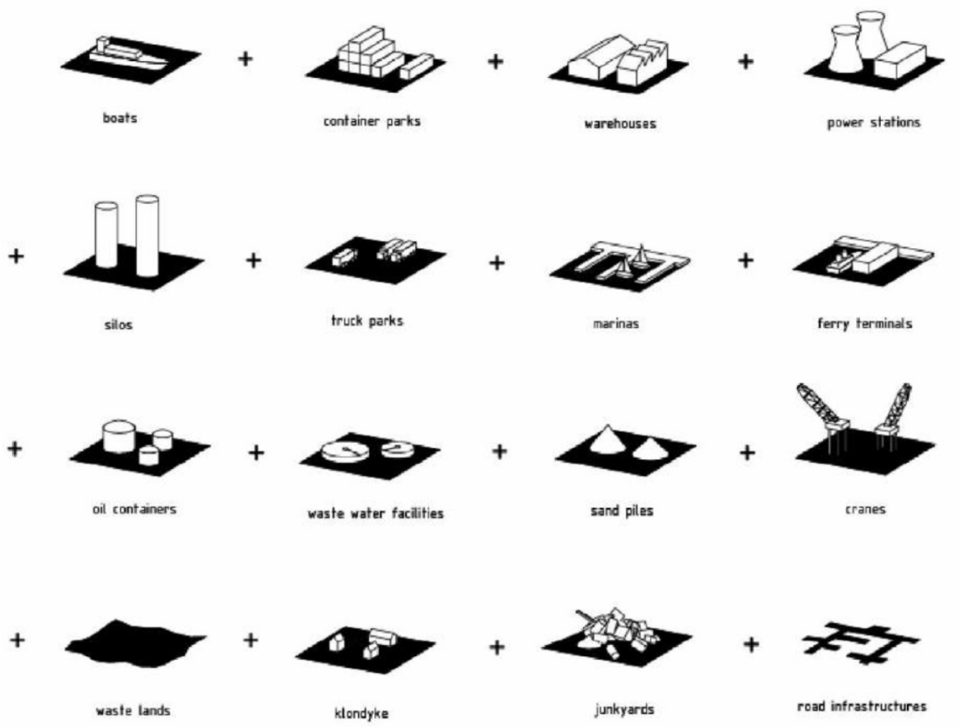

Fig. 1 The Industrial Waterfront – a mono functional structure but with an astonishing wealth oftypologies

Lengthwise, the harbor subdivision works on the architectural perception of sequences: maritime station, support facilities, Ro-Ro handling platforms, warehouses, offices, silos, military buildings, shipbuilding, dry docks, large tow trucks and gantry cranes, cargo platforms, multifunctional and multicolored buildings. Lengthwise, the port is an infrastructure governed by a sectorial rationality and efficiency logic.

The historical port – as a natural waterfront extension – was a place of social, public and commercial activities, with no distinction between public and specialized spaces.

The perception of the waterfront as an open and public space was modified permanently by its progressive strengthening and expansion, creating an unfathomable barrier for the transverse flows that previously connected the waterfront to the city. This created a city-port dualism, from a morphology and transformation process point of view.

The functional and physical division increases the perception of the port as a barrier rather than a filter. The port zones are now unfathomable industrial and manufacturing enclosures, large platforms isolated from the context and crossed by railways, viaducts and highways, full of logistical platforms and large parking lots.

Turning the sense of these conditions aims at rethinking waterfront as a public space. A place where integration and specialization spaces become new open and accessible spatial devices, able to host urban related functions, not only specialized ones, with a project that works on hidden layouts and potential spaces, to reinvent the continuity and the identity of the city.

The integration between these two dimensions is related not only to the port morphology, but also to a different concept of uses and functions, rethinking the port waterfront as an urban regeneration “uncommon machine”, as a landscape infrastructure, as an accessible public space system integrated to the city.
The port-city interface doesn’t have to be restricted to the redesign of specialized area edges, but has to orient the project for the port functional areas, for its spaces and urban infrastructure, outsourcing some parts if necessary.
The *harbourscape* concept, analyzed in the following paragraph, is an history and urban culture meeting place, characterized by attractive and public uses; a space that have a strategic place in the urban territory and that give an identity to this part of the city thanks to the perceptive and functional integration between the environmental part and its historical footprint.

2 CASE STUDIES

2.1 NAPLES: AN HARBOURSCAPE SEARCHING FOR ITS FOUNDING VALUES

Harbourscape emphasizes the idea of a city characterized by the relationships between the historical layout, its urban identity and landscape, as a city palimpsest. A similar neologism is used describing the later mentioned waterfront regeneration project in Aalborg by Hans Kiib[3].
Identifying the port with the landscape and with historical images, means that the waterfront is not an “uncommon machine” anymore, but a part of a larger system that includes territorial and environmental components: this slip of meanings transforms the prospective of a landscape components recycle.

Fig.2 Lengthwise functions

The Naples port is a point of view where it is possible to look up to the environmental landmark, the Vesuvius and the Gulf of Naples (from Posillipo to Sorrento coast); but it is also the fabric of a stratigraphic city, with its monumental front and its urban architectures. It is important to rethink specific waterfront functions and their accessibility, creating “functional platforms” like spine paths and spaces overlooking the

3 Kiib, H. (2007), *Harbourscape*, Aalborg University Press, Aalborg.

sea, where the functions are mixed and not specialized, the enclosure is not interrupted, like Maritime station and local passengers docks: public spaces that – like railway and subways stations – represent big attractors with different flow types.

It is possible to create and improve a "water community" working on lengthwise functions and city morphology, using different functions able to create new accessibility from the city. This community – meant as a community interested in the waterfront requalification– could be able to act on the port area revitalization, with the actual engagement of different stakeholders.

Traditionally, the lengthwise direction – focused on the port-system – is characterized by companies' interests and entrepreneurial subjects. The transverse direction inverts this perspective, connecting the public and private sector. The main problem still remains a Port Authority largely influenced by ship owners and other subjects, unfavorable to the port opening to the surroundings and to a mixed and porous layout. The port is still a contented space, sector managed in opposition to a wide opening, to a re-discover of identity values, to an actual multifunctional role.

In addition, the port expansion continues to grow without any integration with other parts of the city, distorting its "urban area" role, establishing its independence and making urban system compatibility conditions even weaker.

In the last 20 years, a development prospective has been carried on, with the hypothesis of large infrastructural works. In opposition to the port enlargement there is a less sustainable scenario, related to the vehicular congestion problem that could be determined on the back of the port, close to the other regional logistics platforms. This could create a progressive breaking with the urban fabric and the degeneration of the spaces near the specialized port enclosure.

Fig. 3 The port enclosure

Without a project, the port machine keeps on going, creating problems not only for the potential port-city integration, but also for minimal conditions of mutual compatibility.

However, in an integrated system vision, Regione Campania developed il Progetto per la Portualità Turistica (2003), related to the entire Campania riverside, spacing from Garigliano river estuary to Sapri port, including the harbour of Torre Annunziata, Castellammare, Campi Flegrei, etc. The gulf of Naples is at the core center of this network, claiming for its environmental and cultural characteristics. Primary goal of the Project will be the recovery of local ports, with their facilities, services, the enhancement and the expansion of maritime inter-connections, the creation of new boat points, in a complex design in order to rationalize mooring system.

2.2 THE HARBOURSCAPE PERSPECTIVE AND PARADOX: AALBORG (DENMARK)

In the city of Aalborg, part of the Waterfront Communities[4], the port is, at the urban scale, an interesting meeting between the town and the fjord landscape/sea, representing an interface between the local life and the rest of the world, an *Harbourscape*, as in the words of Hans Kiib, who studied this case. Since 2005 a series of workshops and conferences at Aalborg University were made, to find a strategy to give to the city new public spaces, recycling disused port areas. The aim was to develop visionary concepts and design proposals, emphasizing the development and the regeneration of the waterfront in a multiscalarity vision. Four central themes were presented, summarizing the challenges for the twin-city waterfront development: the “multifunctional programming”, “The Harbor as the Core Urban Space”, “The Harbor as a Big Stage and a Public Domain of the Fjord-Side Town”, and “Designing Ten Public Domains along the Edge of the Fjord”.

The regeneration process originated from a comprehensive understanding of the history of the genuine landscape of the waterfronts, developing the unique qualities of the existing architectural typologies, and providing a range of conceptual models for alternative waterfront development to recreate a new waterfront-city integration. The key point of the project was to transform the harbor from a privatized industrial zone into a public domain for the citizens, guaranteeing the population to continue its everyday life and activities.

During the workshop, two teams among the others presented unique conceptual developments, working on a sort of reverse thinking in a paradox approach: the ‘Spine’ and the ‘Bridging’ project. The paradox is that Aalborg city consists almost exclusively of one typology of urban structures and buildings, a homogenous city with a multitude of programs. At the harbor, on the other hand, there are many different typologies, but only one industrial program. This means that the number of typologies is not related to the number of programs and that the harbor can be an opportunity to create different typologies for the inner city.

The Spine project approaches firstly urban life, secondly urban spaces, and finally the edge and buildings along the harbor, not treated as building-volumes, but as edges and frames for the public space, every spaces is modelled on urban life conditions and on providing space for life and contact between inside and outside, the public and the private sphere.

In the Bridging Project they appoint larger areas with recreational purposes, parks and public facilities, using a big amount of un-restored buildings (a surplus landscape) for cultural applications, galleries, temporary functions as summer restaurants, concert halls and other types of events, as a cultural magnet.

Using the hybrid bridge as a metaphor, they connected a traditional economy to the new one and merge traditional private urban spaces with new types of public domains, basing the development of the city on knowledge and culture instead of industry.

2.3 CORE CITY WATERFRONT AND FJORD CITY: OSLO (NORWAY)

The redevelopment of Oslo’s waterfront moves from the need to give back the waterfront to the city and this was made possible by a strategic vision based on a regional scale that brought to the outsourcing of the industrial port.

[4] The project aims to improve waterfront development in nine gateway cities around the North Sea. It will be implemented along three themes: develop a learning network; meeting strategic objectives; setting standards for urban and social design quality. Specific focus will be laid on sustainability and social inclusion.

The accessibility to the waterfront as a public urban area was realized through the redevelopment of spaces partly occupied by still operative and vital infrastructure installation (port, railways and road). This operation allowed reestablishing a contact between the citizens and the waterfront, as a multi-uses working machine but also as an actual public space of the city.

Three main interventions encompassed the social and physical transformation of the contemporary city: the *Festninggstunnelen*, new district in place of industrial manufacture like of Aker Brygge and new important architecture as place of interest.

At the end of 1970s the old arterial roads were saturated, the entries to the inner city and the center itself were severely strained by cars: a comprehensive solution was proposed leading traffic under the ground. The *Festninggstunnelen* (opened in 1990) was a key project to reduce the traffic load and improving the environment in the city center. It also made the western waterfront more attractive by overcoming its "isolation" from the urban core.

Aker Brygge was the site of city's largest industries and was the first out of 16 industrial areas in Oslo that had to be converted. After an architectural competition in 1982, the pier was transformed into a dwelling area, characterized by exclusive housing with an articulation of public, semi-public and private spaces: the concept was "City Collage" with mixed uses. The public and private partnership was essential for financial investments to realize the new district.

Fig. 4 Befor and after the project of the waterfront

The New Opera House project, located in Bjorvik in addition to two other cultural buildings close to it, the Munch Museum and the new library building, is at the center of the project of "spectacularization" of the waterfront. New attractors were positioned in a symbolic way as a new core of the city. One of their main intentions was to provide an open space between the waterfront and the city behind, guaranteeing to eastern neighborhoods a new access to the water. As already mentioned, in order to reach that goal a series of heavy installations had to be removed: port installation needed to be relocated also from the eastern waterfront.

In addition to the program for the planning and for assessment process realized until 2008, the City Council adopted The Fjord City plan. The development plan represents the attempt to consider regeneration of the waterfront as a process that involves the all fjord coast requiring a global vision.

The waterfront promenade will be one of the key attractions and will provide public access to the sea. It will be open to all and attract a broad group of users thanks to its universal design and rich range of activities and recreational facilities.

The fjord tram will ensure good access for all to the Fjord City and its functional and symbolic effects will help to make the waterfront, parks, streets, plazas, commons and other open areas more accessible to the public.

2.4 WATERFRONT RECOVERY AND PORT NEW LIFE WITHIN THE CITY FUTURE: TORONTO (CANADA)

Lake Ontario, after a century of de-industrialization and industrial pollution, needed to be rethought in its relationship with the city and the inhabitants. Toronto the main city of the Ontario region is one of the most involved in redevelopment.[5] During the last decades five districts of the waterfront of the wider designated waterfront area (DWA) of Toronto, were interested by a redevelopment policy through a plan for environmental improvements, economic activity and overall enhancement of quality of life.

Fig. 5 Waterfront districts in redevelopment

Revitalization of the waterfront area meant to deal with soil that has been impacted by decades of industrial uses, when environmental standards were not as stringent as today. Post-fordist drosscapes (Berger, 2006) of the Toronto waterfront became a chance to give a new and wider meaning to the concept of the environmental "smartness" in which the landscape actively contributes to the ecosystem improvement and balance.

Waterfront renewal was officially launched in 1999. The "Waterfront Revitalization Task Force", a task force of the City of Toronto, involving the Government of Canada and the Province of Ontario was established in the same year to study the future of the Toronto waterfront. Great emphasis was given to the target of landscape in the meaning of providing a clean environment by improving water quality, cleaning up contaminated soils, eliminating the risk of flooding and naturalizing appropriate areas.

In 2001 the Toronto Waterfront Revitalization Corporation (later renamed Waterfront Toronto) was formed to oversee and lead waterfront renewal. The organization is directed to support many different goals, from the redevelopment of brownfields and the contaminated land cleanup to the growth of a competitive and sustainable economy based on a compact growth. Various other initiatives have been promoted for the revitalization of the area, including public transit, housing developments, possible removal of the Gardiner Expressway that today separates the city and the waterfront, lakeshore improvements and naturalization of the Don River. At the same time private investments have been fundamental to build a strategic and incremental system. The city gave building rights in exchange for lots to create and improve the open public space system.

Some of the most interesting aspects of the redevelopment were the ability to intersect interests of different stakeholders, to include the citizens in a participated planning and to set a multiscale and multi-sectorial vision, also in the long term view. For example a section of the West Don Lands will be utilized for the Pan Am Games Athletes' Village and then transformed in mix-use neighborhood after the 2015 games.

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[5] Toronto as part of the Great Lakes "manufacturing belt" has been for long time one of the most productive area of the Ontario region. Chemical, automotive and metallurgic sectors were driving the local economy. At the same time a strategic location close to the main North American industrial towns and waterways, made the Toronto harbor dynamic and competitive.

In 2006 West 8 international office won the competition for the central waterfront masterplan proposing a new "Multiple Waterfront" to improve the access to the waterfront and the quality of public spaces: the Primary Waterfront – a continuous water's edge promenade with a series of pedestrian bridges, the Secondary Waterfront – a recalibrated Queens Quay Boulevard with a new urban promenade and public spaces, the Floating Waterfront – a series of floating elements that offer new boat moorings and public spaces in relation to the lake– and connections from Toronto's diverse neighborhoods towards the waterfront.

In 2007 Michael Van Valkenburgh Associates elaborated a masterplan for the Lower Don Lands post-industrial site, which unites transformative landscape methodologies with innovative scientific approaches to natural reclamation and makes them operational at the scale of the city and the regional ecology. Both the urban and the natural elements of the landscape are seen as having the potential to introduce complex new systems to the site that will evolve over the course of many years characterizing the development of the neighborhood.

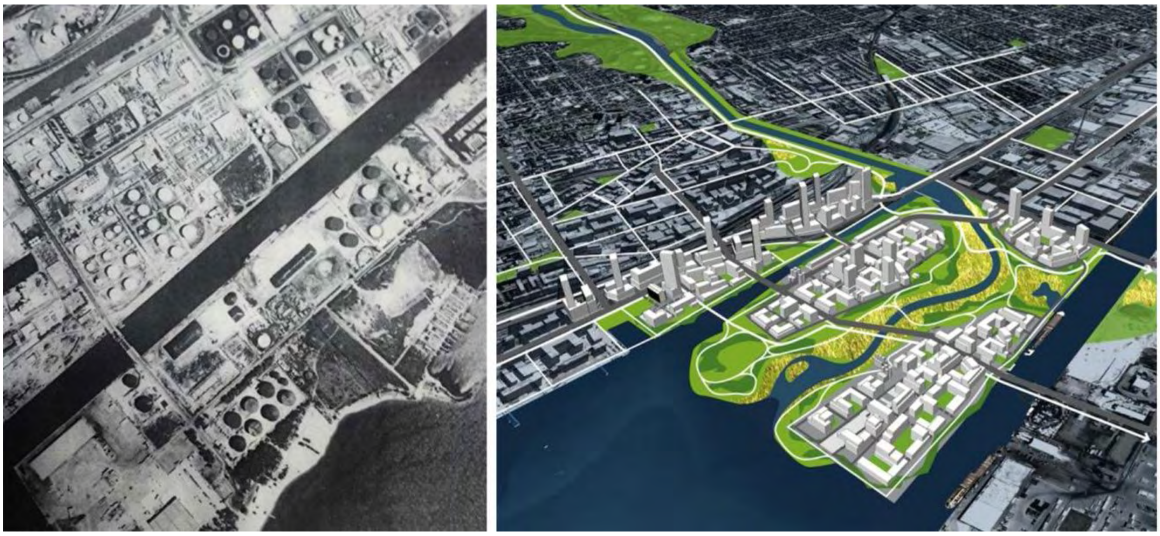

Fig. 6 Lower Don Lands post-industrial site aerial view (1970) and 2007 masterplan by MVVA

3 PRINCIPLES AND POSSIBLE STRATEGIES

Case studies of regional and urban resilience models have been discussed across scales in two countries, two in Scandinavia (Europe) and one in North America (Canada). The towns in Scandinavia and Canada are extremely different as landscapes—politically, financially and in scale. None of them have been through a crisis to the extreme nature as that of Italy and Naples waterfront. Conversely, the cases are presently in the world's wealthiest nations on earth, but each is facing a serious transformation due to the change of the waterfront role after the worldwide de-industrialization process, the closure of factories and the dislocation of harbour activities.

Landscape and public space become driving forces to rethink the port system, defining the waterfront not only as a working machine, but as an actual space of urban identity, connected to the city.

Analyzing the three case studies, some principles may be defined, in a strategic orientation for Naples waterfront too, which is still waiting to be re-connected with the story of the city itself:

- Port in a multiscale logic:

  A multiscalarity vision represents a necessary framework. At metropolitan scale it is possible to rethink the port functions in a regional system, with the possibility of some areas and functions decentralization. At local scale it is possible to create mixed uses along the waterfront (maximizing the public use of the open space). Thinking over port-city relations aims at working on different dimensions, physical and immaterial.

- The waterfront multi sectorial *governance*:
  A subjects co-planning aiming at a common purpose is necessary. Strategic planning related to the waterfront development and combined with architectural, urban space, lighting and parking policies. Multifunctional programming has the advantage of allowing space for programs that assign priority to activities, such as existing industrial and artisan areas, and harbor-related cultural landscapes and event spaces, but also spaces for working and living.
- Waterfront-city integration:
  It is possible to think over the whole urban system, working on ongoing projects and especially on interstitial areas, as an urban regeneration of relevant projects areas. Instead of low density development, this would lead to a concentration of the construction work on a few new spots and to leave the larger areas for recreational purposes, for parks and spaces for alternative applications. Old industrial buildings have proved to be extremely well-suited to cultural applications, galleries, temporary functions as summer restaurants, concert halls and other types of events, etc.
- Partnership as an implementation model (economics and financial):
  Co-planning and partnerships represent the only possible implementation model (urban, economics and financial) for the port waterfront regeneration, that could become an attractor for new activities, flows and private investments.
- Landscape as a device:
  We could use the landscape concept with its multidimensional and multifunctional value, pinpointing and correlating morphological, historical, physical and natural characteristics in a complex and stratified territory. Landscape perspective is founded on the idea that waterfront areas aren't neutral, they simply can't be because, too much has already happened within their influence. Nowadays they have a great opportunity of reconstruction of relationships with open spaces and green areas system, through a wider approach of landscape ecology and urban metabolism.

NOTES

§ 1 by M. Russo. § 2.1 by M. Russo and S. Castiello. § 2.2 by S. Castiello. § 2.3 by C. Di Marco. § 2.4 by M. Prisco. § 3 by A. Attademo and M. Russo.

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Fig. 1: Kiib, H. (2007), *Harbourscape*, Aalborg University Press, Aalborg.

Figg. 2, 3: by Susanna Castiello.

Fig. 4: Municipality of Oslo / http://www.bjorvikautvikling.no.

Fig. 5: http://www.waterfrontoronto.ca.

Fig. 6 left: http://www.portlandsconsultation.ca /. Fig. 6 right: http://www.mvvainc.com.

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SENSITIVITY ASSESSMENT.

LOCALIZATION OF ROAD TRANSPORT INFRASTRUCTURES IN THE PROVINCE OF LUCCA

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ABSTRACT

The work, result of a research carried out in collaboration with the Chamber of Commerce of Lucca, aims to implement a tool for the evaluation of positive and negative effects arising by the “widening” or “new construction” of road transport infrastructures in the territory. In particular, with respect to the impacts generated by the project actions relating to the construction or widening of roads, the research has produced several sensitivity maps of the studied area and a graphical interface, accessible on the Internet and user friendly, allowing the synthetic evaluation of the impacts and the comparison of different scenarios

The implemented methodology, through the use of advanced tools for data management and processing and for impacts quantification and assessment, has allowed us to define a very detailed database related to all components of study area, both natural and anthropic, and to build a "synthetic sensitivity index", obtained from the combination of thematic information about each component and from the relationships that involve each others. It’s therefore to consider an indispensable support tool for planners and evaluators (eg. SEA procedures), but also for others users (eg organizations representing businesses, consumer associations, etc.). In fact it allows to acquire a deep knowledge of the area (environmental and economic resources), to verify the sensitivity of each part of the area with respect to a series of project actions concerning both the construction of new roads that the widening of the existing ones and finally to evaluate different localization scenarios for the same type of project or different impact scenarios for the same localization

KEYWORDS

Evaluation assessment, impact scenarios, localization scenarios, territorial sensitivity, road construction

1 INTRODUCTION

The present research has been developed within an Agreement between the Department of Civil Engeneering of University of Pisa and Chamber of Commerce of Lucca and is aimed to analyze and evaluate the sensitivity of the area of some municipalities of Province of Lucca with regard to the localization of road transport infrastructures.

The research has been developed by the authors of present paper and others (Claudia Casini, Massimiliano Petri, Diana Poletti, Alessandro Santucci and Diego Guidotti); it has been articulated in four steps, that we describe below.

The first step, named “Analysis”, is aimed to individuate the actions related to different phases of construction of road transport infrastructures that can produce some significant impacts (positive or negative) on environmental system, and to create a territorial model through which to be able to develop the following phases of the evaluation: this first step is described in Chapter 2.

The second step, named “Individuation of Environmental Factors”, is aimed to identify environmental and social-economic elements and sub-elements susceptible to be modified by the previously identified actions.

The third step, named “Individuation of Impacts”, is aimed to identify impacts on environmental and territorial system during the phases of construction and exercise of road transport infrastructures, to quantify each of these impacts in a suitable numerical range and to represent them through georeferenced geographical maps.

Each of these impacts between actions generated in building and environmental elements is represented by a “X” within an “impacts Matrix” and will correspond to a georeferenced geographical map of sensibility of the whole study area, in which to each cell correspond the value (included in the range 0-1) of the impact produced by that action on that environmental factor.

The fourth step, named “software construction”, is aimed to built a graphic interface in which, after drawing the layout of a road transport infrastructure, we can visualize, for each environmental factor, a positive or negative index able to quantify the impact of that specific infrastructure on that specific environmental factor: these impact indexes can be calculated considering different points of view, by assigning different weights to the different environmental elements of building actions. The steps 2, 3 and 4 are described in Chapter 3; in Chapter 4 an 5 we describe the analysis related to two specific Environmental Elements, namely “Air” and “Social-economic System”.

2 ANALYSIS AND MODELING OF THE STUDY AREA

2.1 KINDS OF INFRASTRUCTURES AND PROJECT ACTIONS

The classification of infrastructures is the same reported between the Ministerial Decree 5/11/2001 "Functional and geometric rules for road infrastructure construction". In particular we consider:

1) highways and main roads presenting an high capacity and checked accesses, with daily flows between 30.000-40.000 vehicles/day;
2) primary roads, urban and not, with same dimensions of roads in 1) but with continuous accesses along the path and daily flows between 20.000-30.000 vehicles/day;
3) secondary roads with smaller dimensions, with daily flows between 10.000-20.000 vehicles/day.

The impacts have been calculated considering two different kinds of works, namely “New construction” of new roads or “Widening” of existing roads: therefore, six typologies of interventions have been considered (3 kinds of roads for 2 kinds of interventions). In order to select project actions related to the two kind of interventions described below, an analysis of all steps (construction, exercise, maintenance) related to the working of road transport infrastructures have been performed, obtaining six specific actions, namely:

- phase of yard: cleaning of the site, excavations or terrain modifications, material provisioning and disposal;
- phase of exercise and maintenance: ground consumption, traffic flows, variation of accessibility.

2.2 THE STUDY AREA

As study area we have considered those territories of Province of Lucca that are interested by a diffuse and massive urbanization, mainly for what concerns industrial, commercial and tourist locations that present relationships in order to the development of activity that can have impacts on traffic an economic systems. The resulting municipalities are: Lucca, Capannori, Montecarlo, Altopascio, Massarosa, Viareggio, Camaiore, Porcari, Pietrasanta, Forte Dei Marmi, Seravezza, Pescaglia, Borgo A Mozzano, Villa Basilica.

2.3 INPUT DATA

Data have been collected mainly within G.I.S. of Regione Toscana, Province of Lucca and Chamber of Commerce of Lucca: for some themes we performed further elaborations, starting from the rough data, such to be able to produce, by integrating different sources, information more suitable for the aim of this research.

In particular, data coming from the Register of enterprises have a very thorough detail and contain information about each single activity located within the study area. They are classified according to the ATECO 2007, that include: Commerce, Industry and Craftsmanship (both Individual Firms and Society) Tertiary, Transports, Tourism and Public Exercises.

2.4 MODELING OF THE STUDY AREA

The different kind and shape of input data has made necessary to perform a preliminary analysis aimed to homogenize them and make them comparable to each others: to this purpose we created the modeling converting all data into the raster format, to make homogeneous data coming from different typologies, scales and geometric primitives.

The conversion has been performed using a reference grid that divides the territory in square cells (10 meters sided): such trial produced in some cases the loss of a part of the information, but considering the high level of resolution (10 meters), such disadvantage can be neglected. The conversion from vector to raster consists of associating to every pixel a value that must be representative of the whole surface of the pixel: the conversion error mainly depends on the pixels that presents a "mixed" information, because their information must be simplified and each of them must be assigned to one single class.

In this research we both used the "Criterion of prevalence" for some information like "land use" (the pixel has been assigned to a class if the majority of the pixel surface reverts in that class) and the "Criterion of preference" in the cases in which the importance of certain uses is clearly superior to that of others (for instance if also only a small part of the pixel is interested from a tie, the whole pixel has been assigned to the class of the tie), in relationship to the importance of the various environmental factors.

2.5 MULTICRITERIA ANALYSIS

Once the database is completed, it is necessary to establish suitable criteria and methods able to quantify the sensitivity of the various parts of the analyzed territory with reference to every possible interactions between environmental elements and project actions.

It is also useful to consider the possibility to vary both points of view and judgment criteria by using "multicriteria Analysis", a comparison procedure based on the modeling of the preferences of a plurality of subjects and points of views that can interfere within the decisional trial. Such a procedure, beginning from a sets of decision-makers that must choose among a set of alternatives, is aimed to reach a greater coherence among the multiple objectives and to define what can be called the "ideal" compromise: this is achieved by defining a set of criteria (relating to social, environmental, economic, etc.) through which you can 'weigh' the various alternatives. In our case, the problem is to identify, among many localization possibilities, those that are preferable, with particular regard to those relating to environmental and economic aspects.

Implementation and use of multi-criteria analysis are proposed in order to provide the user with a tool useful for the evaluation of new infrastructure, in the context of a territorial system in which many changes may occur that may change the weights that various system users, as businesses, citizens, enterprises attribute to different factors at play.

3 CHARACTERIZATION OF ENVIRONMENTAL ELEMENTS AND IMPACTS

The second step has led to the identification of the main components likely to be changed both positively and negatively by the actions related to road infrastructure change. In particular, we analyze separately environmental elements (air, climatic factors, water, soil and subsoil, vegetation and flora, fauna, ecosystems, landscape) from socio-economic ones (socio-economic, demographic and sanitary arrangement, cultural heritage).

Each component has been divided in sub factors, fit to detail the description of the component itself, especially in relationship to the modifications induced by the selected actions: the components considered meaningful for the study area and the relative factors are shown in Table 1.

The third step has the aim of identifying the impacts generated by the various actions on the environmental components mentioned above, and the criteria and indicators in order to quantify these impacts in an appropriate numerical scale and represent them within the study area through geographical georeferenced maps. In order to identify the impact of each project action on each of the factors characterizing the environmental components, a matrix has built with two general revenue (see Figure 1) corresponding to actions/parts of the work and environmental factors: within the matrix are highlighted intersections where it is considered that the specific action could produce an impact on the corresponding environmental factor.

The impacts were quantified by constructing indicators that use variables of different nature, that are often impossible to measure in the conventional manner, such as data derived from the census, pollution levels, the presence of constraints, etc.: each indicator was built on the basis of elements and phenomena considered significant for each factor, derived from the literature and from actually available data.

The matrix of impacts (Figure 1) is essentially the same in the case of construction or renovation/expansion of existing roads, in the sense that the existence or less of the impact does not vary in the two cases: what it is very different is the quantification of the impact with regard to a specific intervention.

However, the innovative element of this work is not related to the construction of indicators related to various factors or to their quantification aspects, but to the fact that each identified impact is "spatialized" in the study area to a very thorough level of detail: in fact, to each squared cell of 10x10 meters is associated a specific value for each impact identified within the matrix. So, to each relevant interaction between design action and environmental factor (impact) is associated a geographic georeferenced map of sensitivity (raster) of the whole study area: in other words, each raster represents the spatial distribution of the considered impact within the study area. Each map, therefore, represents the sensitivity of a single environmental factor with respect to each of the project actions that characterize the infrastructure under consideration. To get the full impact due to all the actions on all the components, synthesized through the '"synthetic index of sensitivity", you must add the single maps of impacts, which, however, are not comparable in the sense that scales and measure units of the attributes are different between them: for this reason, after to the quantification is necessary to proceed to the standardization of the impacts.

COMPONENT	FACTORS	
AIR	F1	Air quality
	F2	Acoustic climate
WATER	F3	Hydrograph / hydrology
	F4	Water quality
SOIL AND SUB SOLI	F5	Geo morphologic dangerousness
	F6	hydraulic dangerousness
	F7	Land use / pedology
	F8	Geology / Geotechnical
FAUNA	F9	Species in soil and subsoil
	F10	Species in water / soil
	F11	Species in air
	F12	Species in the water / air
FLORA	F13	Terrestrial plants
	F14	Habitat
LANDSCAPE	F15	Visual sensitivity of the landscape
	F16	Qualifying elements of the landscape
DEMOGRAPHIC STRUCTURE	F17	Commuting
HYGIENIC- HEALTH STRUCTURE	F18	Health status and well-being of the population
TERRITORIAL STRUCTURE	F19	Infrastructure system
SOCIO-ECONOMIC STRUCTURE	F20	Commercial activities
	F21	Transport companies
	F22	Tertiary sector
	F23	Tourism and public services
	F24	industrial activities
CONSTRAINS	F25	Parks and protected areas
	F26	SCI,SRI, NP
	F27	Wetlands
	F28	Monumental constraint
	F29	Landscape constraint
	F30	hydro geological r constraint
	F31	Areas of respect and others areas

Tab. 1 Factors characterizing environmental and socio-economic components

Standardization is necessary to make comparable and commensurable the different factors through the conversion of the different dimensional scales to a common dimensionless scale, expressed in the range 0-1, where the value "0" corresponds to the minimum sensitivity value within the study area with regard to the localization of road infrastructures (potentially suitable site) and the value "1" to the highest sensitivity (potentially unsuitable site).

After standardization procedure, the final raster, for each environmental component, have been organized into a software that presents a graphical interface through which the user can to interactively calculate the value of the index of sensitivity. The user is actively involved in the process because the quantification of the synthetic sensitivity index is done through a "weighted combination" of the various components that he can drive by assigning a weight in relation to the relative importance that each component assumes in respect of others and by constructing personal evaluation criteria.

		AR	AR	AQ	AQ	SS	SS	SS	SS	FA	FA	FA	FA	FL	FL	PS	PS	AD	AI	AT	ASE	ASE	ASE	ASE	ASE	VL	VL	VL	VL	VL	VL	VL
		F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19	F20	F21	F22	F23	F24	F25	F26	F27	F28	F29	F30	F31
		Air quality	Acoustic climate	Hydrograph / hydrology	Water quality	Geo morphologic dangerousness	hydraulic dangerousness	Land use / pedology	Geology / Geotechnical	Species in soil and subsoil	Species in water / soil	Species in air	Species in the water / air	Terrestrial plants	Habitat	Visual sensitivity of the landscape	Qualifying elements of the landscape	Commuting	Health status and well-being of the population	Infrastructure system	Commercial activities	Transport companies	Tertiary sector	Tourism and public services	industrial activities	Parks and protected areas	SCI,SRI, NP	Wetlands	Monumental constraint	Landscape constraint	hydro geological r constraint	Areas of respect and others areas
A1	Cleaning up of the site					X	X	X		X	X	X	X	X		X	X															
A3	Material handling of the ground			X		X	X		X	X	X	X	X	X																		
A6	Provisioning-disposal of materials	X	X							X	X																					
A7	Presence of the work- land occupation				X	X	X	X	X	X	X				X	X	X									X	X	X	X	X	X	X
A8	Presence of the work- traffic flows	X	X		X					X	X								X	X												
A9	Presence of the work- Changes in accessibility																	X			X	X	X	X	X							

Fig. 1 Impacts matrix

The system also allows to use a preset criterion based on a balanced scenario in which the same importance has been given to all the components.

At the end of the process is possible to see not only the final synthetic index but also get a more detailed form where to each component is assigned a number that quantifies the sensitivity of the territory in relation to the specific drawn path.

A detailed description of all functions of the software and the graphical interface would require a detail that is not possible here and that can be treated and investigated in a subsequent context.

Anyway, it is very useful to describe, in the next two Chapters, the detailed methodology used in relation to two environmental components chosen as an example, namely "Air" and "Socio-economic System".

4 AIR

The "Air" component has been divided in two factors, namely Air Quality and Acoustic Climate.

AIR QUALITY: for the characterization of this factor we used data of traffic flow quantities (coming from various sources), road characteristics (dimensions, conditions) and net and traffic flow characteristics (speed). The pollutants considered are CO (carbon monoxide), VOCs (volatile organic compounds), NOx (nitrogen oxides) and PM10 (Particulate Matter), which were characterized using a methodology that refers to the CORINAIR project (Coordination - INformation - AIR), an European inventory of emission factors from different kinds of production processes and of industrial and domestic energy conversion (website: http://reports.eea.eu.int/EMEPCORINAIR3/en/): we considered the sub model relating to road transport.

The CORINAIR methodology for estimating emissions from road traffic is based on the calculation of emission factors of the major pollutants on the basis of the definitions of the following variables:

- Type of vehicle
- Fuel type
- Displacement (for passenger vehicles and motorcycles)
- Weight (for freight transport vehicles)
- Year of manufacture
- Speed
- Execution of the heating cycle
- Type of road (urban, rural, highway)
- Length of the path
- Air temperature

Some examples of calculation of the issue factor for diesel motorcar:

$$CO\ (g/km) = 0.9337 - 0.0170\ V + 0.0000961\ V^2$$

$$VOC\ (g/km) = 0.1354 - 0.0022\ V + 0.0000113\ V^2$$

$$NOx\ (g/km) = 0.918 - 0.014\ V + 0.000101\ V^2$$

$$PM\ (g/km) = 0.1208 - 0.0277\ V + 0.0000226\ V^2$$

Below are reported some examples of calculation of the emission factor for diesel passenger cars: for the calculation the "Set of Car" of province of Lucca in 2010 has been used. The sensitivity in each cell is given by the sum of:

- Air Quality to the actual state calculated beginning from the existing roads by applying the model Corinair
- Impact of the road, calculated considering the distance of the receptors (buildings): in this case, the value of maximum sensitivity will be assigned to the cell where the receptor is found and will correspond to the eventuality that the infrastructure is realized very near to the receptor itself, while the least (void sensibility) value will be assigned to the cells that are found to a distance greater than the distance of concentration decadence for the examined pollutant.

ACOUSTIC CLIMATE: For the characterization of this factor we consider that the impacts are mainly influenced by the kind of infrastructure and by the distance of each cell, in which some infrastructure can be built, from residential and sensible receptors: so for each cell we consider the distance to the closest receptors (categorized by type according to their sensitivity to noise as residential buildings, public parks, schools, hospitals, etc.) and each cell is associated with a sensitivity value that is directly proportional to the sound pressure level in dB (A) calculated on the receptors. Table 2 reports, for each type of road, the minimum distance decay over which you have no disturbing noise level for the various kinds of receptors (sensitive or residential).

Each receptor is associated with the maximum value of the cell where he is located (assuming that the road can be built in this cell) and progressively lower values to further cells: if a cell is in the range of influence of the more receptors will be assigned a value equal to the sum of the values of sound levels relative to each individual receptor that is located nearby. The sensitivity value in each cell will therefore be greater the smaller will be the distance from the individual receptors and the greater the number of the receptors involved.

Adding up the various cells of the sensitivity of air quality and the Acoustic climate we obtain the overall sensitivity of the air component (Fig. 2).

NOISE SOURCE	EMISSION	DECAY DISTANCE FOR RESIDENTIAL RECEPTORS	DECAY DISTANCE FOR SENSITIVE RECEPTORS
Roads 1)	76 dB(A)	250 m	1000 m
Roads 2)	75 dB(A)	220 m	900 m
Roads 3)	73 dB(A)	85 m	500 m

Tab.2 Distances of decay for various types of road and receptors

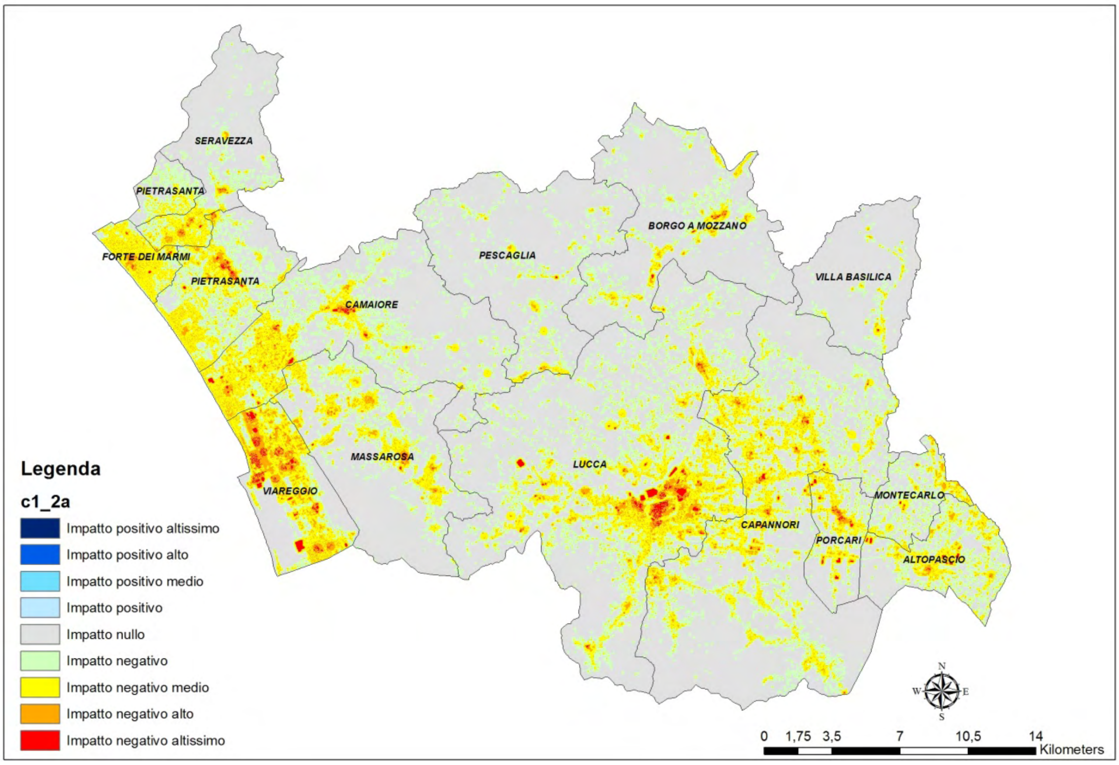

Fig 2 Map of overall sensitivity of the air component

5 SOCIO-ECONOMIC SYSTEM

The most significant impact that the construction or widening of a linear infrastructure causes on the socio-economic system mainly concerns the variation of the accessibility to the various enterprises.

Every economic activity generates and/or attracts a certain amount of traffic that depends on the type of work performed and on the number of employees working within the productive activity: therefore it is assumed that the increase of accessibility that follows the construction of an infrastructure is much more positive, the greater is the amount of traffic generated and/or attracted by the activity itself. In other words, for the same increase of accessibility, will be more favoured (and thus will be associated with a greater positive impact) those productive activities characterized by higher levels of traffic. For the characterization of the socio-economic system component data from the Business Register of the Chamber of Commerce have been used, in which each firm is classified with a code derived from the classification ATECO 2007 adopted by ISTAT as from 1 January 2008, that is the national version of European nomenclature, Nace Rev. 2, published on the Official Journal December 20, 2006 (Regulation (EC) n.1893/2006 of the European Parliament and of the Council of 20/12/2006).

The sensitivity analysis has been developed following the three phases described below.

LOCALIZATION OF ECONOMIC ACTIVITIES: all the economic activities were localized on the territory of the study area (Fig. 3) through a process of geocoding that allows to associate each economic activity with its street number along the infrastructures of the existing road network. The goodness of the result obtained by the process of geocoding depends on the quality of the input address to be processed; if it is in good condition (presence of all the fields, lack of misspellings, etc..) the activities can be georeferenced up to 90-95% of total. In this case the match between the activities and the corresponding street numbers was equal to 92% of the total, but, to improve the quality of the starting data, it was necessary to normalize manually a large number of records: the companies which had been discarded by the automatic procedure was subsequently reinserted manually.

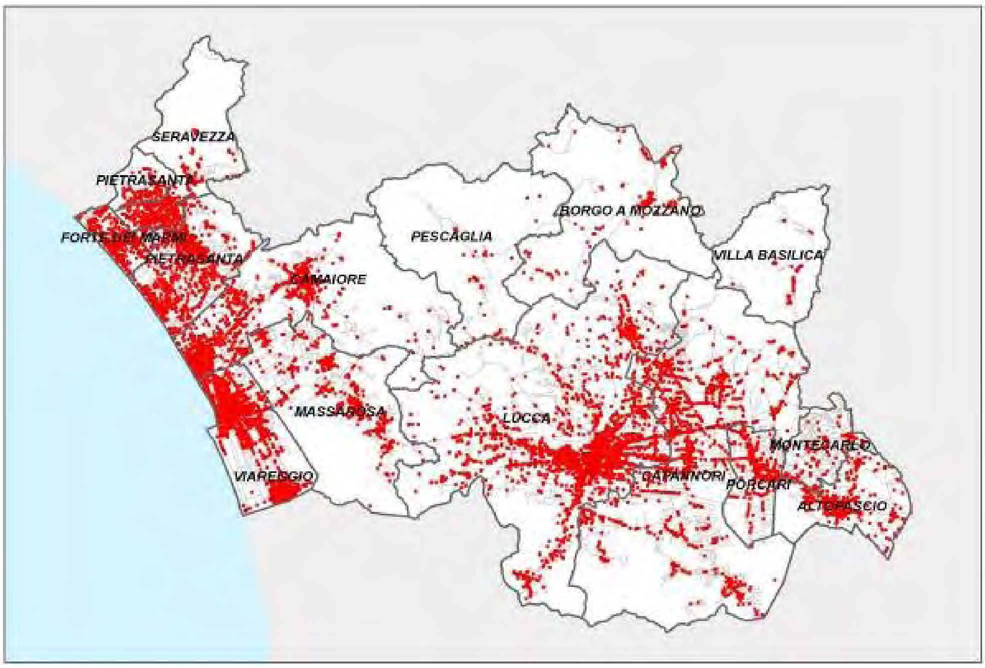

Fig. 3 Georeferencing of activities

CALCULATION OF INDUCED FLOWS: for the calculation of traffic flows, the socio-economic system has been divided into five factors: commercial activities, industrial activities, transportation companies, tertiary, tourism sector and public exercises; each factor was in turn divided into sub factors (Tab. 2) according to flow of traffic generated by each type of activity, calculated using the method Trip Generation. This method represents the most commonly used model for the calculation of the flows attractive potential related to georeferenced activities, ie models of generation of movements: in particular it refers to the american studies contained in the Trip Generation Manual (eighth edition) edited by ITE (Institute of Transportation Engineers), which contains more than 900 classes of activity (Figure. 4) for which are available calibrated models on actual detections of flows attracted from each activity class.

Institutional (Land Uses 500-599)

CODE	LAND USE
501	Military Base
520	Elementary School
522	Middle School/Junior High School
530	High School
534	Private School (K-8)
536	Private School (K-12)
540	Junior/Community College
550	University/College
560	Church
561	Synagogue
565	Day Care Center
566	Cemetery
571	Prison
590	Library
591	Lodge/Fraternal Organization

Medical (Land Uses 600-699)

CODE	LAND USE
610	Hospital
620	Nursing Home
630	Clinic
640	Animal Hospital/Veterinary Clinic

Office (Land Uses 700-799)

CODE	LAND USE
710	General Office Building
714	Corporate Headquarters Building
715	Single Tenant Office Building
720	Medical-Dental Office Building
730	Government Office Building
731	State Motor Vehicles Department
732	United States Post Office
733	Government Office Complex
750	Office Park
760	Research and Development Center
770	Business Park

Fig. 4 Example of codes in the ITE manual

For this purpose are mainly used linear or logarithmic regression models able to predict the number of flows generated and attracted to each category of activity: for each category of activity, flows are modified also on the basis of their size class, represented by independent variable, that may be the number of employees, the surface, the number of beds or other. For this work was therefore necessary to group all the activities within the area, each one characterized by a ATECO code, into homogeneous classes from the point of view of the traffic flows generated, and each identified sub factor was associated with a code of the ITE manual, suitably adapted from the American context to the Italian one. The overall flow induced in each cell was calculated as the sum of the number of employees associated with each activity, multiplied by the unitary flow of each employee.

In Table 3, for each factor are shown the values of the induced traffic calculated by the ITE method, considered in the cell where the activity is localized: the values express the number of vehicles entering / exiting the cell.

FACTOR	SUB FACTOR	INDUCED TRAFFIC FLOW
commercial activities	wholesale trade	15 vehicles/employee
	retail trade - large retailers	87 vehicles/employee
	retail trade - small and medium sized shops	40 vehicles/employee
transportation companies	freight transport	8 vehicles/employee
	maritime transport and Domestic Navigation	8 vehicles/employee
	air transport	8 o vehicles/employee
	management of parking and garages, rental	8 vehicles/employee
industrial activities	heavy Industry	3,8 vehicles/employee
	light Industry	5 vehicles/employee
	manufacturing industry	5,5 vehicles/employee
	warehouses, storage	2,75 vehicles/employee
tourism sector and public exercises	accommodations	20 vehicles/employee
	catering	25 vehicles/employee
	public exercises related to tourismo	60 vehicles/employee
	camping sites	10 vehicles/employee
third sector	office activity not open to the public	4 vehicles/employee
	services provided in public offices	35 vehicles/employee
	commercial services	40 vehicles/employee
	recreation services	53 vehicles/employee

Tab. 3 Values of traffic flows induced in the cell where there is activity by type of activity

Starting from the localization of the individual activities, the values of induced flow decrease depending on the type of road, so that for roads of more relevant size and importance we had a larger radius of influence and vice versa; for existing roads is assumed that the value is, for the same type, half that of the streets of new construction. In each cell the values within all influence radiuses were summed. Figure 5 shows an extract of the map of induced flows in the area near the center of Lucca: the larger circles are associated with the higher values of induced flow and vice versa.

CALCULATION OF ACCESSIBILITY: Calculating the accessibility means to calculate the centrality of the area with respect to the destination or origin elements of the calculation (for example it's possible to speak of accessibility with respect to industrial activities, to health services, to the school system and so on). The calculation consists of the construction of the matrix of distances (measured in travel time on the graph); this matrix shows for each cell "i" "j" the travel time from zone "i" to zone "j".

The active accessibility is used to understand how an area is accessible as the origin of travel towards some defined objectives; is obtained by calculating the O / D matrix (origin destination) of the travel time from each census section to all the other starting from the assigned road graph, that is that resulting from the regional model.

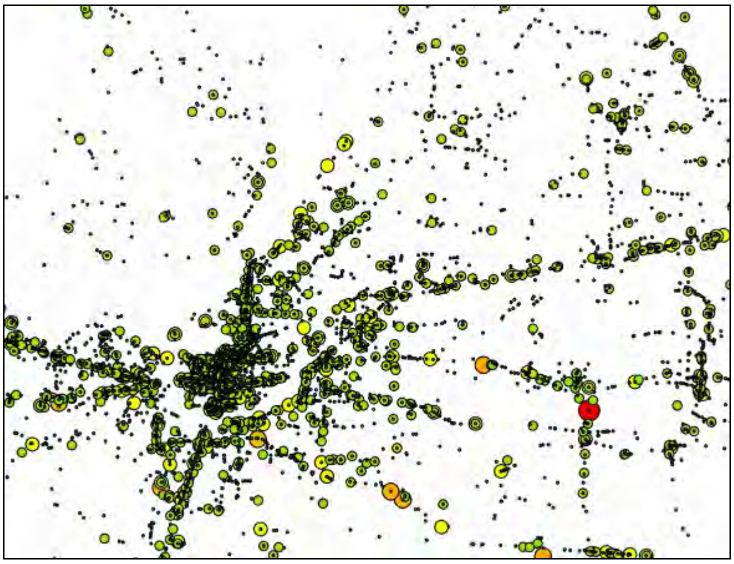

Fig. 5 Detail of the map of induced flows (near Lucca)

The resulting matrix is therefore a square matrix that measures the time it takes to arrive from each section to the others: calculating the marginal row and dividing by the number of zones we get an indicator of the average time to access to the other sections starting from the section of the i-th row.

In this case, the small size of the cell has made it almost impossible to computationally calculate the O/D matrix to the level of disaggregation of each single cell, therefore accessibility active was calculated on the basis of the census sections homogenized for territorial dimension (an aggregation of sections of urban census was carried out to homogenize the territorial dimension of the latter to the average territorial dimension of the suburban sections).

The traffic data used for the calculation are the peak data relating to the time period between 7.00 am and 8.00 am: in this case for all of the census sections of study area starting from all the other sections of the Tuscany Region was calculated the map of accessibility (Figure 6). For the evaluation of the sensitivity of each cell with respect to the construction of new roads were combined, in each cell, the results of the induced flows, in relation to any kind of economic activity, with the data of the accessibility in the current state; to this purpose was used the criterion that the positive sensitivity is greater the greater is the flow indicator associated with each cell, and the lower the accessibility of the cell itself.

By summing the values of the global indicators of the advantage of all cells crossed by the road, the value of which depends on the distance from the firms localized in the area and the value of the flow associated with each firm, is obtained the overall benefit induced by any road layout. The Figure 7 shows the map of the overall sensitivity of the socio-economic system.

6 CONCLUSIONS

Allowing a preliminary analysis and assessment of the environmental and socio-economic benefits of the “widening” or “new construction” of road transport infrastructures, the built instrument constitutes an important tool to support the administrations that deal with analysis and territorial policies.

In fact, on the basis of the sensitivity maps we can evaluate immediately what will be the positive and negative impacts of the proposed road, on each environmental component and, through the composite index, also on the global territorial system

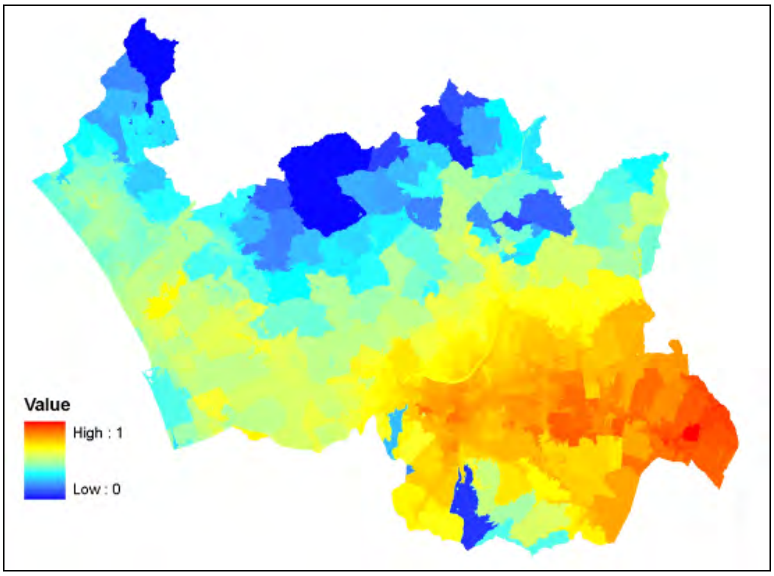

Fig. 6- Map of accessibility

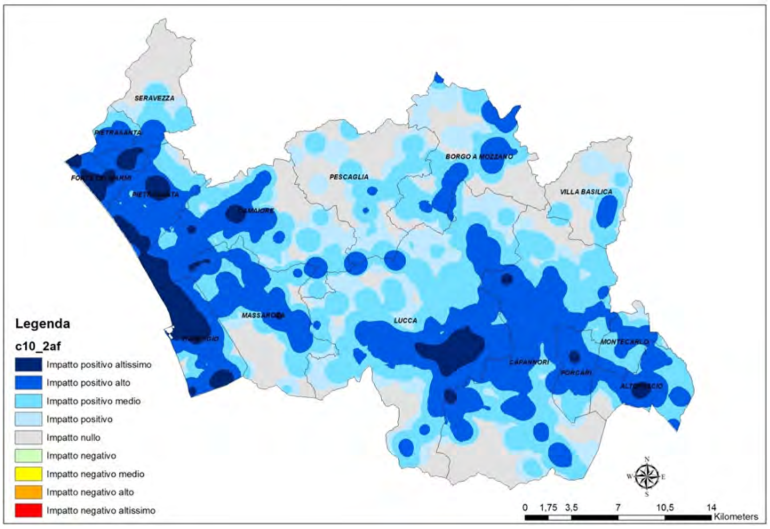

Fig. 7 Overall sensitivity of the socio-economic system

In addition, a graphical interface allows us to trace backwards from the aggregate end result to those relating to the various components and so to investigate the impacts on all of them. In other words, if from the sensitivity analysis related to a particular road project arises an index of high sensitivity, it will be possible, from the consultation of the maps of the individual components, to understand which of them are associated with the critical impacts.

The constructed instrument is also easy to implement and adaptable, depending on further evaluation criteria that might emerge: the scenarios constructed are examples, in fact it is possible to construct, from the same starting maps, endless scenarios by assigning different weights to the various environmental components, according to the needs of the decision makers.

The ability to build scenarios, using a highly differentiated database and the opportunity to assign different weights to the various "local sensitivities" (construction of synthetic sensitivity maps) allows such tool to be used in contests which are highly finalized to the participation of the actors, involved in territorial transformations.

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IMAGES SOURCES

Fig. 1 Impacts matrix.

Fig 2 Map of overall sensitivity of the air component.

Fig. 3 Georeferencing of activities.

Fig. 4. Example of codes in the ITE manual

Fig. 5 Detail of the map of induced flows (near Lucca)

Fig. 6-Map of accessibility

Fig. 7- Overall sensitivity of the socio-economic system

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CREATING SMART URBAN LANDSCAPES

A MULTIMEDIA PLATFORM FOR PLACEMAKING

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ABSTRACT

Infrastructure we have become accustomed to using in a different manner by the cyber city is at the heart of what today is known as the "smart city", in which the whole range of technologies are at the service of the city both to improve the quality of life and ensure its sustainability.

The smart approach to the city construction and transformation finds its roots in the concept of Cyberspace. This is a wide open field, still partially undetermined, which cannot be reduced to one of its components. It serves to interconnect all the devices concerning creation, recording, communication and simulation.

In order to illustrate the smart approach to placemaking - meant as the art of making place for people - and implicitly the achieving of a better quality of life, the new DIV@TER multimedia platform, in course of development, is proposed. Div@ter is a dynamic and interactive platform for the complex-sensitive management of the qualitative data of a territory, whose research project has been financed by POR FESR Lazio Region 2007/2013 Axis 1- Activity 1.1. The synthesis of the Esplanade area in Helsinki case study will complete the paper. This case is in line with the projects and relative goals carried out by Forum Virium Helsinki 2015, which is developing new urban digital services. Among these, the Smart City Project Area is devoted to the development of digital urban services for easier travelling and living in the city through the use of mobile devices which are integrated into everyday objects and activities.

KEYWORDS

Placemaking, smart urban spaces, quality of life, multimedia platforms

1 INTRODUCTION - THE SMART APPROACH IN PLACEMAKING

The emergence of internet as a medium of communication in Europe in the last twenty odd years has not only produced the dematerialization of the territory and the cancelling out of physical distance (Secchi, 2000) but has also opened up spaces and their users to new meanings and uses (Castells, 1989). Hypertext, interactive multimedia, simulation, virtual reality, telepresence, hyper-reality, artificial life and expert systems are only some of the new forms of smart application. All these devices have in common the exploitation of the molecular nature of digitalized information, and the variety of hybridizations between these techniques and the "classic" media, including the telephone, cinema, television, books, newspapers and museums which are arising with (Levy, 1999).
Castells (1989) refers to the "place of flows" as a real or virtual entity which also includes electronic interconnections, where many temporalities, as well as many simultaneities - which become a-temporal - are allowed. With new technologies, space is downsized to zero and, recreated in a virtual dimension, no longer constitutes an obstacle. These relationships are defined by Castells with the term *cyberspace* or *virtual space*, and are described by means of spatial language such as "information highways", "sites" and "squares". The increase of interchangeability of the spatial collocations of the individuals is linked «to the loss in importance of the *place* in social practice, where by "place" is meant a focus of sedimentation of historical memories, collective or individual symbolic representations, social practices and habits, affective bonds with points of transit and ones which are instrumental, provisional and replaceable, *non-places*, in fact. Or perhaps, in the possible re-elaboration or frequentation of other types of places, whether physical or merely virtual, based on the attribution of symbolic values deriving from other considerations and needs» (Belloni, Rampazi, 1996).
Cyberspace, as described by Mitchell, regards all the forms of interaction between both real and virtual worlds. Its origin, as Levy notes, is American and is attributed to the writer William Gibson, who first used this term in the fantasy novel *Negromante*, giving it the meaning of a universe of the digital net, as a place where encounters, adventures and world conflicts can take place.
Mitchell analysed the individual components of the system of new cyberspace as places for socialising, work, culture, leisure, meeting people on the web, and for the various cyber communities that were then being created, each with its own outlook, customs and requirements but all sharing the cyber distance that both divided and united them.
The network contributes to the construction of the living spaces of its inhabitants; now that it too is configured as an urban space, it creates new landscapes and aggregations of functions. In addition to relating to natural and urban contexts, buildings extend their connections, linking up with the structures created by cyberspace through electronic processors which enable their interactions.
The use of internet has led to a different approach to citizen participation in the construction of the territory. Community hubs, network thinking and social networks are only some of the current relational modalities among web communities. High tech infrastructures are ushering in a new culture of exchange, creating new possibilities of interaction within the communities. Thanks to the innovatory contribution of these infrastructures territorial usage is being reorganised, creating contexts where social exchange comes to replace the more traditional contexts.
The interaction between cyber communities and urban places produces a variety of effects. Graham & Marvin (2001) have focused on two elements in particular: the relational modalities between cyber communities and the public sphere; and the implications of the advent of cities which are entirely cyber. As Patsy Healey (1995) has said, " the physical city must be replaced with virtual urbanity, a city of the mind, enabled by telematics. The hope of this new technological revolution is that it will provide channels through

which knowledge and information can be democratised, dispersed around the diversity of relational webs in urban regions".

Consequently, "the art of making places for people" (Cabe, 2000; Carmona et al. 2010; Lynch, 1960), in order to face the new urban topics, has updated its theory and has added representational tools in order to become suitable to illustrate more complex urban scenes. Indeed computer science and new technologies have in recent decades become increasingly useful supports and more a for improvement of studies and applications in the field of area investigations (Ayeni et al., 2004; Asami, Longley, 2012).

In this respect, new approach to mapping the city have arisen, with the main purpose of identifying the urban dynamicity using direct observation supported by ad *hoc* electronic devices, including: virtual (Ratti et al. 2005), multiscale (MVRDV, 2002), configurational (Hillier, 2012) and complex-sensitive (Sepe, 2013a-b).

The different ways of collecting information are translated into specific display modes which cover a wide range of maps and virtual tools, often using combinations of data to obtain new kinds of information.

As regards, the smart approach to *placemaking* and the new DIV@TER multimedia platform, in course of development, will be illustrated in the following. Div@ter is a dynamic and interactive platform (www.divater.it) devoted at improving the knowledge of tangible and intangible resources of a place, often less considered in the smart services of a city, in order to improve the quality of life of citizens and visitors and support local participation and planning.

The research project has been financed by POR FESR Lazio Region 2007/2013 Axis 1- Activity 1.1. The first results of the case study which was carried out in the Esplanade area in Helsinki, and which has been used as a first test of the Platform, complete the paper. The paper is organized as follows: Section 2 describes the Div@ter platform; Section 3 is focused on the Helsinki case study. Finally, Section 4 draws the conclusions.

2 THE DIV@TER MULTIMEDIA PLATFORM

Div@ter is a dynamic and interactive platform for the complex-sensitive management of the qualitative data of a territory (www.divater.it). The Open Source platform, in course of development, allows to import tangible and intangible spatial data from different sources, integrate them with information provided by the users, calculate indicators and represent the information in interactive and immediately understandable maps. It collects the main data using the PlaceMaker method, already experimented in many contexts - including Europe (Sepe, Pitt, 2013; Sepe 2007, 2010), Usa (Sepe, 2013a), China and Japan (Sepe, 2006)- and for different objectives, integrating them with structured data and enabling the development of new services based on them. Div@ter is a Geographical Business Intelligence tool devoted to the re-design of the territory, which is conceived as a unique platform with different entry points, both private and public: for local authorities, professionals and citizens. The PlaceMaker method is an urban analysis and planning method. Its aim is to identify elements that are not recognizable in traditional maps and which constitute the contemporary identity of places, and to outline suitable actions for the protection and sustainable development of these places. By employing a protocol that is at once rigid and flexible, the PlaceMaker method assembles, elaborates and reconstructs data from surveys based on physical reconnaissance, sensorial perceptions, graphical elaboration, photographic and video records, and sets these data against those provided by an overview of expectations, an analysis based on traditional cartography and two questionnaires administered to local inhabitants. It comprises eight phases – five of analysis and three of design – and a Phase 0 that consists in constructing the grid required for the operations which are to be implemented later. The different types of database have to be created to contain the different types of data collected: there are data from anticipatory analysis (sketches, poems, collages, etc...); the denominative and perceptive, the graphical (signs and symbols), the photographic (fixed images), video (moving images) surveys; the elements deduced from the study of traditional planimetries (graphic signs, symbols etc...); the questionnaire administered to visitors to the places (sketches, words, etc...). The product of the PlaceMaker method consists of two complex maps, one of analysis and of design, which represent place identity and project interventions in order both to establish a dialogue with local people and to complement traditional urban planning instruments as a means to make decisions taking account of the intangible aspects of an area. The information collected and systematized in the course of several surveys, questionnaires and analysis is summarized in the maps in the form of symbols. In the Div@ter platform, places and elements identified with PlaceMaker method are represented by inserting symbols and elements into maps connected to multimedia schedules that can be continuously updated (fig. 1).

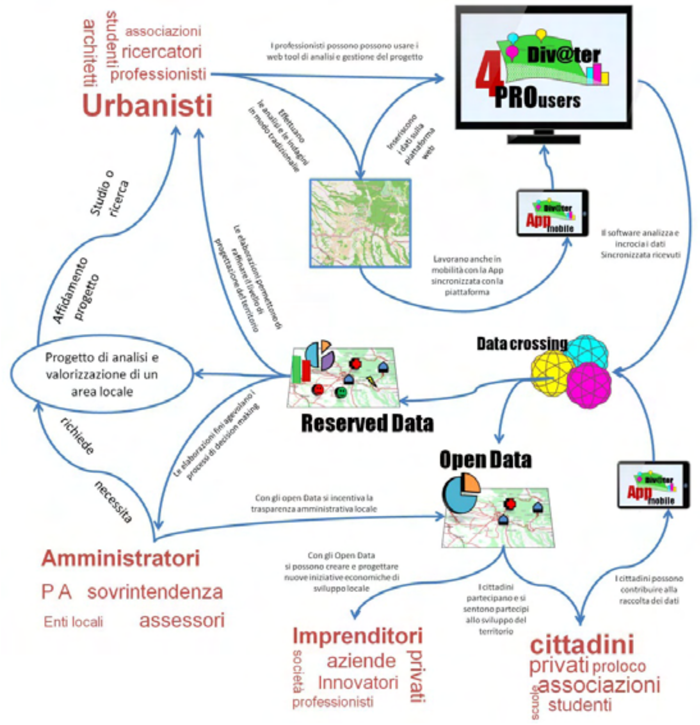

Fig. 1 Div@ter platform: case uses

3 SMART HELSINKI

3.1 FORUM VIRIUM HELSINKI 2015

The case study of Helsinki can be considered in the framework of the new smart projects which are in course of development in this city. Most of them are planned by Forum Virium Helsinki 2015 (http://www.forumvirium.fi), a private non-profit organisation owned by the City of Helsinki, which is developing new urban digital services in collaboration with the private sector and public organizations, the municipality, and residents. The main topic areas which are involved in the general project include: *smart city, wellbeing, new forms of media, innovative public procurement, innovation communities* and *growth services.* In particular, the Smart City Project Area is devoted to the development of digital urban services for easier travelling and living in the city through the use of mobile devices which are integrated into everyday objects and activities. Real-time traffic information among people, open public data, smart urban spaces are some of the services which are implemented in this area. In particular, Smart Urban Spaces - a joint European research project involving nine cities from Finland, France and Spain - has developed smart city services accessible by mobile phone, aimed at making urban living easier (fig.2). The 30 cooperation partners both from the public and private sector include: VTT Research Centre of Finland, the University of Bordeaux, the University of Caen, AICIA and ESI Tecnalia. The participating companies were While on the Move, Fara, Top Tunniste, Bonwal, Thales, NXP Semiconductors, Gemalto, CEV-Group, Intelligeré, Applicam, Moviquity, Telvent, CBT, Palma Tools, Visual Tools and Avenzis & ITMC. The project aims (http://www.smarturbanspaces.org/) are devoting at: "providing SW technology bricks and design frameworks that can be used for designing & adopting context based services (e.g. lbs, presence, instant messaging, local and interoperable services in cities/urban spaces); "starting building a network of European cities aiming and validating local and interoperable services"; "developing a first set of European urban services standards". The final goals include both improving attractiveness, attracting investments, tourists and consumers, and improving the quality of life. To approach these goals, the actions are mostly in line with PlaceMaker case study results which will be described below: "enhancing their local identity; deepening their regional positioning; increasing their international awareness, also by strong networking actions", making easier communication by local administrations "to influence people's positive perception of their city, be they in town or in another region or country".

Fig. 2 Smart urban space devices

3.2 THE ESPLANADE AREA CASE STUDY

The Esplanade area in Helsinki is not affected by problems such as scarce maintenance, the impact of globalisation, chaos, or a clear lack of liveability. The Esplanade owes its interest as a case-study to the fact that, although it has the potential for being one of the most symbolic and representative spots in the city, it is not as attractive and appealing as it could be. The purpose of the case study was to understand if there are critical points where it might be possible to think in terms of smart urban design, enhancing identity, improving the quality of its image, walkability and urban safety. Accordingly, "Better public spaces bring more people outside into shared activities, and build stronger communities. By creating destinations - tables and chairs near a favorite street vendor, a fountain that encourages play, or public ball courts - more people choose to spend time in the public realm. Well-designed and cared-for public spaces are a source of community pride and often generate economic benefits" (Bain, Gray, Rodgers, 2012) .

In the following, the case study of Helsinki will be summarized with particular attention to the tree phases of design - detection of identity resources, questionnaire to users of places, and map of design with identification of project interventions -, carried out with PlaceMaker method.

The detection of the identity resources resulting from the five analysis phases was carried out observing criticality, potential and quality concerning the place identity. As regards criticality, being one of the most representative areas in the city, our area is well maintained, even though road works can be observed in places. Problematic spots are found at the border between the park and Market Square and, to a lesser degree, between the park and the Erottaja square. The former is extremely chaotic due to the casual organization of the market (fig. 3). The street is busy with lorries bringing products to the market, many cars, and buses, which block off the view of the sea. Erottaja seems less chaotic, but conveys a similar impression of a place lacking design.

The park, although well maintained, could be improved in several ways. The presence of benches makes it a place more for lingering than for walking through. However, some parts of the park have becomes a drinking haunt for some people. Furthermore, the appearance of the people frequenting it is somewhat sad, and this impression is borne out by some of the answers to the questionnaire. One of the reasons for this, climate issues aside, might be the scarcity of meeting places or places providing occasions for social contact in the park (fig.4). Furthermore in some parts of the park, especially near the entrance and at the back, stands selling flowers and food and picnic tables are set up without any semblance of order, generating a sensation of chaos. Finally, the noise from the streets flanking the park is quite loud and annoying.


Fig.3-4 Helsinki, Market Square and Esplanade

As regards potential, the Esplanade has it in abundance, being an extensive green area connecting the financial district with the sea and located between two important shopping streets. The currently available attractors fostering socialization, such as the music pavilion and the adjacent cafe, meet the needs of the tourists and younger people, but not of all locals. Furthermore, the nearness of the sea and the views this nearness affords are not exploited to full advantage. The Etelesplanadi side is less attractive than the Pohjesplanadi one, notwithstanding the presence of some fine public buildings, the elegant Savoy restaurant designed by Alvar Aalto, and the Artek shop selling design products by Alvar Aalto.As regards quality, the analysis we performed indicates that the greatest flow of people occurs externally to the central portion, and is especially concentrated on the Pohjesplanadi, where the nearness of the historic centre, the presence of imposing institutional buildings, large hotels, stylish, big-name emporia, and quality souvenir shops, all well maintained, and cafes with sidewalk tables make it more attractive for visitors. The most characteristic part of the Esplanade is that around the harbour, that is, the fish market plaza. Other noteworthy features are that all historical buildings display good quality and the urban furniture has a unique design. The above considerations indicate that the area should be redesigned to make the most of its image and identity resources, to make the park area usable for all age groups, and to improve the Etelesplanadi sector, the fringes of the study area, and views of the sea.

Then, we administered a questionnaire (seventh phase) to users of the place about the identity resources identified in the sixth phase of PlaceMaker method.

0) Nationality and age. Passing through the study area: 1) What do you think about the quality of this place? 2) Did you notice the historical buildings? 3) Did you notice the Artek shop or the interior design of the Savoy restaurants? 4) What do you think about setting up smart attractions in the park suitable for different

ages and kinds of people, and to meet different needs? 5) What about increasing recreational activities such as music concerts or folk festivals using the area comprising the park, Etelesplanadi and Pohjesplanadi as a cohesive whole? 6) What about improving smart public spaces at the edges of the park, near Erottaja square and Market Square? 7) What about improving the park green with more attractive and interactive gardens, partly to be designed by architects selected by an international competition? 8) What about enhancing views of the sea? 9) Did you feel threatened anywhere in the area? To the question 1, the interviewees, independently of age or nationality, replied that it is good, mentioning in particular the buildings and the park architecture and gardens. The interviewees had actually already answered the second question in their answer to the previous question. We nevertheless posed the question to understand whether the interviewees were expressing a general judgment or were aware, for example, that some of the buildings had been planned by Engel. Among the locals, most had noticed that the buildings are in the Neoclassical style, and some also mentioned Engel. Most of the non-local interviewees had noticed the historical buildings, especially on the Pojiesplanadi. A small number answered affirmatively, but without providing further details. As to the third question, most of the locals were familiar with the Savoy restaurant, but not with the fact that its interior was designed by Alvar Alto, although they knew him as a famous architect. More precisely, half of the locals knew about Alto's role in designing the Savoy, while the other half did not. As to the non-local interviewees, independently of age or nationality, only a small percentage knew about the interior of the Savoy or of the Artek store. To the fourth question, "What do you think about setting up smart attractions in the park suitable for different ages and kinds of people, and to meet different needs", the interviewees mostly gave a positive answer, especially younger people and the elderly. A smaller percentage replied that the park was fine as it was. In their answers, the locals and the Finns in general often referred to climate issues as an element to be taken into special consideration in any renovation plan. To the fifth question, regarding increasing recreational activities such as music concerts and folk festivals in the park, the interviewees answered positively, independently of age or nationality. The locals were especially interested in Finnish festivals and folk dances. To the sixth question, "What about redesigning smart public spaces at the edges of the park, close to Erottaja square and Market Square", the locals replied positively, especially as regards the part of the park towards Market Square, which they perceived as chaotic. The non-local interviewees, independently of age or nationality, were unable to give a precise answer. As to the seventh question, about the creation of more attractive gardens, half of the interviewees answered that the gardens were already pleasant and well designed as they were. The other half asked for further clarifications about the question. After being told that the idea was to create gardens in some of the less attractive parts of the park, partly through international competitions, they answered positively. As to the eighth question, about the enhancement of sea views, most of the interviewees answered affirmatively. The locals, in particular, underscored the importance of the sea as a symbolical element of the city. To the ninth question, "Did you feel threatened anywhere in the area", all the interviewees answered that they usually felt safe there.

Finally, we laid down project proposals to enhance place identity (fig.5). What we propose is a set of closely interconnected actions to improve the three parts of the Esplanade as a single axis, as well as the perception of this axis as a "gate" to the sea.The first action is that of Improving Urban Attractivity, to be implemented in several steps. The first step is that of *enhancing the port and sea*, making the most of the nearness of the port and the sea, both in the park and in the two streets flanking it, by designing spaces and urban furniture inviting people to stop or look. This step is important insofar as it highlights what is one of Helsinki's strong identity elements, to which the park should serve as a gate of sorts, or, at any rate, provide privileged access. The second step goes in the same direction. It consists of *redesigning the edges of the park*, that is, the urban space between the park and Market Square – which is presently chaotic but nevertheless representative, partly because of the presence of street peddlers selling typical products – and between the park and Erottaja square, where the somewhat neglected Swedish Theatre by Engel stands. The third step is *designing small smart public spaces* to enhance the character of the Etelesplanadi stretch, which is presently less distinctively characterized than the Pojiespanadi stretch. The second action is that of Connecting Places. This is one of the most important actions to be undertaken to allow the area to be perceived as a cohesive whole. It comprises three main steps. The first is *to introduce small public spaces* to connect the park with its lateral streets. The second step is to place more emphasis on *connections with nearby places of interest*, such as Senaatintori (Senate Square), the Vanha kirkkopuist park, and the Amos Andersonin Taidemuseo. The third action is to Improve urban furniture. Taking account of Helsinki's major design tradition, as reflected by the presence in this area of the Artek shop and of the Savoy with its interior designed by Alvar Aalto, this action has the dual purpose of promoting the place and project a strong identity image. To this end, the first step is *to set up design objects drawing on local tradition in public places*, partly as a means to evoke urban furniture and decorations designed by Aalto as found in the shop on the lateral streets. The second step is *carrying out a smart lighting project covering the whole park* in order to improve its illumination during the dismal dark months. The third is *to create some light temporary structures for exhibitions* in the three sections of the area, in order to allow it to be used to better advantage and be perceived in its continuity. The fourth action is Introducing Activities. This action mainly concerns the park and involves setting up activities here for different kinds of users to allow it to be used more extensively during different periods of the year. The setting up of such activities, in conjunction with the cultural and commercial activities in the lateral streets, would contribute to the more general intent of reinforcing the perception of the park and the streets on either side of it as a single axis. The first step is *to introduce smart and interactive games* such as chess, checkers or bowls, to be included in newly planned green zones, or set up in already available spaces in the park. This first step would be carried out especially for the benefit of the elderly, who have more free time on their hand, and of lovers of open-air games in general. The second step is *to set up playground areas* with wooden recreational equipment for children. Children and their parents already use the park, but setting aside some areas and recreational equipment for them would increase everybody's enjoyment of it. The third step is *to set up temporary exhibitions.* These exhibitions should be suitable for open spaces and designed to create a continuity between the three sections of the area. The fourth step is that of *improving entertainment* by organizing traditional street performances, as are already held, for example, at Christmas time, and enriching the program in the park's House of Music to expand the use of this space during the year. The fifth action is Introducing Traffic Regulation Measures. Especially at the edges of the park bordering on Mannerheim and the port, chaotic traffic detracts from people's enjoyment of the area. Two steps could be taken to address this issue. The first would be *to reduce traffic* with appropriate measures, especially at the points most used by public transportation. The second would be to *reduce annoying noise.* The street lights, for example, emit rather loud signals that are so noticeable as to make this one of Helsinki's characterizing elements. The reduction of noise and traffic could help to improve the livability of the lateral streets. The sixth action is Improving Green. Although green is strongly present in the park, a more dynamic use of it could increase its attractiveness. The first step would be *to offer plants for sale directly in the park*. Some of the less decorative garden areas could be replaced with '*didactic' gardens* using native plants and shrubs with strong scents and bright colours, with labels showing their names, available for purchase on the spot. Such an activity would be an element of strong interactivity, especially in the brighter months. The buyer, whether a local or a tourist, would thus be able to bring back home part of the garden and make it live on elsewhere. The second step is *to call a competition for the design of a part of the garden*, to be planned in the winter months and carried out in the summer months, choosing year after year a new theme harmonising with the characteristics of the place. The third step is *to add plants with bright colours and unusual scents*, and also pleasing to the touch, or yielding edible fruit – such as strawberries – to stimulate visitors' olfactive, visual, tactile and gustative senses, and waterworks in the fountains to stimulate their auditory sense. The fourth step is *to rearrange the currently present kiosks* to fit with the new activities in the park.

Fig.5 Helsinki, complex map of design

4 CONCLUSIONS

Nowadays, new approach to mapping the city have arisen, with the main purpose of identifying the urban dynamicity using direct observation supported by *ad hoc* electronic devices, such as the Div@ter platform which was proposed. In particular, over the last few years, Helsinki has been improving its *smart-oriented* image, and investing on the regeneration of neglected areas, public spaces, and housing. In this direction, the Esplanade area case study, which represent the first test of the platform proposed in the paper, is meant. The possibility to share the information contained in the maps carried out with the multimedia platform on smart phones and tablets represents an important occasion both for local administrators, in order to better comprehend the qualities and criticalities of the area, and citizens and tourists, who desire to have a deep knowledge of this place. It is important to undertake actions in the Esplanade area because it is one of the most representative place in the city. The nearness of the historical centre and of the port make it a highly potential attractive area and this calls for more attention to the needs of various kinds of users. Our case-study shows how the identity of this place can be enhanced by reorganizing spaces and activities, and reinforcing already present cultural resources and the continuity of the park with its two lateral streets. In this case, urban improvement action is not called for to address issues such as overcrowded streets or polluting vehicle traffic, or the maintenance of streets and buildings. As our analysis has shown, the area has spots with multiple assets, but, as in the case of the Erottaja, next to empty spots that are not exploited to full advantage. Likewise, places for socialization are abundant on the Pohjesplanadi but scarce inside the park and on the Etelesplanadi. The kiosks are arranged in a chaotic and random way, especially on the side of the park near the port, one of the most representative spots in the area. In the Esplanade area, the aim of our project is especially to improve public spaces, and hence needs to be fleshed out at a more detailed scale. The purpose of the actions we propose is, above all, to improve the connections - also thanks to the Div@ter smart tool - between the three parts that make up this place, so that each part may contribute to improve the other, adding to the value of the public space as a whole and making the most of the place's natural and cultural resources, as well as its commercial resources. The improvements we propose take account of children's need for playgrounds and the elderly's need for recreational activities also offering opportunities for socialization, such as chess or bowls. They also strive to meet the demands of residents and locals for smart and agreeable places where to stop, and of tourists, who are often pressed for time and could find in the attractions of the park a reason to slow down and relax.

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IMAGES SOURCES

Figg. 1,2: Images elaborated by Francesco Fagnini, Lynx

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Figg. 4,5,6: author: Marichela Sepe

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VIRTUAL POWER PLANT

ENVIRONMENTAL TECHNOLOGY MANAGEMENT TOOLS OF THE SETTLEMENT PROCESSES

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ABSTRACT

The Distributed Energy Resource (DER) systems represent a possible option for the implementation of the Low Carbon Cities development scenario, consistently with EU orientations. Many surveys, especially of engineering and information technology origin, are contributing to DER systems spread through testing the Virtual Power Plan (VVP): a technological system aimed at synchronously managing the information and energy fluxes, and able to have an effect on the urban metabolism balance and on the energy chain organizational model.

In the event of a wider VVP spread, consequences for the urban structure social and technical conversion process might be envisioned. Such systems gain importance in terms of starting urban renewal processes, introducing new rules for the local energy and environmental infrastructures.

In this way, it is envisioned the need for a deeper comprehension of the VVP innovative functionalities, this comprehension being significant for all the branches of knowledge which are interested in developing methods and tools for the Environmental Technology Management and Planning of the settlement processes.

The author, who is interested in producing and organizing an energy, distributed, renewable and interactive model, shows, through a critical analysis of the Electricity Networks Europe program study cases, the operating potential of the new system, emphasizing the consequences on the settlement process development, thus providing a first definition of the strategic features for the VVP technical and social implementation.

KEYWORDS

Distributed Energy Resource, Energy Planning, Urban Renewable Processes, Urban Metabolism

1 INTRODUCTION

In the latest sixties (1960s), Tomas Maldonado explained the complexity control problem (Maldonado 1970). Maldonado's consideration was a contribution to the debate about the fate of consumption society which disclosed the increasing flow of people, goods, energy and information. In respect to the emerging dynamics, a decrease of complexity came to be envisioned; the reduction was conceived not in terms of simplification of reality or of a return back to pre-industrial models, but in terms of ability of guiding the technological innovation in a less invasive way, respecting the environment precarious balance.

As it has been acknowledged, the relations between environment and technology have been progressively altered throughout the course of sixty years. First of all, this alteration has occurred through the fossil energy supply technologies, which a wide scientific literature considers the main cause of the continuous impoverishment of the eco systemic services (Rifkin 2002).

Furthermore, it has been emphasized that in European areas as well as in Western industrial societies in general, environmental vulnerability is more strictly related to the prevailing obsolete energy devices rather than to the demographic pressures dynamics, which pertain more strictly to the Asian development models (Commoner 2003).

Nowadays, the technological change concerning the energy supply system is an essential part of European Community sustainable development policy which, among different possible options, suggests the implementation on a large scale of the DER systems (Distributed Energy Resource) (European Commission 2009).

This development scenario has made possible two meaningful achievements in the last ten years: validating the energy model from a technical engineering perspective (Lasseter 2002); introducing the Virtual Power Plant, new machinery being able to coordinate in an innovative way energy and information flows (Asmus 2010).

These new resources need a more in-depth analysis focusing in particular way on the transfer process from engineering tool to a device supporting the eco efficient cities conversions and management process. Furthermore, as far as the transfer process mentioned above is concerned, it might be worthwhile emphasising the issue of the man-machine interaction.

From this perspective, it is worth quoting Winer and his pioneering cybernetics studies on complexity control, starting from human and social premises: on one hand he expounded the possibility of new technological devices supporting anthropic activities; on the other hand, he emphasised human beings peculiar tendency to social organization, thus avoiding the distortion of technological innovation concept and value (Winer 1950).

In the latest years, researches on the information development, on the messages between man and machines and between machines and machines have acquired a greater importance. Actually, the infrastructural dematerialization processes generated from informatics devices diffusion is the main focus of the current scientific debate as well as of Horizon 2020.

In relation to new themes of survey, it seems crucial a scrutinized analysis of the innovation profile and of the implementation spheres as well as of the potential consequences for the material and immaterial processes of urban planning related to the generation of the Virtual Power Plant, which is a new generation machine working as a contribution to the scientific community, in order to characterise the concept of Smart Cities.

2 VIRTUAL POWER PLANT: INNOVATION PROFILES

In the international sphere, the concept of Smart Cities is associated to a diversify sequence of experimentations (Chourabi *et al.* 2012), whose central idea concerns computer applications for the fluxes complexity management (Farhangi 2010). Although it has been acknowledged the technical feasibility of Maldonado's prophetic idea about the need for enhancing fluxes control faculties, thus keeping bringing the scientific and industrial sphere attention the implementation of a new efficient and ecological urban model seems to be still difficult. From these facts it is possible to infer that man's tendency to social organization Winer emphasised still plays a pivotal role by suggesting a fair balance between technological innovation and urban intelligence.

In this sphere, the Virtual Power Plant analysis is fulfilled through an association between technological innovation profiles and several rising features defining an evolving process:

First of all, VVP are tools capable of assembling different sustainable energy systems in only one profile; as a consequence, they are aimed at the greatest technological diversity in order to prevent the infrastructural uniformity which is typical of the fossil system. From these facts it can be deduced the capacity of a system based on energy inclinations, which become the new likely rules for the territorial infrastructural process.

Then the new devices are oriented towards a direct connection between the settlement layout spatial features and immaterial fluxes. In this way it is possible overtaking the limits of urban metabolism previous abstract model and envisioning a salvage of settlement morphological and typological conditions, which are employed in order to measure the potential level of energy infrastructure implementation.

Finally, the new devices can work as a support to the management of connection between energy needs and consumptions. Interaction, which is meant as the innovative capacity of effectively solving the environmental imbalances, involves the invisible technology concerning the energy chain organization and the redefinition of roles and competences.

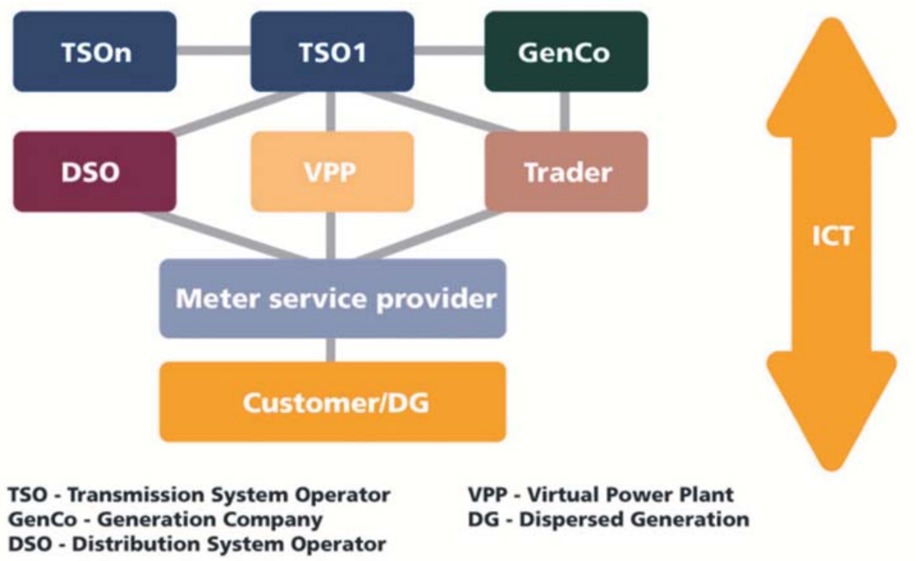

Fig. 1 The VPP represents an instrumental device involving the innovations ICT introduces in the energy supply chain different phases.

2.1 REFERENCE THEORETICAL MODEL AND PURPOSES

This survey refers to a clear theoretical framework, according to which DER systems are related to a Large Technological System (LTS) (Hughes 1985). Such a concept differs from the infrastructural economist matrix

traditional definition, in order to involve the idea of an open system interacting with the context conditions (Maldonado 1997). As far as the energy infrastructures are concerned, thanks to equipment and functionality indexes, the classification and assessment traditional system is replaced with a High Technology components model: Hardware, physical transformations; Software, intangible flows management systems; Brain-ware, man-system interaction; this model is considered more appropriate for the innovation profiles mentioned above. The general features of the theoretical structure and the components characterisation modalities have been already discussed (Sibilla 2012).
The aim of this survey is first suggesting to the scientific community a new understanding of the VVP as a supporting tool for the DER system diffusion, following the LST model, and then contributing to assess its likely consequences and application to urban planning and design processes. The survey premise lies in the awareness that VVP features envision new possible operations aimed at balancing the fate of the ongoing eco systemic impoverishment. These new generation machines are endowed with components able to receive messages from the outside as well as to change their behaviour like the autopoietic systems (Sibilla *op.cit.*). Furthermore, these machines can involve environmental cyclical variables in an arranged planning process, thus providing a meaningful contribution to the settlement structures renew, through a territorial distinction process.
The following dissertation will be focused on a selection of the most innovative applied research programs, particularly belonging to the completed and well documented Framework Programme (FP6), whose themes enumerate Virtual Power Plant technical and non technical implementation. Furthermore, the survey will analyse in depth Virtual Power Plant implementation in different geographical and urban contexts, thus implying a falsification of the innovation profiles stated before. Finally, thanks to some information collected through a survey on study cases, strategic suggestions for a LST model based application of VVP are provided.

2.2 VIRTUAL POWER PLANT: STUDY CASES

Several research programs have contributed to DER system analysis, envisioning them as a solution for future energy infrastructure. Such an evolution foresees the gradual replacement of the great traditional power plant with a renewable, interactive, safe and sustainable system for energy supply. In this context, the Electricity Networks Europe program belonging to Framework Programme (FP6) is significant. The case studies test energy system new forms of structure on territorial areas differing in geographical condition and urban structure. Some of the plans are listed as follows: *Fenix: Flexible Electricity Networks to Integrate the Expected Energy Evolution*; *Uniflex-pm: Advanced Power Converts for Universal and Flexible Power Management in Future Electricity Networks*; *Smart Grids TPS: Secretariat of the Technology Plattaform for the Electricity Networks of the future*.
The three research programs mentioned above share the same orientation, which results from observing that energy resources handed out inside the traditional distribution networks will cause operating problems in many EU countries; these problems will be due to the traditional networks incapability of supporting an energy increase from renewable sources which, as it has been acknowledged, are based on a typical intermittent operation. This technical and plant design problem shows clear operating consequences for the spread of renewable and off-center systems; consequently, such a technology might actually help to build low-carbon cities, with clear benefits for nuclear technologies. In order to exceed this operating limit, research has suggested new frontiers of experimental investigation; one of the innovative ideas lies in an aggregation of small renewable resources fueled building structures in a virtual production unit: the micro

grids. As it is possible to infer from the selected programs, this new infrastructural system questions the whole traditional energy supply apparatus.

The Smart Grids TPS program is one of the main spreading tools of the achievements concerning the energy infrastructural system evolution in Europe. Particularly, the survey provides documentary evidence of the diversified Information Communication Technologies (ICT) implementation to the new energy structure interactive operation, based on the distributed generation model. The program approach consists in investigating the ICT impact, through a new analysis of the whole energy chain. Indeed, this kind of systems integrates into each other over every level of the chain: energy production, management, allocation and final uses (European Commission 2007).

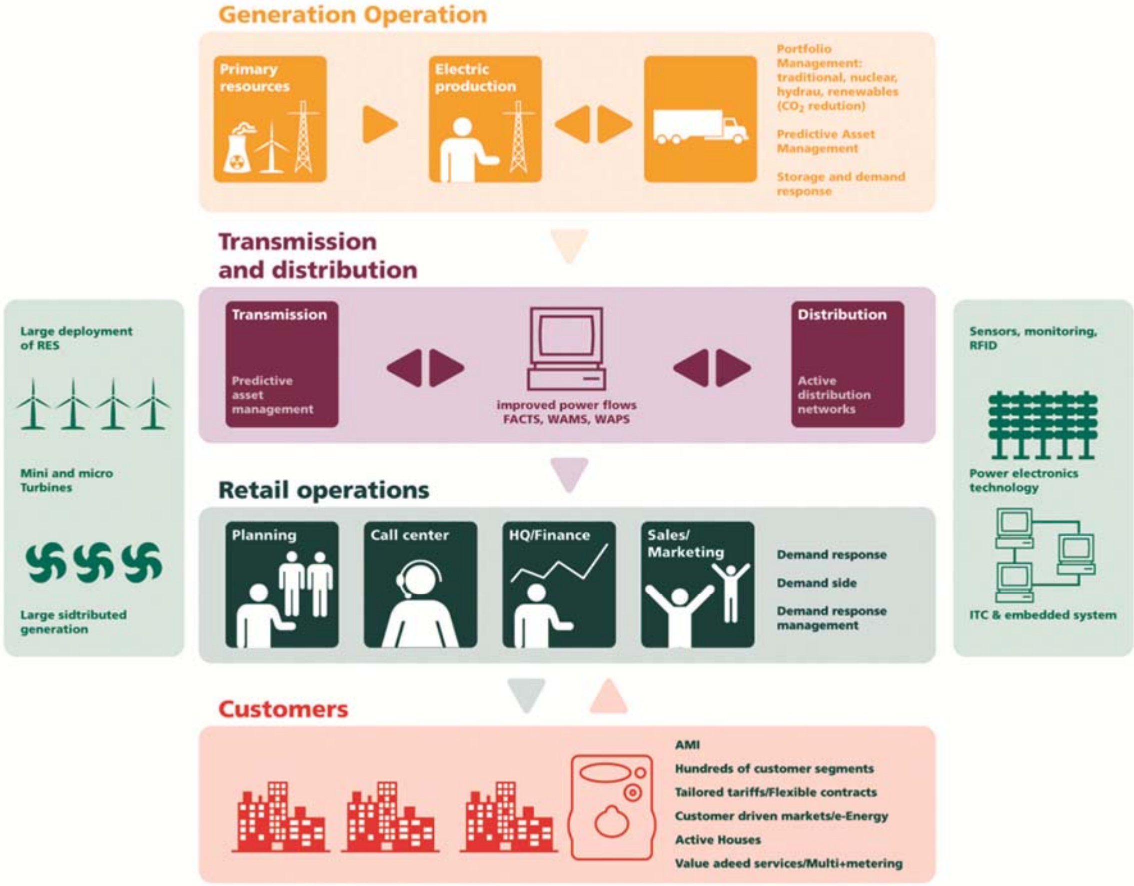

Fig. 2 The figure shows the different levels of innovation distributed generation and computerized control introduce in the energy supply chain.

The Uniflex-pm program focuses on the state of art of renewable technologies; it discusses the potential of the wind power, as well as of the solar energy and of the biomass CHP (combined heat and power) system; additionally it also discusses the conservation of energy technological potential. Even though on one hand, the survey clearly explains the product innovation in terms of efficiency and the current limits to a presuming energy independence implementation in the short term; on the other hand, it faces the integration issue from a non technical point of view, thus examining in depth the market rules innovation dynamics, according to the renewable and interactive micro grids logic. In such a context, the ICT systems work as an adjustment tool not only to the energy fluxes, but also to information aimed at self regulating of the exchange and of the operating system in agreement with local peculiarities. Such an agreement requires a deep knowledge of territory, by mapping for instance, the renewable energy sources (Iov *et al.* 2009).

The micro grid management is the main focus also of the Fenix program which is aimed at increasing the off-center systems diffusion by analyzing their feasibility as well as optimizing their contribution to the electric energy traditional system. The program just mentioned is one of the first in Europe introducing a wider concept of the VVP practical potential. Also in this case, the main theme is the energy and information fluxes control, but, differently from the former cases, experimentations provide more cause for reflection over the infrastructural systems innovation and territorial vocations; this difference is due to the fact that in this case, two different geographical areas are compared in order to define the network optimization features in relation to specific local needs, thus testing the VVP as a tool able to foster the infrastructural distinction process (Kieny *et al.* 2009).

2.3 VIRTUAL POWER PLANT: PRACTICAL EXPERIMENT

Within the Fenix program, the Virtual Power Plant acquires innovative and peculiar features. It is called Large Scale Virtual Power Plant (LSVPP), thus showing its role as an instrument for assessing flexibility and integrating ability, in only one technological profile of different renewable sources supply systems, geographically scattered. The estimation of the system effectiveness refers to two application scenarios in extremely different areas: Working Borough Council (Great Britain), called North scenario, and Alava (Spain), South scenario. These areas differ from each other in terms of geographical and climate profile, social characterization and of the settlement structures typological and morphological configuration.

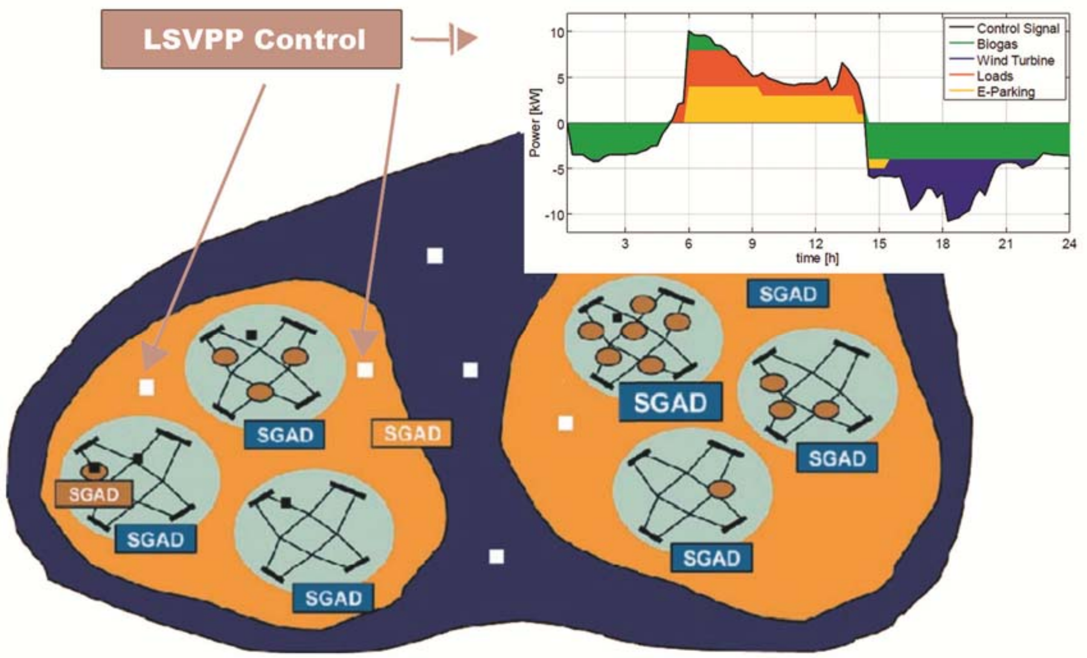

Fig. 3 The Fenix program tested the energy supply different systems integration, these systems being implemented in different environmental areas. Through the LSVPP supervision, optimization scenarios concerning energy efficiency and cost throughout the day are identified

As far as the Working Borough Council study case is concerned, the plan of action has established the installation of intelligent meter aimed at supervising the small plants already distributed on the territory analysed. The aim of such an installation was double. On one hand, the experimentation surveyed the energy system behaviour by changing the perspective from a single system logic to aggregated profiles, thus converting itself in an infrastructural system. On the other hand, it assessed the supplying systems pertinence in relation to energy final use; in other words, every supplying system in the whole structure acquires a specific weight depending on its contribution in that practical case.

As far as Alava study case is concerned, the proof program analyzed different varieties of built urban tissue. In this case, the electricity grid covers an area of 2,963 km, with a population of 300,000 people and, consequently, a service addressed to 169,000 users living in different areas: 70% urban areas, 12% sub-urban areas, 17% rural areas. This experimentation involves all the renewable technologies: Aeolian, photovoltaic, cogeneration, micro hydroelectric and biomass systems. In such a case, the technological diversity made possible testing activity and reactivity to the assembled systems local context circumstances, thus providing differentiated assessment of the renewable systems that can be used in relation to the typological and morphological features of the settlement structures.

In both cases, energy systems pertinence was assessed through simulations of virtual production and consumption cases, by the VPP implementation.

3 VIRTUAL POWER PLANT: A TOOL FOR TERRITORIAL VOCATIONS

The Fenix program emphasised the several aspects the VPP involves. One of the first aspects is the operation supervision of the several systems whose complexity varies with the networks extension as well as with users and with the riches of connected supplying systems. In this sense, the VPP turns to a Technical VPP (TVPP) whose task is coordinating the several information for the network operations; for instance, the several intermittences coordination and, consequently, the different intensity and frequency profiles, associated by assuming a hybrid photovoltaic and wind system. Another meaningful aspect lies in the possibility of constructing virtual scenarios or controlling and adjusting the real ones to current needs. This is a regulatory tool thanks to which the VPP turns to a Commerce VPP (CVPP) programmed in order to balance the different components features in relation to the optimisation of consumption, monetary costs, environmental carrying capacity and market regulations.

The aspects experimentations emphasised are significant and the technical feasibility resolution represents a starting point in relation to the innovative themes discussed. Since the Fenix Program closing (2009), other experimentations on VPP have been fulfilled, increasing these new machineries possible implementation. Consistently with this continuous increase, this survey will is suggesting a capacities transfer of the new instrumental systems as urban and territorial renewal tools. In this sense, the Fenix program stresses some peculiarities of the VPP as a tool for:

- programming the potential levels of the territorial renewable energy infrastructures;
- assessing the territorial energy vocations, in agreement with the local context material and immaterial conditions;
- planning connections between physical structures and energy and information flows in a single optimisation profile;
- testing the technical, adjustable and resilient operation for an active energy system.

Emphasised in this way, the innovation profiles produced by the VPP show direct connections with the urban planning and design processes, where the new equipment implementation makes possible and beneficial the development of rising capacities such as:

- the technological capacity of choice making, defining priorities and differentiating energy on the base of territorial needs and vocations, which can be estimated through active and analytical processes;
- technical capacity of introducing environmental variables in the different levels and phases of the energy system construction, involving the innovative rules concerning the settlement physical structure;

– the capacity of managing an energy dynamic and interactive chain; from this perspective the Prosumer (producer-consumer) is a central figure which gathers all the social, legal and economic innovations, associated to the new energy model.

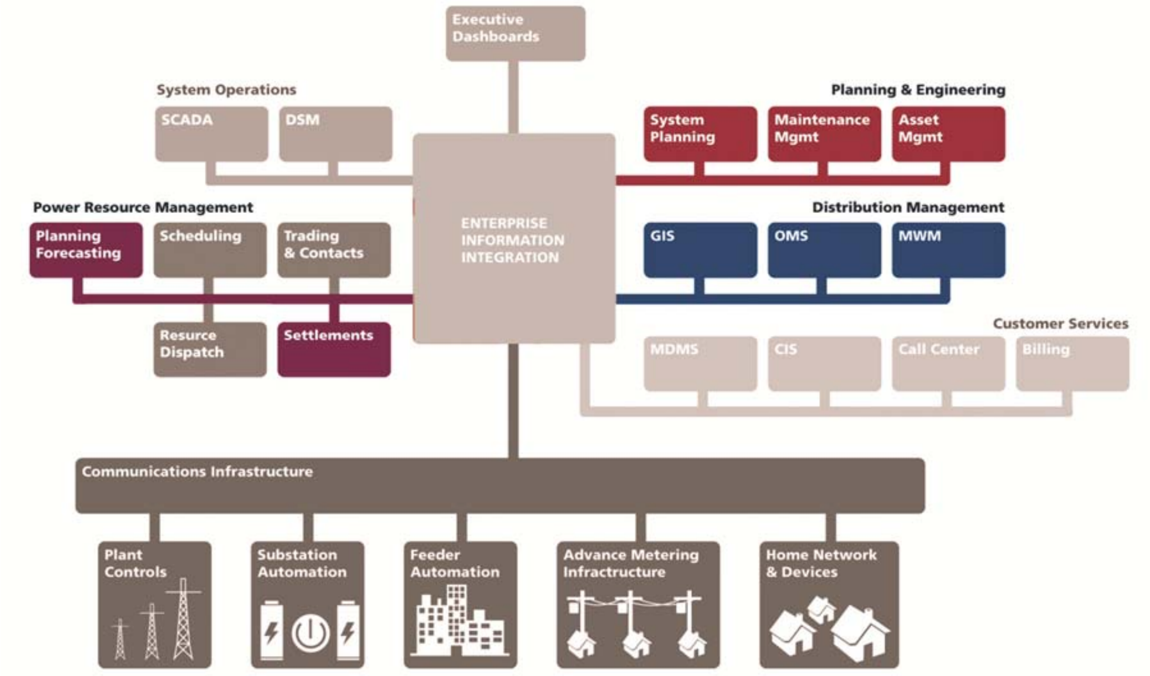

Fig. 4 The ability of testing information complex fluxes can envision new developments of the energy – settlement shapes interaction planning and management. Therefore, new key concepts and energy planning priority elements are conceived.

3.1 IMPLEMENTATION FEATURES

Introducing innovation profiles within weak and little accustomed to change infrastructural systems such as the fossil system, involves a series of normative, technological, social and market obstacles. Electricity Networks Europe program, and in particular way, the surveys submitted suggest innovative feasibility exactly through the DER system integration in Micro Grids, which are organized by VPP capacities. The micro dimension, indeed, represents in the short term the best intervention scale to work out a kind of complexity that might be too high, taking the risk of causing the failure of an actual opportunity for the settlement structure renewal. The network logic, by virtue of VPP adjustment capacities, makes possible in the medium term aggregations in increasingly large units with an increasingly big importance both for the energy free market logics and for defining a specific territorial energy planning.

In relation to the state of art as well as to European energy policy orientations and Horizon 2020 research themes, it seems worthwhile declaring the presence of a urban intelligence as a rising capacity of a complete balance between technological innovation and environmental quality, this being a balance where energy infrastructural innovation might work as an instrument for the mandatory need for counteracting the settlement structure uniformity and vulnerability. It is on the base of this need that the VPP analysis should turn from an engineering perspective to a larger scientific disciplinary perspective, since the energy and information flows synchronized control represents an impulse to contrast the environmental unconcern forms.

The new interactive renewable off-center infrastructural energy model calls for the capacity of modelling the complex dynamics and interdependence among fluxes, through a synchronized involvement of the economic, environmental and technological aspects. The fulfilled surveys show that the implemented experimentations are all subordinated to the construction of work tables which are rich of stakeholders. Actually, it seems it does not exist a mechanically established model able to consistently foster the configuration of a micro grid. Despite the innovations and the capacity just emphasised, new generation machines still have the same problem as the previous generations: this is a technology which a sense and a value should be assigned to. In relation to this aspect, the study cases analysis was aimed at estimating the purposes and the strategies implemented in order to diffuse the DER systems; particularly, the survey documented a series of cases where the VPP role proved to work as a structure for programming, assessing, planning and testing the micro grid typology. The implementation features suggested refers to material and immaterial actions able to explain the several aspects it is worth taking into account; furthermore these features are addressed to all the subjects and spheres likely involved. In general, they are aimed at facilitating the introduction of innovation profiles within local peculiarities, thus recommending themselves as a benchmark for the building of work tables able to bring out implementation priorities and peculiarities related to the surveyed context.

3.2 STRATEGIC PROFILE

As it has already mentioned, the DER implementation systems through the VPP are based on a series of purposes and strategies which can be changed and upgraded; they are summarized below.
Purposes:

- Introduce DER systems in urban design and planning.
- Disseminate actions to build supply chains of local micro-grids.
- Determine opportunities for social-economic development related to the local micro-grids.
- Optimize quality and performance of energy supply and storage equipment.
- Develop advanced management strategies for the local micro-grids.

Strategies:

- Implement training and disseminate useful information to the energy operators who will be involved in the project DER.
- Organisation of workshops to involve local operators and actors in order to overcome barriers and start building appropriate energy supply chains .
- Establish differentiated incentives according to specific DER systems .
- Test the Large Scale Virtual Power Plant (LSVPP), evaluating the flexibility and controllability of energy supply and the provision of specific ancillary services for the local context.
- Implement the potential of the most effective forms of Renewable Energy Production and the most appropriate technology of energy storage, in single or diversified form, and manage them through integrated platforms (LSVPP).
- Define technical, economic, social and regulatory aspects for the integration procedures of each specific DER system.
- Quantify, through simulation tools, the impact of DER penetration, in order to design more effective cost allocation systems of local energy trade mechanisms as well as the most appropriate ancillary services.
- Preparation of specific databases containing information on public and private buildings as well as on the geographical and climate conditions needed to configure the type of DER system.
- Evaluate the potential of local energy market and demand for energy in order to simulate development scenarios for the integration of DER systems.

– Prepare recommendations and action plans at a local level for the implementation of policies to develop “green” local grids.

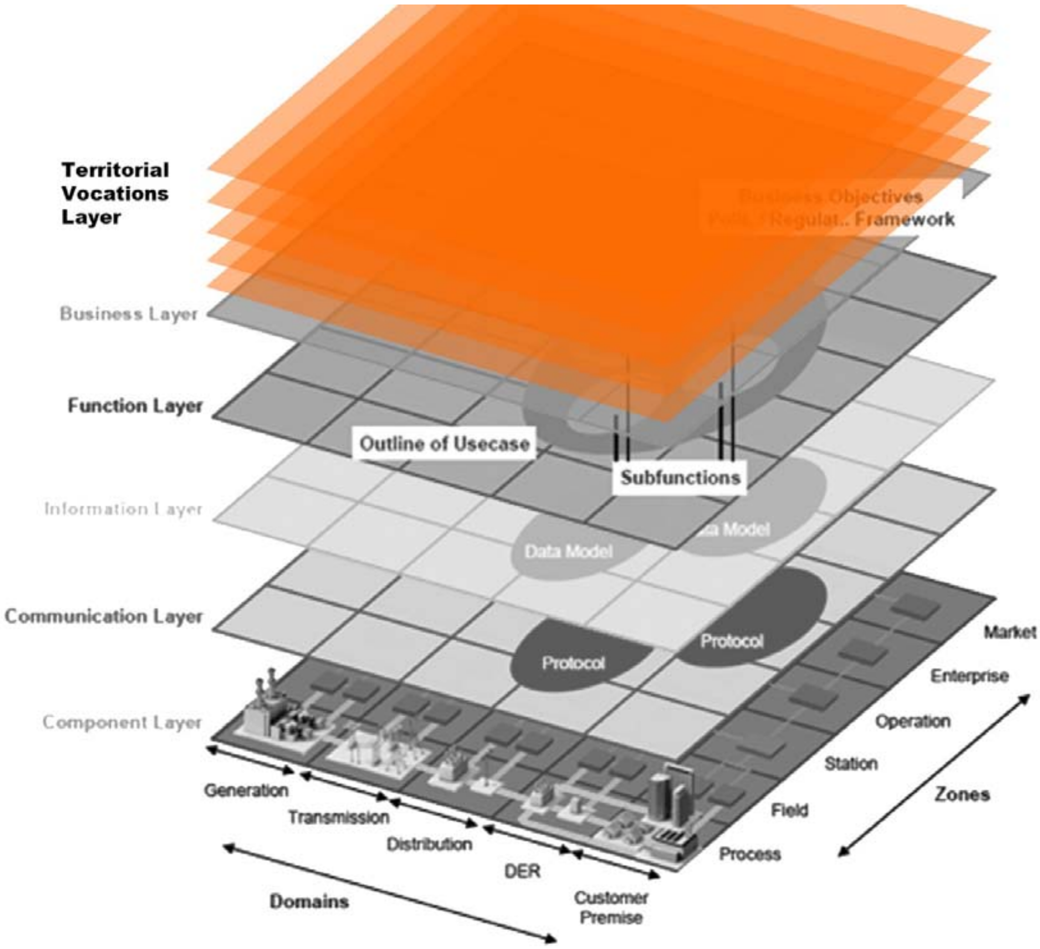

Fig. 5 One of the still open challenges consists in using the VPP in order to integrate territorial vocations in the local planning reasoning, these vocations being, for example, the energy potentialities of specific territorial areas.

4 CONCLUSIONS

Thanks to the survey here submitted it has been possible to bring out the fact that the interactive, renewable, and distributed energy model nowadays represents a considerable infrastructural system for the purpose of helping to build Low Carbon Cities. Furthermore, the survey was aimed at emphasising other aspects besides the technical capacity, thus involving the sense and value both of the technological innovation and of the environmental qualities, which can be related to the VPP implementation possibilities; as a consequence, the VPP is suggested as an appropriate tool for the environmental technological management of the new energy model. It has been emphasised the VPP capacity, on one hand, of integrating the complexities derived from local geographical condition within its own operating procedure, and on the other hand, of managing and coordinating the energy and information flows inside a high technological diversity system. Moreover, the new tool the survey suggests is able to: show the regions energy vocations during an urban development planning phase; explain through virtual simulations the efficiency of the physical integration process between settlement structure and sustainable energy system; supervise during the operating phase the different operating levels, thus adjusting itself to the external circumstances changes.

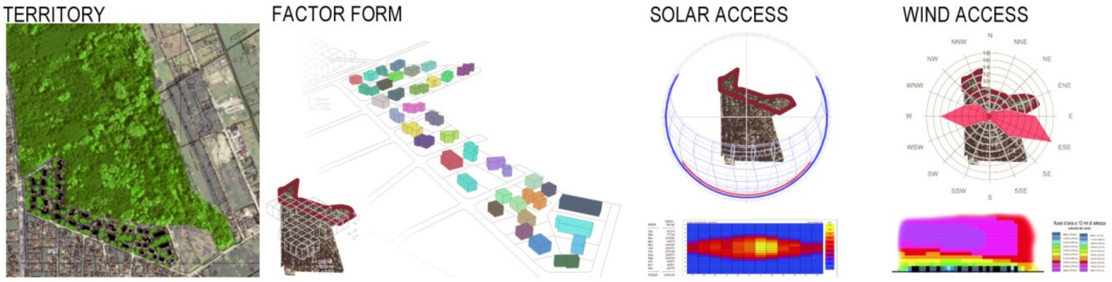

Fig. 6 Case study in progress: Regional Park San Rossore, Tuscany, Italy. The pictures show the energy territorial vocation which come into view at different examination and information levels. This information could be managed by the VPP, optimizing integration in the planning tools.

Furthermore, the survey collected and sorted a sequence of purposes and strategies aimed at fostering the integrated implementation of the VPP meant as urban renewal instrument. Concluding, the analysis here discussed represents a contribution for the success of a new infrastructural model which proves to be more suitable to the interactions between material and immaterial processes; this model is observed in the similarities between Large Scale Virtual Power Plant and Large Technological system. Quoting Zeleny, these new technologies can be defined as "High Technologies" able to work efficiently on their own if it is possible to discover their components and interactions, and their overall symbiotic action within human systems (Zeleny *op.cit.*). Therefore, new generation machines can foster an appropriate social conversion alongside the technological one.

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IMAGES SOURCES

Fig. 1-2: Advisory Council of the European Technology Platform (ETP) (2010), The Smart Grids Strategic Deployment Document, Brussels, 44.

Fig. 3: FENIX program, modified by author.

Fig. 4: Advisory Council of the European Technology Platform (ETP) (2010), The Smart Grids Strategic Deployment Document, Brussels, 26, modified by author.

Fig. 5: SG-CG/M490/A Framework for Smart Grid Standardization, modified by author.

Fig. 6: Images processed by the author.

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ECOSYSTEM SERVICES AND BORDER REGIONS

CASE STUDY FROM CZECH – POLISH BORDERLAND

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ABSTRACT

Land-use management and planning of cross-border regions is a complex problem. Different legislatures, development visions and interests on both sides of the border make it even more complicated. Introducing ecosystem services concept into land-use planning and management at cross-border regions is a challenge. However not much is said about this issue in literature.

This paper aims to present result of the study concerning to ecosystem services concept in the context of cross-border part of Pradziad Euroregion. The studyed area is situated within Czech – Polish borderland. First part of the research concerns to land-cover analyze of the region. The second one to Czech and Polish land-use strategies, which are binding at NUTS 4 and 5 level in the studyed area.

Resoults of the research indicates asymmetry of the cross-border landscape of the analyzed region. The asymmetry is indicated by different types, biodiversities and areas of ecosystems identified on both sides of the border. It is also identified by differences in land-use strategies concerning to the region.

It is discussed to what extend ecosystem services concept can be implemented in planning legislature of the cross-border region.

KEYWORDS

Ecosystem services, Land-use management and planning, Czech-Polish borderland, Assymetries of cross-border landscape

1 INTRODUCTION

1.1 ECOSYSTEM SERVICES IN THE BORDERLANDS

As noted by MEA (2005), Ecosystem services (ES) are the different benefits people receive from ecosystems. ES include: supporting services, provisioning services, regulating services and cultural services (MEA 2005). ES concept has been growing into importance since last years. That fact is indicated by selected internationally published studies (e.g. Fisher *et al.* 2009, Tuan *et al.* 2012). Several attempts have been made to introduce ES into land-use planning and management (Scolozzi *et al.* 2012, Steiner 2014). Also the aspects of economic valuation of ES were explored as an element of policy and decision making (Laurans *et al.* 2013). Furthermore it is crucial to make the ES concept more actionable for local communities. Actionable science as defined by Palmer (2012) has the potential to inform land-use decisions, to influence policies and strategies, which affect the environment. This can be the way to pustule by Xiang (2014) "ecological wisdom for urban sustainability".

Different national legislatures, land-use planning and management regimes, implemented policies, economic potentials, historical and political issues makes the problem of cross-border land use planning and management difficult to solve. Moreover not much have been said about ES in the context of land-use planning and management of European cross-border regions. While studying such case, firstly the diagnosis concerning to land-cover of the region needs to be made. Secondly national planning documents at local administrative level has to be analyzed in the context of ES implementation. Such approach can help to make the ES concept actionable for land-use planning and management. Outlined research method was used to analyze described in this paper case study.

1.2 THE CASE STUDY

The paper analyze the case study of the part of Euroregion Pradziad. The Euroregion is located between Poland and Czech Republic. The studied part of the Euroregion Pradziad covers an area of two Polish districts: Nysa and Prudnik and Czech district Jesenik and commune Krnov, Bruntál and Rýmařov (Fig. 1).

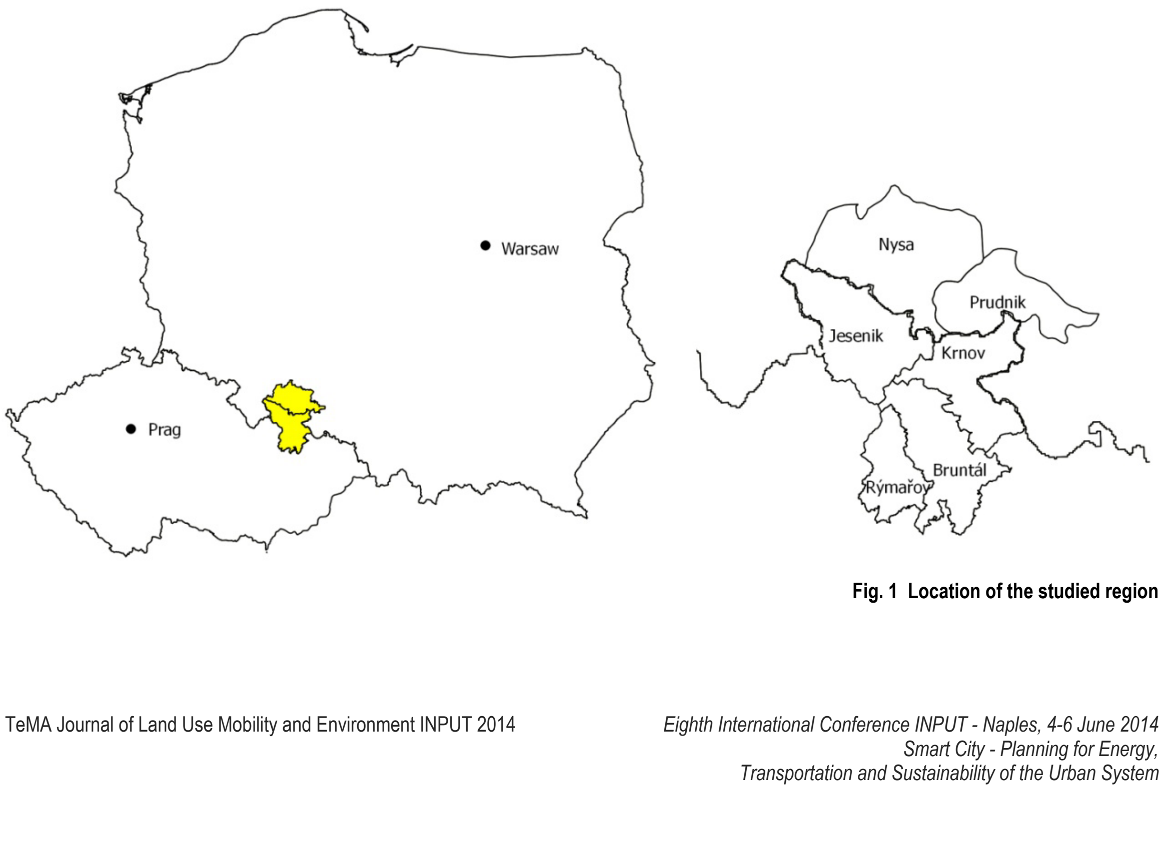

Fig. 1 Location of the studied region

The districts and communes are located beside the border line between Poland and Czech Republic and cover borderland part of Pradziad Euroregion. The mentioned Polish districts covers area of the NUTS 4[1]. The Czech district Jesenik (communes with expanded competence) covers an area of NUTS 4 and commune Krnov, Bruntál and Rýmařov of NUTS 5. Eurostat statistics for NUTS 3 level characterizes Polish districts as "intermediate rural, remote regions" and Czech as "intermediate rural regions, close to the city"[2]

In Poland at NUTS 4 level district governor is responsible for preparing land-use studies, strategies and analyzes. Detailed land-use plans are prepared at NUTS 5 level. In Czech Republic at NUTS 5 level communes and NUTS 4 "communes with expanded competence" are responsible for land-use strategies, other general land-use analytical documents and detailed land-use plans.

2 RESEARCH METHOD

2.1 FIRST STEP OF THE RESEARCH

Firstly, the diagnosis concerning to ES potential at the analyzed part of the Euroregion was performed. The diagnosis was partially prepared during the student workshop, which was held in the frame of the project titled "Edu2Work Cooperation between schools and public institutions located at Czech – Polish borderland in the frame of education increases chances at labor market". The project is conducted by Palacký University from Olomouc, Czech Republic, Central Mining Institute from Katowice, Poland with help of experts from Opole University of Technology. The five day long student workshop was held in April 2014 in Vidnava, the small town located in district Jesenik, next to the Polish border. The author lead one workshop group consisting of two students from Olomouc (Michael Cestr, Dan Horalík) and two from Opole (Dorota Michna, Michał Bartecki).

For the diagnosis following data was used: (i) Corine Land Cover (CLC) and other land-cover data available from European Environmental Agency, (ii) statistic data available from Czech Statistical Office and Polish Central Statistical Office, (iii) photographs prepared by workshop team members.

Workshop team members prepared the analyze of the region land cover. The area of the analyze covers Polish districts of Prudnik and Nysa and Czech district of Jesenik and "communes with expanded competence", Krnov, Bruntál and Rýmařov. The analyze was prepared with use of Quantum GIS 2.2 software.

2.2 SECOND STEP OF THE RESEARCH

Secondly, the performed analyze concerns to the land-use strategies. Districts of Nysa, Prudnik, Jesenik and Krnov commune were chosen to give a general overview of the ES implementation potential in the part of Polish – Czech borderland. The aim behind this selection was to perform the analyze on the administrative level, which is large enough to cover significant part of the land. On the other hand, land-use strategies for the selected districts and commune describe in a clear way development aims and problems of the studied area. Moreover districts of Nysa, Prudnik, Jesenik and Krnov commune have comparable land-use strategies. Namely following four documents were analyzed:

- District Jesenik: Land-use strategy for Jesenik district titled "Rozbor udržitelného rozvoje území pro správní obvod ORP Jeseník".

1 NUTS - Nomenclature of territorial units for statistics is a hierarchical system for dividing up the European Union.

2 Source: http://epp.eurostat.ec.europa.eu/cache/GISCO/mapjobs2009/0501EN.pdf.

- Commune Krnov: Land-use strategy for Krnov commune titled „Územně analytické podklady pro správní obvod městského úřadu Krnov".
- District Prudnik: Land-use strategy for Prudnik district titled "Strategia Rozwoju Powiatu Prudnickiego".
- District Nysa: Land-use strategy for Nysa district titled „Strategia Rozwoju Wspólnoty Międzygminno – Powiatowej Ziemi Nyskiej na lata 2004 – 2015".

Inside the content of each document, potentials for implementing ES concept were searched. Czech documents were analyzed according to identified land-use problems, while Polish documents according to land-use goals. The criteria for the selection was that certain problem or goal has to revere to ES concept. Based at the outcomes of the second step of the research, some conclusions for further land-use planning and management in the context of ES concept were drown.

3 RESULTS

3.1 FIRST STEP OF THE RESEARCH

During the first part of the study seven land-cover groups were identified. All groups reflect to Corine Land Cover (CLC) classification. Codes of that classification are given in brackets. Below list of identified land-cover groups is systematized from the ecosystems characterized by relatively little biodiversity (shades of red) into the ones characterized by high biodiversity (yellow, blue and shades of green) (Tab. 1, Tab 2):

- Urban fabric: continuous urban fabric (111) and discontinuous urban fabric (112).
- Industrial, commercial and transport units: industrial or commercial units (121), roads and rail networks and associated land (122), mineral extraction sites (131), construction sites (133).
- Agricultural areas: non-irrigated arable land (211), fruit trees and berry plantations (222), pastures (231), complex cultivation patterns (242), land principally occupied by agriculture, with significant areas of natural vegetation (243).
- Artificial, non-agricultural vegetated areas: green urban areas (141) and sport and leisure facilities (142).
- Water bodies: water bodies (512).
- Forest and semi natural areas: broad-leaved forests (311), coniferous forests (312), mixed forests (313), natural grasslands (321), moors and heathland (322), transnational woodland-shrub (324).
- Wetlands: inland marshes (411), peat bogs (412).

Moreover Nature 2000 and protected areas were identified, thanks to data available from European Environment Agency (Tab. 1, Tab 2). It was assumed that the higher biodiversity of certain ecosystem, the better potential to supply different ES.

Results of the first part of the study indicates **asymmetry of the cross-border landscape** of the analyzed region. The asymmetry is characterized by different types and areas of ecosystems identified on both sides of the border, their different biodiversity and different percent of each land-cover group on both sides of the border. Moreover identified on both sides of the border ecosystems have different potential to supply and absorb ES. The asymmetry is also indicated by following issues concerning to demographic data and land-cover (Fig. 2, Tab. 1, Tab 2):

- Higher amount of inhabitants on the Polish side of the region.
- Much higher density of urban fabric at the Polish side of the region.
- Much higher density of agricultural areas, dominated by non-irrigated arable land, on the Polish side of the region.
- Much higher density of forest and semi natural areas on the Czech side of the region.

- Much higher density of wetlands on the Polish side of the region.
- Much higher density of Nature 2000 and protected areas on the Czech side of the region.

CLC GROUP	CLC CODE	AREA [HA]	GROUP AREA [HA]	PERCENTAGE OF THE REGION [%]	AMOUNT OF INHABITANTS
Urban fabric	111	0,00			
	112	6 953,07	6 953,07	3,09	
Industrial, commercial and transport units	121	849,78			
	122	0,00			
	131	208,75			
	133	53,64	1 112,17	0,49	
Agricultural areas	211	41 339,61			
	222	0,00			
	231	35 729,61			
	242	131,95			
	243	26 325,20	103 526,37	46,07	
Artificial, non-agricultural vegetated areas	141	0,00			
	142	215,80	215,80	0,10	
Water bodies	512	869,76	869,76	0,39	
Forest and semi natural areas	311	4 951,87			
	312	66 700,30			
	313	28 390,54			
	321	301,15			
	322	104,15			
	324	11 540,49	111 988,50	49,83	
Wetlands	411	0,00			
	412	54,54	54,54	0,02	
Nature 2000		60 429,31	60 429,31	26,89	
Protected areas		54 788,87	54 788,87	24,38	
Analyzed region		224 720,20	224 720,20	100,00	136 062

Tab. 1 Land-cover and inhabitants amount of the Czech part of the analyzed region

Figure 2 compile each identified group of natural ecosystems (yellow, blue and shades of green) with high ability to supply ES (high biodiversity) with identified gropes of antropogenized ecosystems (shades of red) with high demand for ES (low biodiversity).

This analyzes indicates higher potential to supply ES on the Czech side of the region and higher demand for ES on the Polish side of the region (Burkhard *et al.* 2012). This fact is also confirmed by higher amount of inhabitants on the Polish side of the region (Tabb. 1,2).

Moreover, indicated in yellow, blue and shades of green land-cover groups (ecosystems) can be described as "service providing areas" (SPAs), while land-cover groups indicated in grey as "service benefiting areas" (SBAs). Following Fisher *et al.* (2009) and Syrbe & Walz (2012) SPAs as should be understood as "spatial units that are source of landscape services". While the same authors describe SBAs as spatial units, which can be characterized by "demand" for services and are complement to SBAs. Polish part of the region has higher amount of SBAs, Czech part of SBAs. That strenghts the cross-border landscape assymetry. In cases when SPAs and SBAs are not contiguous Syrbe & Walz (2012) defines service connecting areas (SCAs), which link providing and benefiting areas[3].

CLC GROUP	CLC CODE	AREA [HA]	GROUP AREA [HA]	PERCENTAGE OF THE REGION [%]	
Urban fabric	111	64,82			
	112	10 119,44	10 119,44	5,68	
Industrial, commercial and transport units	121	581,92			
	122	26,34			
	131	211,15			
	133	0,00	819,41	0,46	
Agricultural areas	211	121 841,69			
	222	28,34			
	231	8 220,09			
	242	4 524,43			
	243	5 974,75	140 589,30	78,93	
Artificial, non-agricultural vegetated areas	141	304,93			
	142	397,14	702,07	0,39	
Water bodies	512	2 424,18	2 424,18	1,36	
Forest and semi natural areas	311	7 538,44			
	312	6 881,95			
	313	6 298,71			
	321	542,19			
	322	25,07			
	324	1 367,42	22 653,78	12,72	
Wetlands	411	820,25			
	412	0,00	820,25	0,46	
Nature 2000		9 910,99	9 910,99	5,56	
Protected areas	14 069,97	14 069,97	7,90		
Analyzed region	178 193,25	178 128,43	100,00		198 842

Tab. 2 Land-cover and inhabitants amount of the Polish part of the analyzed region

3.2 SECOND STEP OF THE RESEARCH

Land-use strategy for **Jesenik district** describes 10 thematic areas: geological environment and geology, water regime, environmental hygiene, nature and landscape protection, agricultural land and land designated for forestry, public transport and technical infrastructure, socio-demographic conditions, housing, recreation, economic conditions (Ekotoxa 2010). All those thematic areas are obligatory for land-use strategies in Czech Republic prepared for NUTS 4 and 5 regions. Four thematic areas were selected to search for connections with ES concept: (i) environmental hygiene (ii) nature and landscape conservation, (iii) agricultural land and land designated for forestry, (iv) recreation. For selected thematic area several, described in the analyzed document, problems were selected. The selection was made according to potential of implement ES concept (R – regulating services, P – provisioning services, C – cultural services; Tab. 3).

[3] Service connecting area (SCA) can include river valley, ecological corridor, hollows, etc.

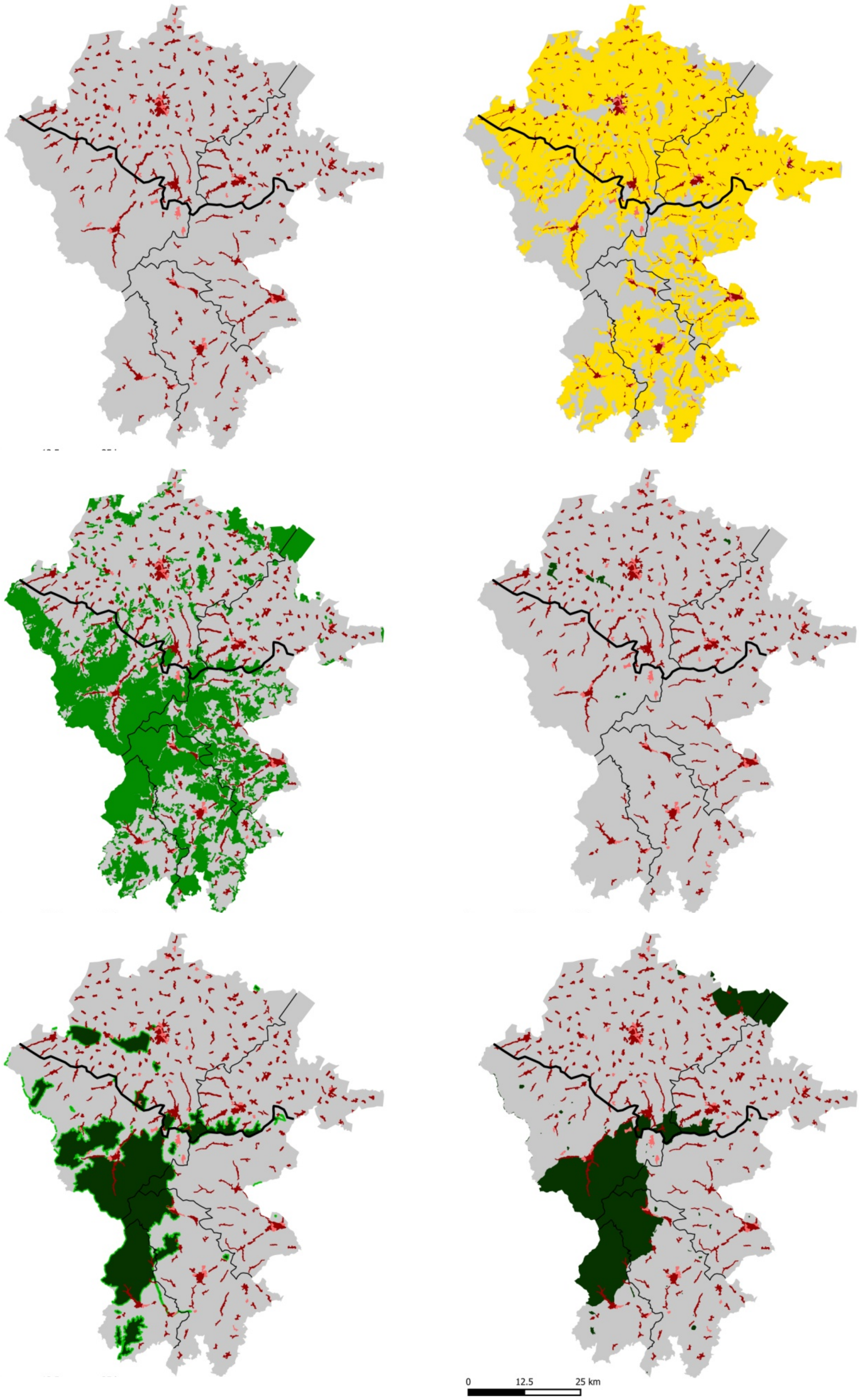

Fig. 2 Land-cover of the analyzed region

THEMATIC ANALYZE	IDENTIFIED PROBLEMS	ES
Environmental hygiene	– Ensure sufficient area to increase forest coverage and purposeful planting of greenery (	– P,R
Nature and landscape conservation	– Expansion of buildings in the open countryside and fragmentation of the landscape	– R
	– Clashes with ecological corridors	– R
	– The creation of conditions for the preservation and expansion of scattered vegetation in the landscape	– P,R
	– The creation of erosion control measures	– P,R
Agricultural land and land designated for forestry	– Forest protection	– P,R
	– Exploit the possibilities of forestation of unused agricultural land	– P,R
Recreation	– Unused potential of good natural and cultural assumptions of local landscape	– C
	– No need to worry about exceeding the limits of ecological sustainability in the context of tourism development	– C

Tab. 3 Potential of implementing ES concept in Jesenik district

In land-use strategy prepared for **Krnov commune**, for each obligatory thematic area, SWOT analyze was prepared (Haluza, 2008). After SWOT analyzes main land-use problems areas were identified and described in four following categories: (i) problems in the field of communes spatial development, urban problem, total 56 problems (ii) transport problems, total 12 problems (iii) ecological problems, total 61 problems (iv) water regime problems, total 6 problems. The document is more detailed than the one concerning to Jesenik district, however issues concerning to ES are packed mostly into one problem area namely "ecological problems" (Tab. 4).

ECOLOGICAL PROBLEMS REVERE TO FOLLOWING ISSUES	ES
– Change of local ecological corridors into dysfunctional	– P,R
– Continuity of local ecological corridors	– P,R
– Minimum width of local ecological corridors	– P,R
– Disabled functionality of local biocenters	– P,R
– Size and connections of local biocenters	– P,R

Tab. 4 Potential of implementing ES concept in Krnov commune

Land-use strategy for **Prudnik district** defines eight strategic goals: (i) economic, cross-border cooperation, (ii) arrangement of natural environment - technical infrastructure and system solutions, (iii) tourism - the use of historical, cultural and environmental aspects, (iv) education adapted to the labor market and lifelong learning, (v) activation of food processing and shaping of agricultural restructuring, (vi) improving the quality of life and ensuring the stability and prospects for the local community, (vii) preservation of spatial order and sustainable development, (viii) better efficiency of development planning (Klepacz 2000). From the above listed, strategic goals number two, three, five and seven were selected for further analyze concerning to ES concept (Tab 5).

STRATEGIC GOAL	DETAILED STRATEGIC GOAL	ES
Arrangement of natural environment - technical infrastructure and system solutions	– Natural environment inventory of Pradziad Euroregion – Improvement of communication infrastructure solutions with attention to natural environment impact – Adjusting the riverbeds and increase flood safety – Increase flood safety and protection of water potential by building retention reservoirs – Protection of meadows melioration and planting crops in mid-field open spaces – Improving the quality of soil	– P,R,C – R – R – R – R – R
Tourism - the use of historical, cultural and environmental aspects	– Using the landscape potential to build bike routes and touristic paths – The development of agritourism	– C – C
Activation of food processing and shaping of agricultural restructuring	– Adoption of a comprehensive program concerning to processing of agricultural products	– P
Preservation of spatial order and sustainable development	– Economic activation along Osobłoga river	– P,R,C

Tab. 5 Potential of implementing ES concept in Prudnik district

Land-use strategy for **Nysa district** defines seven strategic goals and eight operational goals: economy, agriculture and rural areas, infrastructure and communication, social infrastructure, culture, natural environment protection, tourism, cross-border and interregional cooperation (Rada Powiatu w Nysie, 2004). In three operational goals detailed proposals concerning to ES were identified (Tab 6).

OPERATIONAL GOAL	INCLUDED PROPOSALS	ES
Economy	– Sustainable development of the sub region – Enhancing development of agriculture	– P,R – P
Natural environment protection	– Increasing the area and protecting forests	– P,R
Tourism	– Building infrastructure like: paths, bike and water routes – Promoting eco-tourism and agro-tourism – Using the existing nature potential for tourism development	– C – C – C

Tab. 6 Potential of implementing ES concept in Nysa district

4 DISCUSSION

"Task Force" group consisting of representatives of following institutions: Czech and Polish Euroregions, the Czech – Polish cooperation managing institutions, national coordinators and other Czech and Polish stakeholders, has selected several Czech – Polish investment priorities. Among those priorities issues concerning to: (i) "protecting, promoting, developing of national cultural and natural heritage" and (ii) "protecting and restoring biodiversity, soil protection and promoting ecosystem services including NATURA 2000 and green infrastructure" were included (Opolska Fundacja Inicjatyw Międzynarodowych 2013). That fact indicated rising understanding of ES concept and need for more detailed incorporating it into national land-use planning / management regimes.

Two reasons indicates "asymmetries" of the Czech and Polish land-use strategies prepared at NUTS 4 and 5 level. Firstly, land-use strategies are not obligatory documents for Polish districts (NUTS 4). However many of Polish districts decide to prepare such documents. Polish land-use planning system assumes that general land-use decisions are taken firstly at national level and then at voivodeship level. Detailed decisions are described at commune (city) level (NUTS 5). While in Czech land-use planning system it is obligatory to prepare land-use strategies at the level of NUTS 4 / 5. That is the basic reason why Czech documents are more detailed than Polish ones. Secondly, Czech and Polish documents have different structure (Ministerstwo Budownictwa Rzeczypospolitej Polskiej *et al.* 2006). Czech land-use strategies revere obligatory to following thematic analyzes: geological environment and geology, water regime, environmental hygiene, nature and landscape protection, agricultural land and land designated for forestry, public transport and technical infrastructure, socio-demographic conditions, housing, recreation and economic conditions. That makes the structure of Czech documents clearer that structure of Polish documents. It also allows Czech document to be more precise that Polish ones. More detailed Czech land-use strategies, obligatory at NUTTS level 4 / 5, are better tools for incorporating ES concept into land-use management and planning. This fact, together with bigger demand for ES on the Polish side, creates the risk of uneven use of ES in the analyzed region. This indicates the need for better implementing ES idea into Polish land-use management and planning systems at NUTTS 4 level.

Asymmetries of Czech and Polish land-use strategies makes ES idea difficult to implement in cross-border land-use planning and management. However, implementation of most of the selected in this study development problems and development / operational goals influence ecosystems in way they are able to provide different services (Tab. 3, 4, 5, 6). Some of the identified land-use problems and goals concerning to fragmentation of the landscape, forestation and forest protection partially overlap on both sides of the border. In general identified land-use problems / goals revere mostly to provisioning (P) and regulating services (R). Analyzed data is not enough detailed to assess precisely which of those two ES categories are represented more often. Nevertheless, it is more clear where cultural ES (C) are influenced (Tab. 3, 4, 5, 6). That fact show high importance of cultural ES for the analyzed region and for the construction process of the cross-border region (Paasi 2010).

How l-u planning and management documents concerning to different borderland regions can revere to ES concept? This should be implemented in few steps. Firstly by diagnose what kind of asymmetries characterizes certain borderland. Diagnosis should concern to land-cover of the borderland area and land-use legislature. Secondly by identifying where and what kind of ES demands occur in particular area and who has those demands (Ernstson 2013). Thirdly by arranging bilateral discussion about land-use goals (existing and planned) concerning to both countries (Spyra 2014). This discussion should lead to defining bilateral land-use goals taking into account ES. Monetary values of certain ecosystems should be used as arguments during this process. Those bilateral goals should be included in national land-use documents, preferably at NUTS 4/5 level. Other possibility is that agreed land-use goals concerning to ES could be described in bilateral document, sort of cross-border land-use strategy.

Future research needs, concerning to the studied thematic area, refers to several issues. Firstly more detailed diagnosis concerning to land-cover / use should be performed. Calculations could be based on more precise data available at the basis of INSPIRE regulations[4]. Then more detailed outcomes of the diagnosis would allow to analyze detailed land-use plans of selected communes (NUTS 5), located beside the border.

[4] INSPIRE - Infrastructure for Spatial Information in the European Community.

With the help of such results, service connecting areas (SCAs) can be defined and thus, reducing the risk of uneven use of ES in the analyzed region, can be obtained. SCAs should be clearly described in Polish and Czech detailed land-use plans at NUTS 5 level.

5 CONCLUSIONS

Continous efforts are needed to better introduce ES concept into land-use stretegies concerning to borderlands. Each cross border landscape and cross-border region can be characterized by certain asymmetry on both sides of the border. The assymetry has to be included as important factor influencing land-use planning and management of the cross-border region. In the discussed case study assymetry of the landscape are indicated by land-cover and demographic issues. Dynamic of spatial supply and demand of ES in connection with SPAs and SBAs of ES co defines asymmetry of the cross-border landscape (Burkhard et al, 2012, Syrbe & Walz, 2012). That issue should be the basis for further consideration of ES potential in land-use planning and management of the studied region. Land-use strategies should describe possible tools for minimizing negative impacts of cross-border landscape asymmetry. Necessary to describe in land-use documents actions should concern to:

- Disproportion of SPAs and SBAs in the analyzed region
- Lack of clearly defined cross-border service connecting areas SCAs (Syrbe and Walz 2012)
- Identifying what kind of ES demands are characteristic for the analyzed region (Ernstson 2013)

Moreover assymetry of the functional region is indicated by differences in land-use legislation. Land-use strategies covering whole cross-border area are needed.

To make the ES concept actionable for the corss-border region and to use it as a part of cross-border region "construction process" it must be open (and understandable) to different stakeholders on both sides of the border. It can not be left only to researchers and politicians (Jax *et al.* 2013).

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THE CREATIVE SIDE OF THE REFLECTIVE PLANNER

UPDATING THE SCHÖN'S FINDINGS

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ABSTRACT

The self-reflection on their own work has always been present in all designers, including architects and planners. In the mid 80-90 Donald Schön has made more explicit this aspect, which until then had not found a systematic scientific treatment.

The results of Schön are the basis of practical planning of the 90s period. However, the Schön's analysis reveals a context of knowledge of mental functioning typical of the conceiving period.

From the 90s until now numerous advances in knowledge of the mechanisms of rationality, reflection and creativity have been made, and in this context we are interested in the progress made in the field of creativity.

We try to integrate and update the Schön's reflection with the new available theories such as the CK theory to offer planners a more innovated range of tools in order to understand and make better use of their creativity and self-reflection about their own creativity.

KEYWORDS

Creativity, Self-reflection, CK theory

1 INTRODUCTION

The aim of the paper is pointing out the advances about rationality mechanisms, reflection and creativity of the practitioner/planner. For a proper understanding of the innovation made by Schön it is useful having a brief excursus about the Schön's starting context.

In the Sixties the practitioner is conceived as an expert, as an incarnation of the knowledge of his own field. But in the subsequent years the figure of the practitioner was affected by a crisis phase. It was verified that the practitioner solves problems but often he can't foresee all the consequences of his choices and the problematic situations that could take place. So it was clear that a practitioner moves himself and his decision in a limited rationality situation. There was a great loss of trust in them and the practitioners themselves felt not being enough to follow progress and all technological news.

The Schön's thought plays a fundamental role in this context characterized by the need of change and by the need of a new awareness of our knowledge. His innovation consisted in highlighting some mechanisms of reflection during the action and about the action, so that according these new assumptions, the practitioner is not more the infallible expert, but a reflexive practitioner, someone that knows that has to think deeply about what is doing, about his choices and their consequences. Should be noted that Schön, in his book, takes through all the professionals while our study focuses on the analysis of the role of planners. Our research aims to understand what happened in the twenty years since following the Schön's book publication, The Reflexive Practitioner (Schön 1983), with a special attention to the creativity theme. In chapter 2 we propose a short recall of Schön's findings; in chapter 3 we talk about the advancement on creativity studies, in chapter 4 we try to apply new techniques about creativity to Schön's findings; in chapter 5 we purpose four examples of four different plans analyzing their genetic formation; in chapter 6 we have some conclusions.

2 THE SCHÖN'S FINDINGS: A SHORT RECALL

Schön refuses the Sixties vision about the practitioner's knowledge and removes the separation between research and practice. He recognize that practitioners can be reflexive researchers when they have to deal with situations characterized by uncertainty, instability, unicity and conflict.

The practitioner, through the reflection-in-action, and on action per-forms a research activity on his own practice in a continuous process of self education.

He recognize errors and accepts that the succeeding uncertainty can be a possibility for a new discovery. Reflecting during action can modify the action itself.

The reflexive practitioner deals with every problem he has to solve thinking that it is an unique one, then thanks to his experience and his memories of practice he refers to some elements of the repertoire that is familiar to him , in order to know how to behave, avoiding problems already faced in the past in similar situations.

If practice should be based on a scientific theory that can only be achieved through controlled experiments, this can't happen in reality, in fact Schön sustains that a true experiment generally takes place during practice and consists in looking at where action leads. The most important question of the experimental phase is: What if ?, so the practitioner must consider not only the current choice but also the tree of subsequent situations to which it leads. Therefore, the reflection-in-action necessarily implies the experiment.

Virtual worlds are useful and comfortable contexts of experimentation for practitioner, in which they can temporarily remove or check out some of the obstacles against a strict daily reflection-in-action. The skill in handling media, languages and repertoires is essential for the reflective conversation of the protagonist with the situation.

According to Schön's conception, the relationship between the practitioner and the client – the one who makes use of the professional's work- must also change: Like reflective practice takes the form of a reflective conversation with the situation, so the relationship of the reflective practitioner with the client takes the form of a reflective conversation (Schön 1983).

First, the practitioner must reflect on his own tacit understandings, which consist in the construction of the problem, strategies of action and model of phenomena, and must make them available to the client.

The client, then, must act in many ways as a reflective practitioner, because he must cultivate skills through the reflective conversation with the professional.

2.1 SCHÖN'S FINDINGS ABOUT PLANNING

As regards the planning, its social context is characterized by the presence of institutions organized around conflicting interests. Planners do not follow the model of centralized planning anymore, but they carry out practice in relation to a growing variety of stakeholders and control systems, and they have developed a variety of new or transformed roles, such as spokesman, strategists, consultants or technicians. The professional role requires a specific behaviour from the professional, but according to it, each individual develops a particular way of structuring his role, which is connected to the problems setting, the type of strategies he adopts and the interpersonal theories of action he develops. This degree of freedom is a clear form of creativity.

It is also clear to us that the reflection in the course of the action of a professional is a creative process too, because it varies on the grounds of a number of factors such as the scope, the level of detail and the structure type of the role that the same professional has built.

3 THE ADVANCEMENT ON CREATIVITY STUDIES

The creativity problem can be indicated as an highly representative index of the scientific culture of XX century, a sort of guiding idea: the discover of the creativity problem. Previously there were informal notions or almost-technical ones, heterogeneous notions with multiple applications. In the XVIII century the creativity was considered like a superior knowing position, a superintellectual activity or an activity opposite to the intellect, a peculiar intuition. So there was something like creativity vs regularity or creativity vs legality. (Garroni 1978)

The scientific problem of the creativity is outlined when creativity started to be considered in a systematic way: a creativity according rules or a creativity submitted to a general legality.

According the cognitive psychology the creative thinking, or the productive thinking is connected to a genetic consideration: it is the evolutive side of the intellectual abilities and of the correlated structures.

Starting from Darwin is in place a deep review of the almost classic opposition between instinct (animals') and intelligence (humans'). Instinct and intelligence are not two different and opposite types of behavior but they are formally the same, id est humans and animals are unified under the sign of the biological and of the cultural one. It means that even animals are cultural animals, able to produce a creative culture (new behaviors) and to transmit it (Garroni 1978).

Piaget institutionalizes the creativity notion: creativity is the structural transformation, it is the internal motor and it characterizes the appropriation of the reality carried out by man. Creativity acts in favor of an effectiveness and continue knowledge construction. Creativity can't be disjoint from the accordance to rules, creativity is rule chained (Garroni 1978)

So the idea of creativity as mental attitude of human beings is born only in the twentieth century. Among the definitions of creativity, there's one particularly interesting for our research: "Creativity is to combine existing elements with new and useful combinations" (Poincaré 1924)

In the cognitive environments of artificial intelligence research (Boden 2000; Hofstadter 1995; Johnson-Laird 1988; Minsky 2006), creativity is seen as a normal function of the human intellect, to be analyzed according to a strict theoretical and experimental scientific investigation. The modeling and design of artificial space environments, cities and urban architectures in particular, must take into account highly heterogeneous information sources.

From the analysis carried out so far in this field emerges the important role played by memory in the work of the designer. In fact, he takes the elements stored in his memory to build intrinsically creative solutions to the problem that he needs to solve.

Memory is the mental function that assimilates, retains and recalls information learned during the experience. It's necessary distinguish between short-term memory (MBT) and long-term memory (LTM), (Atkinson and Shiffrin 1968). Information are remembered, in the first type of memory, for some tens of seconds or minutes, while, in the second one, for prolonged periods and in this case, once stored in the brain, can be retrieved when it is necessary.

The relationship between memory and the project is not a deterministic one. Designing processes have an iterative, nonlinear and recursive proceeding and they follow one another in the inner part of a design procedure; so we have to consider: (i) memories – bases elements, (ii) memory about elements use, (iii) succession of mental actions that produce objects.

Creativity acts according the meta operational intention, that plans activities to reach the wanted results, a chain of operations not conceived before. Human adaptation in the ambient never be a total one, creativity is the adapting mood to the chronicle incompleteness to the adaptation and the self-reflexive creativity analyses the results of the creative behavior trying to discover out limits and errors and refining choices.

Research on creativity has led to the formulation of new theories and methods, which have made a great contribution to designers in improving the knowledge and in using their own creativity.

One of the main theories is the CK theory, in which two spaces are individuated, one of concepts, C, and the other of knowledge, K. A concept is defined as a proposition without logical status in the space of knowledge. The space of knowledge is defined as a set of propositions with a logical status, in accordance with the knowledge available to the designer.

The design process is defined as a co-evolution of C and K through a logic of processes of expansion of the two spaces (Hatchuel and Weil 1999, 2002), we'll describe later too.

Moreover, assuming that the action and the adaptation of an agent are not independent from the environment in which these agents act, a new version of the CK theory has been proposed, known as the theory C/K/E, (Kazakçı and Tsoukias 2005). It includes an environment E, which is functional to the creation of tools adaptable to the design. The theoretical framework given by the C/K/E theory offers the possibility of a theoretical and personal background, as a creative and adaptable design tool that uses constitutive memories and foundation references.

4 REVIEWING FROM THE METHODOLOGICAL POINT OF SCHÖN'S CONCEPT OF CREATIVITY

In his book Schön does not deal with the issue of creativity in an explicit way, but creativity does emerge, tacitly, almost unawares. Schön argues that action must necessarily be accompanied by reflection, in order to create new solutions during the analysis of the problem and in order to act in real time to apply them but never talks about creativity.

The biggest difficulty in analyzing creative processes is about their non-transparency: we can't read inside ourselves while our head is working, but we can be conscious about something is happening and we could lead it in a someway. When you're observing a creative process you have to know that the process will change because it is reflecting about itself and the analysis studio becomes a bigger deal (Legrenzi 2011) Thanks to the research carried out in this field in the last twenty years we know that creativity is an integral and essential aspect of the figure of the practitioner. Creativity depends on the context, the environment, the teachers, landmarks and lifestyle choices.

A closer look at creativity as search outlined a view of creative concept generation as a very general search process, even if that formalisation has not been developed much in the past few years. Researchers established that it is methodologically beneficial to have fully precise, detailed and formal accounts of any mechanisms being considered as 'creative' (Ritchie 2012). For an example Creative Systems Framework (CSF) (Wiggins 2006a; 2006b) emphasises the notion of search as the central mechanism for simulating creativity, and outlines how a metalevel search could represent some phenomena sometimes discussed as 'transformational' creativity. It is important to realise the importance that the underlying intuitive ideas have: creation as the exploration of a 'conceptual space', and possible 'transformation' of that space. (Ritchie 2012).

We can imagine the thought distinguished in two different branches in reasoned thought and intuitive thought (Bruner 1966). The reasoned thought proceeds step by step with the almost complete mastery of information and it is based on a precise reasoning, on logical or mathematical tools or on defined actions. The intuitive thinking on the other hand does not proceed with a plan which is organized in a formal way and it belongs to the people who think intuitively. The merger of these two types of thoughts leads the designer to recall past actions useful to the context in which he is located, digging through the contents of his memory using the association and order's principles. The subsequent reasoning is possible only through knowledge. To know means possess information obtained through experience or learning, but, as it is clear from Schön's thought, this is not enough, be-cause the practitioners must also be aware to know to reach the conscious knowledge.

4.1 SCHÖN'S FINDINGS ABOUT PLANNING

In his book Schön doesn't explain how the practitioner must behave in the practice of the profession itself. He asserts that the reflective professional, through the reflection in action and on action, is protagonist of a continuous process of auto-education.

As the search has recognized the importance of the creativity in the planning and design processes, and the importance of the self-consciousness about creativity, many techniques are been developed to implement and enhance creativity itself. So, the planners have a higher range of conceptual and operational tools to better understand and utilize their creativity. Our aim is trying to integrate the Schön's reflection in the light of these advancements. Here we give brief outlines about three.

We already talked about an important technique the CK theory, it concerns a continued cooperation between the set of concepts and the set of knowledge, through continuous movement between these two spaces. The result is a new object before unknown, something that existed in a different form in the K space which is enriched with new properties encountered in the C space, it returns back to the knowledge space as something 'accepted', with its own set of properties which have logic (Hactuel 2002).

Another branches of studies about creativity focused on the 'combination' of the elements. This involves the addition of part or all of one design prototype called the combining design prototype to an existing design prototype called the focus design prototype. Creative design is not only the production of "novel and valuable ideas", but also using odd ideas for the generation of valuable new knowledge. Analyzing a creative design action we recognize three different parallel processes:

1. combination;
2. analogy;
3. mutation.

The operations of creative design can be captured with a high level of generality (Gero 2006)

Another important theory that gives important techniques to enhance creativity is TRIZ. It is a Russian acronym for "Teoriya Resheniya Izobreatatelskikh Zadatch", Genrich Altshuller theorized it. It is an attempt to improve on a random approach to innovation and invention by structuring the creativity in paths which have been shown to yield results. The TRIZ approach encompasses a number of different tools and techniques for specific domains, including 40 inventive principles and contradiction tables, for an example some of them are: segmentation, extraction, local quality, asymmetry, et cetera.

In a someway all this could have a start in Schön's the idea that planning, and in general a practitioner activity deals with the 'problem solving'. Problem solving consists in the research of the problem solution, it is no longer the only appropriate response to reality, at least if not completed by the problem setting. There is then a more 'problematic' approach to the reality, which considers each situation in its complexity and in its uniqueness: the "reflection-in-action".

During the process of reflective conversation with the situation, the practitioner, from the applicative point of view, can take advantage of some tools, specific for the different phases, in order to explicit and represent the whole process in a formal manner.

In the first phase of the formulation of the project – the problem setting – Schön proposes the use of the conceptual map. It is a graphic instrument of representation of information and knowledge, and it is useful to the practitioner to conceptualize his knowledge of the problem he has to solve. The conceptual map aims to contribute to the achievement of 'meaningful learning', ie it useful to change the practitioner's cognitive structures.

In the subsequent phase of problem solving, the professional can take benefit from the mental map, it is different from the conceptual map. The mental map supports the elaboration of thought and the creativity, so it is useful in the research of possible problem solutions. A mental map is a tool based on recall, exploiting the mental unconscious resources; it can be the starting point of a creative process.

Moreover, mental maps are particularly efficacious as tools of annotation and learning, in order to help the personal orientation and the creation of work groups. They can be also used in the "reflective conversation" between professional and client, because they are considered by Schön as a real work group.

5 FIRST ATTEMPT TO APPLY REVISED SCHÖN'S CONCEPTS TO PLANNING

For a first trial of application of Schon' concepts revised in the light of recent theories of creativity, we consider urban planning at municipality level (ruled by the PGT – Governance of the Territory Plan).

In every part of a PGT we can recognize creativity working, and in particular the practitioner has more freedom in outlining the Plan Document (DdP). In the DdP are observed some elements of creativity concerning the phase of definition of the indicators, as they are not standard. Among the PGTs we analyzed, those of Inzago and Cologno Monzese are the richest in terms of indicators and some examples are: the daily movements of the population and the level of unemployement.

However, the creativity knows most important points of expression in the construction of future scenarios. Future scenarios are generated from the knowledge framework, when the planner prospects a scenario, he builds 'memories of the future', ie in the specific future image of the community, starting from his wealth of experience and memories. This process, called 'visioning', also includes the definition of actions required to really achieve this future image of the city. In the whole process an active participation of the citizens is necessary, in order to take into account the community's wishes. Moreover, thanks to the citizen's participation, the planner is able to create a comprehensive SWOT analysis that highlights strengths, weaknesses, opportunities and risks relating to each objective. This analysis is made explicit, for example, in DdP of Cologno Monzese but not in the Casirate d'Adda one.

The exercise of visioning could seem to the planner himself 'only' a deductive process, instead, he makes use of his own creative skills that are not declared in the plan, because often he is not aware. In fact, in PGT analyzed only the final product is reported. For an example, in the PUG of Lecce five different strategies are shown: Lecce as a sustainable city, competitive and innovative, accessible, as a city which regenerates itself and eventually as a city that enhances itself.

From all this it follows that the role of a planner is very complex, in fact he should be: a political expert (to understand interests playing and know how to manage the conflict), a creative set designer (to build the future vision of the city), an historian (because he must know the past, ie local identities, in order to understand the present and build the future) and a reflective practitioner (because he must be aware of his creativity in order to construct the memory of the future).

6 CONCLUSIONS

The analysis made about the mechanisms of creativity seemed us being promising, should now be must be deepened by defining more accurately the processes of thought and action that are typical of the designer/planner.

Moreover, from the applicative point of view it would be useful to extend the research in the future to a large amount of PGT in order to see if these concepts are valid in all cases.

Through scientific studies focused on memories, knowledge can be improved in this field of research both starting from existing general theories and generating other ones.

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ACHIEVING PEOPLE FRIENDLY ACCESSIBILITY

KEY CONCEPTS AND A CASE STUDY OVERVIEW

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ABSTRACT

The present paper stems from the evidence that one of the reasons of the “crisis” of today's cities probably depend on mobility issues.

But what should be done to confront all the negative impacts of passenger transportation, without curbing mobility? Can Urban Engineering be applied to promote a friendlier mobility, that should be not only environment and climate friendly, but user friendly as well? And how?

A "people friendly" accessibility approach is presented and conceived as a solution to better integrate land uses with the transport system, satisfying people's expectations (especially those of vulnerable users) to easily reach the opportunities they wish to engage with.

The case study of Amsterdam, as walkable and cycle friendly city, is briefly presented and reveal good practices in the field of urban and mobility planning.

Finally, an isochronical accessibility analysis of Amsterdam is applied: it represent catchment areas of railways stations and of supermarkets, and it highlights how much the structure of the city supports bicycle use.

KEYWORDS

Urban planning; Friendly mobility, Accessibility, Amsterdam

1 INTRODUCTION

In the recent years, some Italian authors started to express the idea of a "crisis" of the City and of the Urban Planning discipline in Italy. A new approach to mobility issues in urban planning – that may for example take into account accessibility issues as discussed further in this paper – is often seen as a possible solution to overcome the crisis of today's cities (see, i.a., Campos Venuti 1999; Salzano 2003; Campos Venuti 2010; Benevolo 2012).

Campos Venuti (1999; 2010) argues that mobility planning represents a crucial factor to solve the problems of the contemporary city, and he suggests a "rail therapy" (what he calls "*cura del ferro*") to make the major Italian cities grow (Campos Venuti 1999). For Salzano, the "traffic paradox" is among the aspects that most contributed to the crisis of cities (Salzano 2003, 4): "moving about" has nowadays become a torment and a waste of time, a dissipation of public and private resources, a misuse of space and energy, and a worrisome source of pollution. Historically, the city has been the place of the relationships among people, but it is now degenerating. In the years of the "civilization of the car", the city has become a place of segregation, isolation, and difficulties for communication. Therefore, Salzano argues that mobility issues rank among the most urgent challenges for today's urban and territorial planning practice. A new organisation of the transport system, that allows a consistent modal share shift from on road individual transport to collective and rail transportation means is required. And in the meantime, a new organisation of the city, playing with the location of the urban functions and the management of times, can reduce the demand for mobility (Salzano, 2003).

The crisis of mobility is therefore seen as the most emblematic factor of the crisis of the city: passenger mobility is nowadays a very critical issue. Mobility is vital for the quality of life of citizens as they enjoy their freedom to travel (European Commission 2011), and plays an essential role in economic and social development in every society. But, in the meantime, it entails several negative consequences, both on the environment and on the liveability of our cities.

Current passengers' modal split is highly overbalanced towards road transport and private cars. In 2010, total passenger transport activities in the European Union (EU-27) by any motorised means of transport were estimated to have amounted to 6,424 billion passenger kilometres, and passenger cars accounted for 73.7% of this total (European Commission 2012). On the contrary, non-motorised means of transport, such as cycling and walking, account only for a very marginal share of road transport: the average person in the European Union cycles about 0.5 km, walks about 1.0 km, and travels 28 km by car per day (WHO Europe, 2004). In 2010, the European Union had 477 passengers cars per 1,000 inhabitants (European Commission, 2012). And Italy is among the EU countries that have the highest motorization rate[1], with 606 passengers car per 1,000 inhabitants (Eurostat 2013).

What should be done to confront all the negative impacts of passenger transportation, without curbing mobility, or hindering in the meantime, the right to move freely? Can Urban Engineering be applied to promote a friendlier mobility, that should be not only environment and climate friendly, but user friendly as well? And how?

[1] According to Eurostat data, only Luxembourg shows a motorisation rate higher than Italy, with 672 passengers car per 1000 inhabitants (Eurostat 2013) (Eurostat motorisation data are based on 2009 values).

2 TOWARDS A FRIENDLIER ACCESSIBILITY

Cities depend on mobility: contemporary society is a mobile society, where lifestyles and business practices are inextricably linked to mobility (see, i.a., Bertolini 2012). Therefore, mobility should become a central issue in planning, and there is a need to find a balance in response to what Bertolini (2012) defines the "core dilemma" of mobility planning: dependency vs. lack of sustainability.

The literature on these topics is extremely wide, and assumes that there are tight and complex relationships between urban planning and mobility. Within this framework, many authors agree that a shift from mobility-oriented to accessibility-based transport planning is nowadays the key towards a sustainable transport planning (see, i.a., Banister 2008; Handy 2002; Marshall 2001). And the World Business Council for Sustainable Development (WBCSD 2001) states that «for mobility to be sustainable, it must improve accessibility while avoiding disruptions in societal, environmental, and economic well-being that more than offset the benefits of the accessibility improvements».

Accessibility expresses the interactions between the activities located in a region and the transport system serving it. It is an essential feature of a well-functioning city or region, and represent a fundamental principle, because it provides a framework for understanding the reciprocal relationships between land use and mobility (Hull, Silva and Bertolini 2012).

Furthermore, accessibility focuses transport planning on the connection of people and activities instead of on the transport system: it represents a shift of focus from the means (e.g. infrastructures and their performances) to the ends: the fulfillment of people's expectations. Accessibility involves a person-centered planning view: thinking in terms of accessibility represents a way of thinking in terms of people and individuals rather than on traffic.

For all these reasons, accessibility is a key issue within the People Friendly City vision, a concept developed since the beginning of the '90s in the researches coordinated by Prof. Roberto Busi in Brescia (see, i.a., Busi 2011; Busi 2012). The final goal of this vision is to greatly influence the quality of life in urban areas, starting from a focus on vulnerable road users.

With reference to accessibility, Busi (2013) argues that researchers and urban planners should have in mind that the final aim of mobility is reaching the final destination, possibly in an easy and pleasant way. People's daily lives are made up of a growing diversity of activities and locations, and mobility holds all of this together (Bertolini 2012). But, as reminded by Busi, the city is too often designed in such a way as to prevent it being used easily and calmly by the most vulnerable citizens. The city is therefore seen by them as inaccessible or even hostile (see, i.a., Busi 2009, Tiboni and Rossetti 2012). Tira (1999) remarks that land uses, public spaces, facilities and residential areas should be planned and designed considering the possibility to be reached, and considering the different modes of transport.

Finally, Busi (2013) shows a bit of skepticism regarding the use of accessibility evaluation models, due to the fact that accessibility has too many implications, that go further ahead the proposal of uncritical mathematical solutions like models. He proposes instead the creation of cultures and the development of techniques geared towards accessibility. According to this idea, case studies are probably one of the most useful approaches: the following section presents the case study of the city of Amsterdam.

3 AMSTERDAM CASE STUDY OVERVIEW

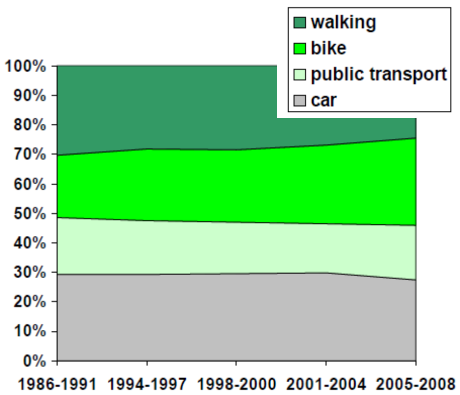
In the '90s, a Dutch National Report on transportation concluded that car based mobility growth should be reduced to a given target: mobility growth was restricted to 30%, while forecasts were predicting increases of 60% and more (Dutch Ministry of Transport and Public Works 1990). And the city of Amsterdam applied some policies to reduce car use.

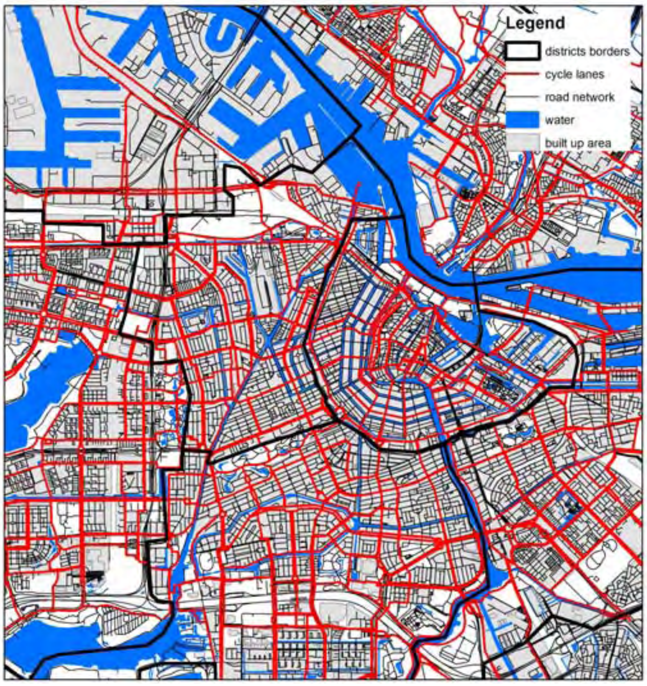
Today, the city of Amsterdam counts approximately 800,000 inhabitants and covers an area of 219,33 km². But, how is mobility in Amsterdam structured? Which are the main mobility patterns? And how do these affect the urban accessibility?

Amsterdam is, arguably, a walkable and cycle friendly city. In the city of Amsterdam, 32% of daily movements are made by bicycle, 27% on foot, 22% by car and 16% by public transport (source: DIIV, 2013 based on 2011 data). Bicycle use is encouraged by a wide and well-connected network of cycle paths (figure 2).

DISTRICT	CAR	PUBLIC TRANSPORT	BICYCLES	MOPEDS & MOTORCYCLES	WALKING	OTHERS
Centrum	14%	10%	48%	3%	25%	1%
West	16%	21%	34%	2%	26%	1%
Nieuw-West	33%	14%	25%	2%	20%	6%
Zuid	17%	15%	36%	0%	31%	1%
Oost	19%	10%	41%	2%	27%	1%
Noord	39%	17%	16%	0%	27%	1%
Zuidoost	27%	31%	13%	1%	26%	2%
Amsterdam	22%	16%	32%	1%	27%	2%

Tab.1 Modal Split in Amsterdam. Data source: DIIV, 2013





Figg. 1 and 2 Modal Split in the city of Amsterdam (1986-2008) (left). The cycle lanes network in the city of Amsterdam (right)

In addition, the public transport network in Amsterdam is widespread (fig. 3). There are a dense rail metro system (4 lines), a tramway network (16 lines), and a bus network.

The different public transport modes have completely integrated fares (not only in Amsterdam, but in the whole Netherlands), thanks to the OV-chipkaart, a smart card that can be used to pay buses, trams, metro and trains.

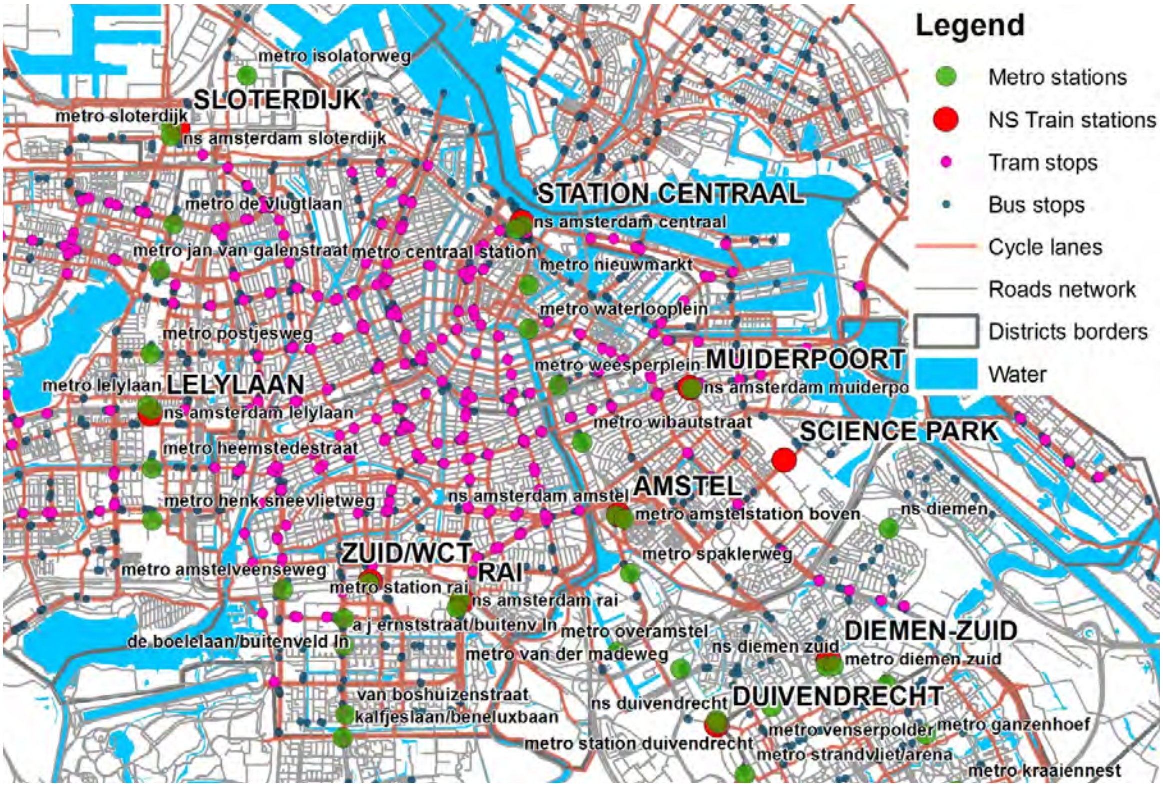


Fig. 3 The public transport system in the city of Amsterdam.

In Amsterdam there are examples of train stations area redevelopment, partially in accordance to Transit Oriented Development (TOD) principles: the ZUID station area is an emerging business centre while BIJMER ARENA is an emerging leisure centre. Both the stations are characterised by a mix of moderate to high density land uses that highly support public transport use (fig. 4).
Furthermore, one of the most important factors in lowering individual motorised vehicle use lies in the multimodality: the integration between bicycle and train is therefore highly encouraged (see section 2.2).

Fig. 4 The Bijmer Arena railway station in Amsterdam

But, which are the main land use and mobility policies implemented in Amsterdam in the last decades?
In 1990, a Dutch National report on transportation concluded that the growth of mobility by car should be reduced to a given target. Three main land use and transport policies have been implemented in Amsterdam (Le Clercq & Bertolini, 2003): a compact city policy, which aimed at concentrating activities and reducing trip

lengths and is part of wider efforts that involved the whole Randstad Holland area; a policy to expand the public transport system, particularly to new city extensions; and the ABC location policy.

The ABC location policy was designed by the National Government to help curbing the growth of car use and in reinforcing urban vitality. The policy aims to match the mobility needs of businesses and amenities with the accessibility of different locations according to the motto "the right business at the right place" (Martens and van Griethuysen 1999). The Dutch authorities rated business locations according to their accessibility profiles: "A" locations were well-connected by public transport, "B" locations were fairly accessible by both public and private transport and "C" locations were poorly connected by public transport, but had good road access (Martens and van Griethuysen 1999; Le Clercq and Bertolini 2003; Santos *et al.* 2010).

Among the best practices on sustainability and integration between urban and transport planning, Amsterdam has also developed a car-free neighborhood: GWL Terrein (see, i.a., Scheurer 2001; Foletta and Field 2011). GWL Terrein was built between 1996 and 1998 on the former site of the municipal water utility (Gemeente Water Leidingen). GWL Terrein is a compact neighbourhood consisting of high-density housing: it is composed by 625 residential units and covers an area of 6 hectares of land. It is located 2.5 km far from Amsterdam central station, and it is well connected by the public transport system: the tram line n. 10 links GWL Terrein with the city centre. Furthermore, it is served by car-sharing facilities.

GWL Terrein provides a compact mix of both social and market-rate housing, and addresses environmental concerns. Among the peculiarities of GWL Terrein there is a lack of parking spaces for the inhabitants to encourage a car-free environment: the average parking supply is 0.2 per unit.

Fig. 5 Pictures from the car-free neighborhood of GWL Terrein

2.2 MAPPING ACCESSIBILITY IN AMSTERDAM

To show some of the results of the policies implemented in Amsterdam, some GIS-based accessibility analysis in the city of Amsterdam were performed[2].

The first analysis aimed at assessing the integration between bicycle and train for commuters, while the second one assessed the accessibility to supermarkets by bicycle.

Amsterdam is served by ten railway stations of the Dutch Railways. Five of them are major stations served by intercity trains (Sloterdijk, Zuid, Amstel, Bijlmer Arena and Amsterdam Centraal), while others are served only by regional trains (Leylaan, RAI, Holendrecht, Muiderpoort and Science Park). To display the

2 The analysis was conducted by Silvia Rossetti during a visiting research period at the University of Amsterdam hosted by Prof. Luca Bertolini.

accessibility to these stations, the GIS environment was used and isochrones were built, incorporating the catchment areas of the train stations by bicycle (fig. 8) and on foot (fig. 7). From the maps, it emerges clearly that the whole municipal territory is easily accessible by bicycle from the train stations: most of the territory can be reached in 5-10 minutes cycling. Bicycle is seen in Amsterdam as a complementary mode to trains, because it makes possible the combination between the speed of the train for the long distances and the flexibility of the bicycle to reach the final destination of the journey. The integration between railway/public transport and bicycle to reach the final destination is encouraged also by good bicycle parking facilities at the train stations (fig. 6).

Fig. 6 Underground bike storage at the ZUID (left) and at the AMSTEL (right) railway stations.

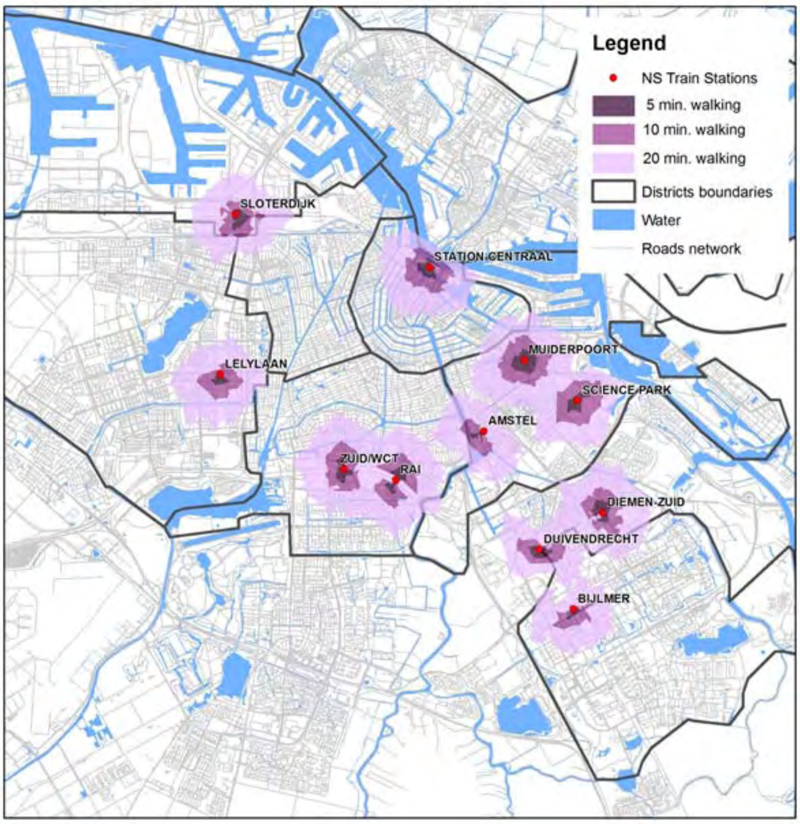


Fig. 7 Catchment areas of train stations by walking

Fig. 7 and 8 show the global accessibility level to the city and the catchment areas covered by the transport network (railways and bicycle paths). A subsequent step of the analysis is the assessment of the activities, opportunities and attraction points (services and facilities, jobs, ...) located on the territory. In this paper, this kind of analysis is provided with reference to retail services: supermarkets and grocery shops.

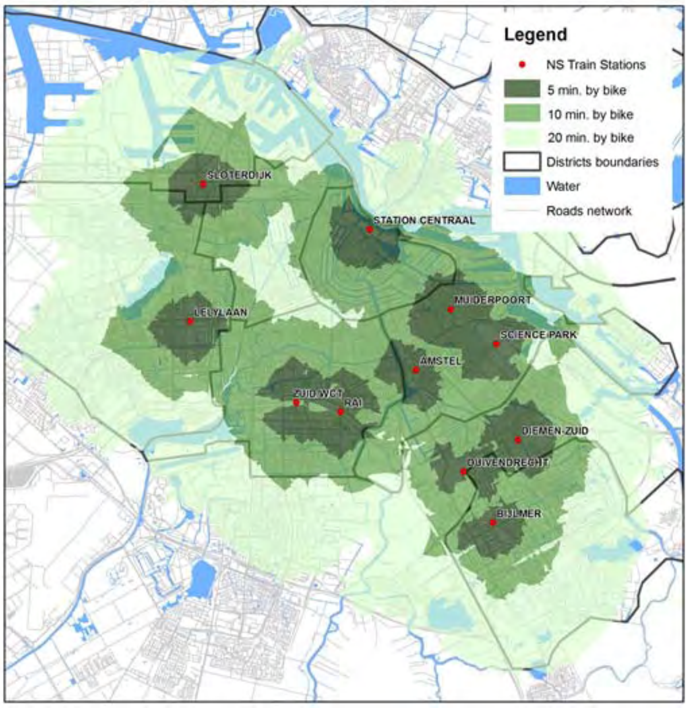


Fig. 8 Catchment areas of train stations by bicycle

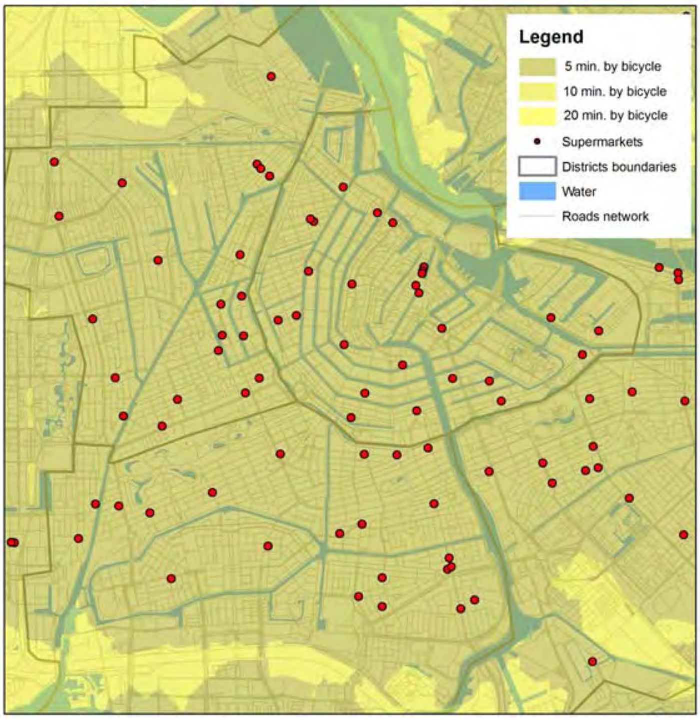


Fig. 9 Accessibility to supermarkets by bicycle in the City of Amsterdam

This services are often (at least in Italian cities) reached by car. Does it happens also in Amsterdam? Or not? To answer this question, a second analysis focused on supermarkets was performed. It aimed at highlighting that the above mentioned urban mobility structure in Amsterdam has major implications on the retail structure as well: instead of few big hypermarkets, to be reached almost exclusively by car, Amsterdam has a range of medium scale supermarkets, easily accessible by bicycle for a daily-based grocery shopping.
Therefore, isochrones by bicycle were built from each supermarket in the area. Figure 9 shows that the whole city is dotted with supermarkets within 5 minutes by bicycle.

4 FINAL REMARKS

A people friendly approach may be seen as complementary, or even opposed, to the “smart city” concept. While the primary objective of a smart city is to optimise energy resources and transport management to make urban areas maximally efficient, a people friendly city approach re-centers the attention on people and individuals, favoring cities with enjoyable spaces and accessible to all (Tiboni and Rossetti 2012).
As a matter of fact, the quality of life is not only a land use issue, but also a mobility issue. A "people friendly" accessibility approach can therefore be conceived as a solution to better integrate land uses with the transport system. The final goal of this approach is an increase in the quality of life through the satisfaction of people's expectations (especially those of vulnerable users) to easily reach the opportunities they wish to engage with.
The case study of Amsterdam, as walkable and cycle friendly city, is noteworthy, because it incorporates different sets of policies and good practices that together lead to the creation of people friendly environments. It shows that to achieve a “people friendly” accessibility, infrastructural improvements to provide the city with more sustainable travel choices are not enough. Infrastructures and transport strategies must be fully integrated with urban planning policies and practices geared towards life styles less dependent on cars. To show an example (that also relates with the accessibility to supermarkets analysis provided for the City of Amsterdam), a strong policy focused on retail facilities was implemented in the city of Freiburg (see, i.a., Tiboni and Rossetti 2011), where suburban retail structures are only allowed to sell bulky goods (like furniture) in order to ensure access to basic shops within walking distances from dwellings and residential areas.
Furthermore, also road safety plans and policies plays a crucial role: it has been proofed that accessibility as strong interrelations with Road safety. According to a report by WHO Europe (2004), real and perceived safety concerns are an important barrier preventing many people from choosing walking and cycling as means of transport. Therefore, accessibility without safety is useless: a destination can be optimally accessible both from a transportation and an urban planning point of view, but if it is not safely accessible by the users (e.g. pedestrians have to cross a road with a lack of pedestrian protection facilities), it will be not perceived so accessible.
Finally, all policies and strategies should be accompanied also by a cultural and behavioural shift in the citizens, to be reached through educational and public awareness enhancing activities.

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IMAGES SOURCES

Fig. 1: O+S Amsterdam (Bureau Onderzoek en Statistiek). Figg. 2, 3: Elaborations edited by Silvia Rossetti based on data provided by the City of Amsterdam (2013). Figg. 4, 5, 6, 7, 8, 9: Pictures and elaborations edited by Silvia Rossetti (2013).

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PLANNING PHARMACIES

AN OPERATIONAL METHOD TO FIND THE BEST LOCATION

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ABSTRACT

The theme of the spatial distribution of the pharmacies on the territory is closely connected to urban planning and to services supply. In Italy, the regulatory change that took place in 2012, triggered partly by the need to adhere more to a constantly changing economic system, has led to a revision of the existing situation, consisting both on the method to quantify the pharmacies distribution and on the efficiency of the service. If Law 27/2012 has effectively allowed municipalities to increase the number of pharmacies that they can settle on the municipal territory, it has also started a process of rethinking the logic of pharmacies location and of their catchment areas.

In this framework, the present paper aims to discuss the merits of a regulatory evolutions that sparked the process of liberalization of locations, integrating the law guidelines and goals with an operating logic process, usable and useful to translate goals into planning actions in a continuous dialogue between law and territory, constraints and opportunities, equity and accessibility of the care services.

Following this logic operations, we have investigated the urban context of Castelfranco Emilia, assuming the location of new offices on the basis of pharmaceutical analyzes.

KEYWORDS

Pharmacy, spatial distribution, Law 27/2012, liberalization process, population density, equal care services, accessibility, GIS

1 URBAN AND REGULATORY CONTEXT

1.1 TERRITORIAL DISTRIBUTION OF PHARMACIES IN ITALY, BEFORE 2012

According to Article 32 of the Italian Constitution, the pharmaceutical service is intended as a public service preordained to health care and treatment of pain and it aims to ensure the proper dispensation of the means (drugs and services) used in its protection. This principle is laid down in Article 32 of Law no. 833 dated 23rd December 1978, which instituted the National Health Service; this law, in Article 25, includes pharmaceutical care (in the same way of medical-generic care, specialized nursing, hospital) in the care services borne by the Local Health Units (Giordani 2011).

For these reasons, the activity of pharmacies can be considered inside the aim of granting a public service.

This approach can be basically traced to the Giolitti reform of 1913, which stated that *"pharmaceutical care to the population, and therefore the practice of pharmacy, is a primary task of the state, carried out directly through by the local authorities (municipalities), or delegated to private individuals to be carried out, under a government license"*.

Before that, the principle of the free leading of the pharmacy prevailed (also known as CRISPI Reform, law no. 5849 dated 22nd December 1888): it was considered as a private asset and could be started without territorial constraints and limitations, with the only obligation of the responsible leading of a pharmacist, which could not necessarily be the holder or the owner of the pharmacy.

With the law of 1913, the owner of the pharmacy, while remaining a private individual, was bound by a relationship of special subordination to the Public Health Authority that, in the prevailing public interest, called back the power to impose obligations, performances and restrictions on the activity. Starting a pharmacy was not discretionary, but it was made on the basis of a planned action, the “pharmacies district” (called “pianta organica”) of the pharmaceutical location.

The tool of the pharmacies district was later confirmed in year ‘68 laws (Law 221/68 and Law 475/68), which, while making several major changes to the institute of pharmacy, maintained the public action in territorializing the service through the pharmacies district.

The pharmacies district is the outcome of the planning, at public level, of the equal distribution of pharmacies on the land, with the purpose of protecting the right to health, ensuring accessibility to the population in terms of equal and non-discriminating.

According to Article 1 of Law 457/68, the pharmacies districts the act in which "the number of the pharmacies, each individual location and the area of each of them are defined". The pharmacies map, then, was to be considered as an act that divided the municipal land into areas (defined as bordered areas of land), within which each pharmacy has to be set and work.

The criteria for the definition of pharmacies districts were then revised by Law 362/91 according to which:

- the number of authorizations is determined in order to have 1 pharmacy every 5,000 inhabitants in municipalities with a population of up to 12,500 inhabitants and 1 pharmacy every 4,000 residents in other municipalities (*quorum*, demographic criterion);
- every new pharmacy must be located no closer than 200 meters from the other pharmacies, and in order to satisfy the need of people in that area. That distance has to be measured on the shortest way between pharmacies’ doorsteps (topographic criterion).

The usual procedure that was followed to determine where a pharmacy had to be established, met the following logic: proceeding hierarchically, first the main town was taken into consideration, then villages and then hamlets, excluding villages and hamlets that already had a pharmacy.

1.2 THE INTRODUCTION OF THE LEGISLATIVE DECREE 1/2012 (NAMED "CRESCITALIA"), AND THEN ITS CONVERSION INTO LAW 27/2012

Article 11 of Law no. 27 dated 24th march 2012, that has converted the Legislative Decree no. 1 dated 24th January 2012, the so-called "liberalizations decree", has introduced, among others, some measures to reform the pharmaceutical distribution by modifying Law no. 475 dated 2nd April 1968, as amended.

Through this reform the legislator has set the goal, as well as to facilitate access to ownership of pharmacies by a larger number of candidates, to facilitate the procedures for opening new pharmaceutical locations, while ensuring a more widespread presence in the municipal territory of pharmaceutical services (art. 11, c. 1), an equal spatial distribution of pharmacies (art. 11, c. 1, letter c) and the extension of the accessibility to pharmaceutical services also to people who live in sparsely populated areas (art. 11, c. 1, letter c).

So the Law has provided:

- the modification of the standard demographic baseline, established so that there will be 1 pharmacy every 3,300 inhabitants, referring to the registered population at 31.12.2010;
- the planning of the new pharmaceutical locations on the territory, inside areas that are identified and chosen by municipalities according to the 3 goals cited above;
- in addition to the pharmaceutical locations previously determined, and within the limit of 5 percent of the locations, including the new ones, it is possible to establish a pharmacy:

  "a) in railway stations, in civil airports for international traffic, in maritime stations and in service areas, with hotel and restaurant services, on high traffic density motorways, provided that there is not already a pharmacy at a distance of less than 400 meters;

  b) in shopping malls and in large retail outlets with a sales area of more than 10,000 square meters, provided that there is not already a pharmacy at a distance of less than 1,500 meters".[1]

The new demographic criterion is quite clear, as it plans to open 1 new pharmaceutical location every 3,300 inhabitants (*quorum*). This means that the number of pharmacies that are up to each municipality is obtained by dividing the total number of inhabitants by 3,300 and rounding up; the difference between the so-calculated theoretical number of locations and the existing ones shall consist of the new locations, placeable according to the goals of equal and widespread geographical distribution and accessibility of pharmacy services also to people living in sparsely populated areas.

In addition, the condition of proximity should be also taken into consideration, expressing the exclusion of the placement of a new pharmacy within certain metric radii, as follows:

	Distance radius	**Regulatory reference**
From another pharmacy	200 meters	ex L. 475/1968 (e s.m.i.)
From a pharmacy in railway stations, in civil airports for international traffic, in maritime stations and in service areas, with hotel and restaurant services, on high traffic density motorways	400 meters	ex L. 27/2012, derogating from the *quorum*, with a maximum number of additional openings equal to 5% on a regional basis
From a pharmacy in shopping malls and in large retail outlets (S_v > 10,000 m²)	1,500 meters	

[1] The law has given to Municipal Councils and no longer to the Regional Authority the responsibility for the siting new pharmaceutical locations, so the Councils were required to adopt a deliberation to establish the new locations within 30 days after the entry into force of the Law that converts the Liberalisation Decree.

The new law has introduced some critical elements in siting new pharmacies.
First, a criticality can be identified in the lowering of the minimum threshold for opening a new pharmacy at 3,300 inhabitants and assigning an additional one on the criterion of "rest for excess" (ie the surplus population, compared with 3,300 inhabitants, allows to open another pharmacy, if it exceeds 50 percent of the parameter itself, so equal to 1,650 inhabitants); in fact, since the experience of the operators, it should be noted that pharmacies located in villages with a population of less than 1,000 inhabitants did not survive and they closed, so the rounding up of the ratio by which a one more pharmacy is assigned, can be further considered risky for the survival of the pharmacies in the area.
Second, the generic nature of the location goals (equal and widespread distribution, accessibility to those who live in sparsely populated areas) has made some locations questionable and has given raise to many appeals to the Administrative Court by the actual owners of the already existing pharmacies, highlighting the need to support these proposals with spatial analysis tools, in order to guarantee the achievement of law objectives and the transparency of the choices.
In fact, if the operation of liberalization made by the Law, as it might be guessed, leads to a reduction in the potential catchment area of the existing pharmaceutical locations, to some extent eroded by new locations. Therefore, it will be necessary to compare multiple potential locations for the new seats, if any, building possible scenarios in an analytical and punctual way, in terms of users and territorial accessibility, as well as in terms of reduction of the adjoining catchment areas, with the aim of minimizing losses to the existing (and future) seats and sharing the benefits on the as widely as possible amount of population.

2 WORKING METHOD

2.1 MAPPING OF THE BASIC ELEMENTS

The location of a new pharmaceutical seat must take into account some elements that could result potentially conditioning or synergistic compared to the service itself, which must be geo-referenced and mapped in order to allow to undergo the subsequent spatial analysis:

1. Pharmacies, as point features
2. Pharmacy district of each seat, as polygon feature (relevance area, usually described with words only)
3. Medical facilities, as point features
4. Groups of doctors (or UTAP, Territorial Units for Primary Assistance), as point features
5. Shopping malls (with S_v > 10,000 m^2), as point features
6. Para-pharmacies, as point features without relevance areas.

Those elements become the subject of subsequent processing and evaluation as described below.

2.2 ANALYSIS AND LOCATIONAL CRITERIA

The evaluation of new pharmacies locations can't be divided from the analysis of the current situation, based on the existing catchment areas. Therefore, the analysis started from the configuration, both in form and essence, of the pharmacy maps of each different seat already present on the territory, also including the relevance areas ever assigned or already forecasted.

2.2.1 POPULATION DENSITY

The law requires to determine the need for new pharmacies based on the residential population at 31.12.2010. However, although this data is available from the municipal registries as total number on the main town and on villages, its spatial distribution for each house number on the whole territory is not always available.

To fill this gap in spatially geo-referenced information, data obtained from the last available census, at 2001, unbundled on census section, have been used (source: ISTAT). They have then been updated proportionally (on villages and hamlets) to the value of residential population in at 31.12.10. This operation could be addressed as an oversimplification; nevertheless it was necessary, in order to produce a geo-referenced database of the residential population also for those municipalities that are not able to provide this detailed information.

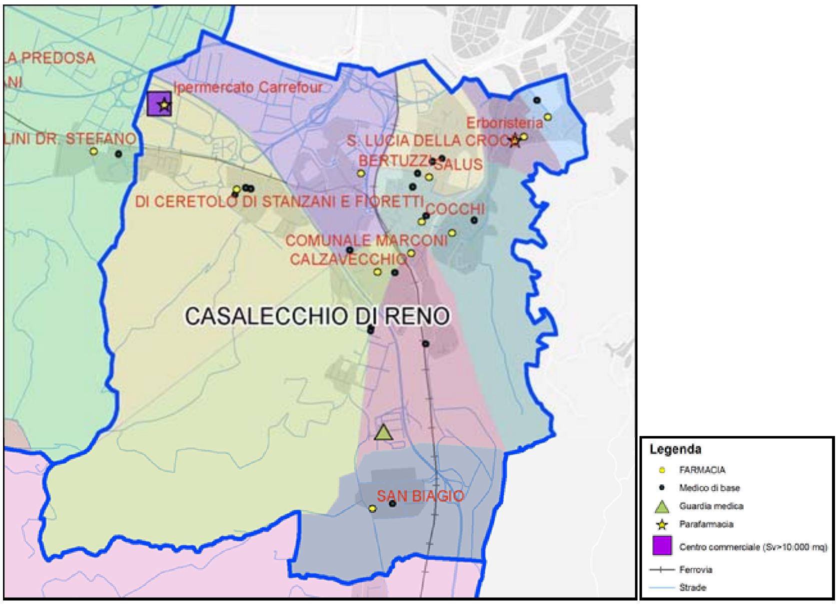


Fig. 1 The basic elements for the analysis: pharmacies, UTAP, medical facilities, para-pharmacies, shopping malls on the pharmacy map

In order to make these data more useful and targeted, using GIS software, the census sections have been crossed with the residential built-up ground cover (ie, excluding urbanized but not-built-up areas -green areas- and industrial and craft areas). The result is essentially the proportional allocation of the number of inhabitants, identified and referred to a large area (census section), only on urbanized and useful portions of the census section.

By doing so, we have tried to ensure a realistic distribution of the population on the urbanized territory, keeping the information on the age group, which is useful for the purposes of this study.

Through these steps, we obtained a map with the demographic distribution, in absolute terms, on the urbanized territory: this data, referring to different extents of land, does not give useful quantitative information in order to put two or more portions in competition; given the need to site new pharmaceutical locations that will serve the greater the more portion of the inhabitants, and then to plan the locations in an efficient and equal way, it is necessary to have data in relative terms, so referred to the portion of land on which they insist.

The total number of inhabitants of each portion of urbanized territory has then been divided by the area of the portion, in such a way to obtain a population density comparable on the entire municipal area (inhabitants/km^2).

By mapping this variable, it is possible to assess the competition between the different areas that are potentially suitable to accommodate new pharmacies, in order to highlight the “Best Location” in accordance to this criterion.

2.2.2 URBAN ACCESSIBILITY

The criterion of accessibility to each pharmacy seat has been interpreted in order to intercept the higher number of inhabitants within 400 meters (6 minutes walk) and 2,000 meters (10 minutes by car) from its location, in order to compare some possible alternatives.

After having identified the possible locations based on the criterion of population density described above, some different future scenarios have been developed, verifying for each of the alternative locations the catchment areas served within 400 and 2,000 meters.
The best location is therefore sited inside the area that maximizes the number of served inhabitants.

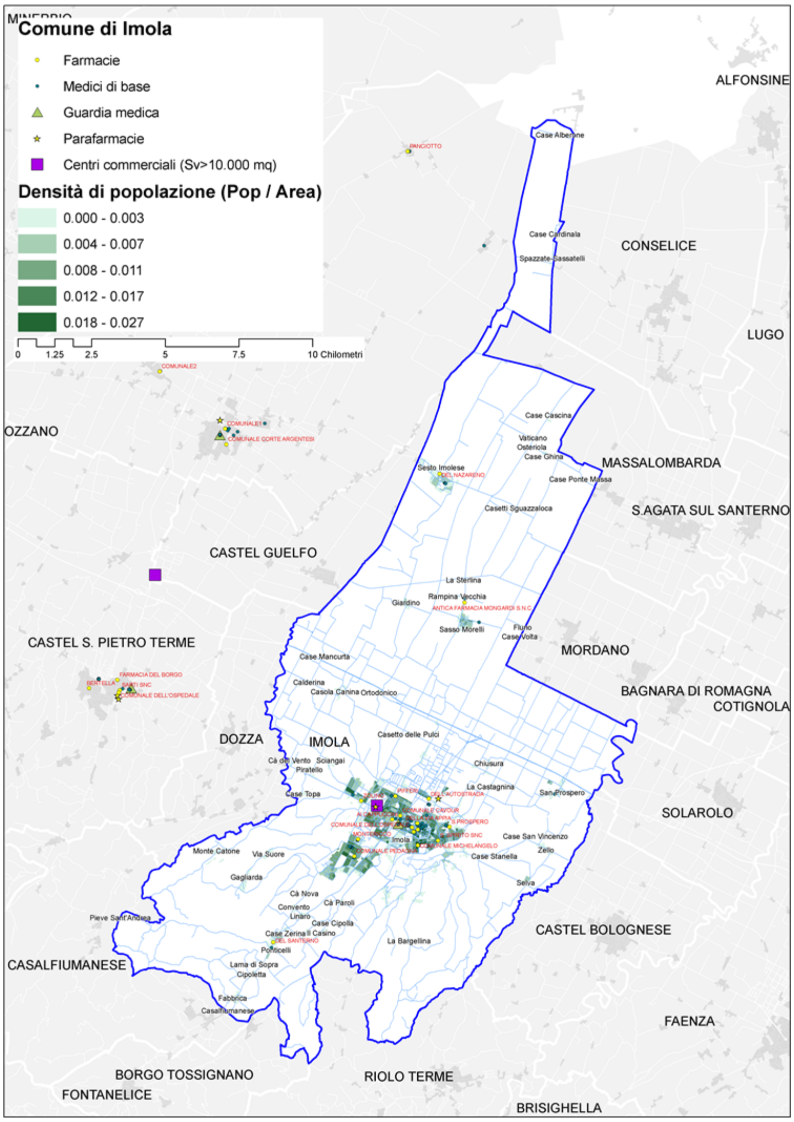


Fig. 2 An example: the distribution of population density in Imola territory

3 OPERATIONAL APPLICATIONS OF THE METHOD: THE CASE STUDY OF CASTELFRANCO EMILIA

The analysis and then the assessment of potential locations where to settle the new pharmacies is developed following the 3 goals of the Law and applying the criteria described in the previous paragraph; starting from the territorial level, we analyzed the hierarchy of settlements, ie their consistency in terms of inhabitants (in the catchment and in populated areas), proximity to other pharmacies and to UTAP, and, in some cases, possible street connections; once that some possible macro-areas where to site a new pharmacy have been identified, we have to come down to the urban level by analyzing in detail the catchment area of new and existing pharmacies within 400 meters and 2,000 meters, respectively corresponding to about 6 minutes walk and 10 minutes by car.
The result of the assessment could change if a more compact situation (thus with a capital center with a number of residents much more higher compared to the villages/hamlets) or a more widespread situation (so with towns of comparable consistency in terms of inhabitants) is examined.

3.1 EQUAL E WIDESPREAD DISTRIBUTION ON THE TERRITORY (GOAL1 AND GOAL2)

The municipality of Castelfranco Emilia, a municipality located along the Via Emilia in the Emilia-Romagna Region, has an area of 102.47 km^2 and a population of 32,102 inhabitants (as before 31.12.2010), highly concentrated in the main center (20,600 residents). The average density is therefore of 313.3 inhabitants/km². Using the demographic criterion (3,300 inhabitants per pharmacy + rest > 50%), Law 27/2012 allows 10 pharmacies to be opened in the municipality; on its territory there are already 7 pharmaceutical locations (fig. 3) to which it has to be added an eighth urban one, unassigned, already provided by the reform of the pharmacies districts completed in 2010, and located in the northwest quadrant of the municipality (fig. 3).

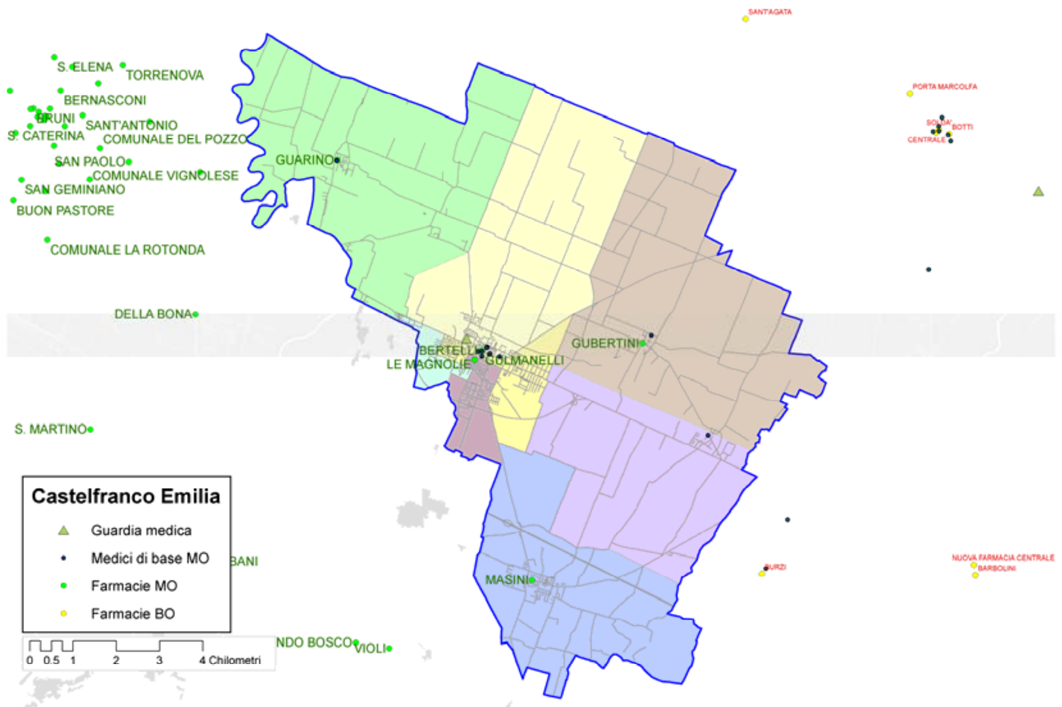


Fig. 3 The pharmacies district of Castelfranco Emilia

Assuming to settle only one of the two pharmacies still allowed, an equal distribution of the 9 pharmaceutical locations, existing or new, would mean, in a theoretical way, that each one would serve a catchment area of about 3,500 inhabitants, a value that would ensure fairness of service, both from the point of view of population (ie to ensure that only a small number of inhabitants is served by multiple locations pharmaceutical and that, on the contrary, a part of the population is not served), both from the point of view of competition between the different pharmaceutical locations, which could therefore count on homogeneous catchment area.

In detail, in Castelfranco Emilia there are 3 "urban" pharmacies located in the center of the main town, as well as a fourth location already planned but not yet assigned.

The three existing urban pharmacies, overall, serve a catchment area of about 17,500 inhabitants, of whom about 3,700 have more than 65 years, as follows:

- Bertelli pharmacy: 7.184 inhabitants (widespread houses included), 1.574 aged
- Gulmanelli pharmacy: 6.196 inhabitants (widespread houses included), 1.408 aged
- Le Magnolie pharmacy: 4.050 inhabitants (widespread houses included), 690 aged

The current situation potentially shows a larger catchment area for the first of these, while the fact that Le Magnolie pharmacy has a smaller number of residents related to their district is not really significant, since, being situated within a mall, actually it catches customers coming from other areas of the town and of the surrounding municipalities.

The other three existing pharmacies are located in the surrounding villages instead. The Masini pharmacy, located in Piumazzo, can count on a large catchment area inside its assigned district(it is about 4,900 inhabitants, widespread houses included, of whom more than 1,000 aged); Gubertini pharmacy, located in Manzolino, has a catchment area if nearly 2,700 inhabitants (widespread houses included), of whom about 470 aged; Guarino pharmacy in Gaggio di Piano village has a catchment area of about 2,700 inhabitants (widespread houses included), of whom about 550 aged.

Among the main remaining villages there’s La Cavazzona, whose pharmaceutical location has recently been assigned (for a potential catchment area of 2,121 inhabitants, of whom 320 aged).

The other villages and towns in the municipal area are much smaller, and count up to a few hundred inhabitants. Pioppa and Panzano, neighboring villages placed north of the main town, and, if considered together, would arrive to cover about 550 inhabitants.

To fully comply with the goals of the Law, ie to ensure the widest accessibility of pharmacy services also to those citizens living in sparsely populated areas, a new location sited therein could have also been assessed; however, considering the small catchment area that this one would serve, a new pharmaceutical location in that position, would not probably survive.

Therefore, the assessment of a new location within the main town has been considered, however, taking into consideration both the need of the accessibility for these villages, and the need to expand the coverage of the service to outlying areas, rather than to offer alternatives to areas already served within the city center. The location of an additional pharmacy inside the main town has therefore to be carefully assessed in order to identify the most uncovered areas and to avoid, as far as possible, serve closely the central areas, that can already rely on the presence of 3 existing pharmaceutical locations.

Another issue to be analyzed deals with the distance between pharmacies that has not to be lower than 200 meters, that the Law requires to pursue in an equal and widespread distribution of new locations in the municipal area.

3.2 ACCESSIBILITY OF PHARMACY SERVICES (GOAL3)

Considering the accessibility of the 6 existing pharmaceutical locations, it appears that virtually almost the whole population (27,410 inhabitants) is served by at least one pharmacy within 2 kilometers, which is about 10 minutes by car, and about a third inhabitants has a pharmacy within 400 meters from home (11,621 inhabitants), ie by a pedestrian walking distance in 6 minutes on average (fig. 4).

In general, then, the municipal territory has a good coverage, but nevertheless it has significant imbalances from area to area. Within a radius of 400 meters from the existing pharmacies around 4,649 inhabitants are served by two pharmacies, reachable in about 6 minutes walking (which is in fact the average time required to complete a distance of 400 meters) and well 3,840 inhabitants have even 3 pharmacies within 400 meters. This redundancy of the service, concentrated in a very small area of the main town, goes instead to the detriment of the 20,481 inhabitants of the town who do not have any pharmaceutical location within walking distance (ie placed within a distance of 400 meters) and are therefore forced to use the car to reach one of the existing locations. The new location could be provided in the most suburban areas and not immediately in the center of the main town, where, besides being in conflict with the potential catching areas of existing pharmacies, it also provide an unnecessary service at the expense, however, of areas that would most benefit from the opening of a new pharmacy. Therefore, it is possible to identify alternative locations that better meet the requirements of the Law and thus ensure a better distribution of the service on the territory, highlighting the distribution of the density of the population in the municipality and in detail in the main town (fig. 4).

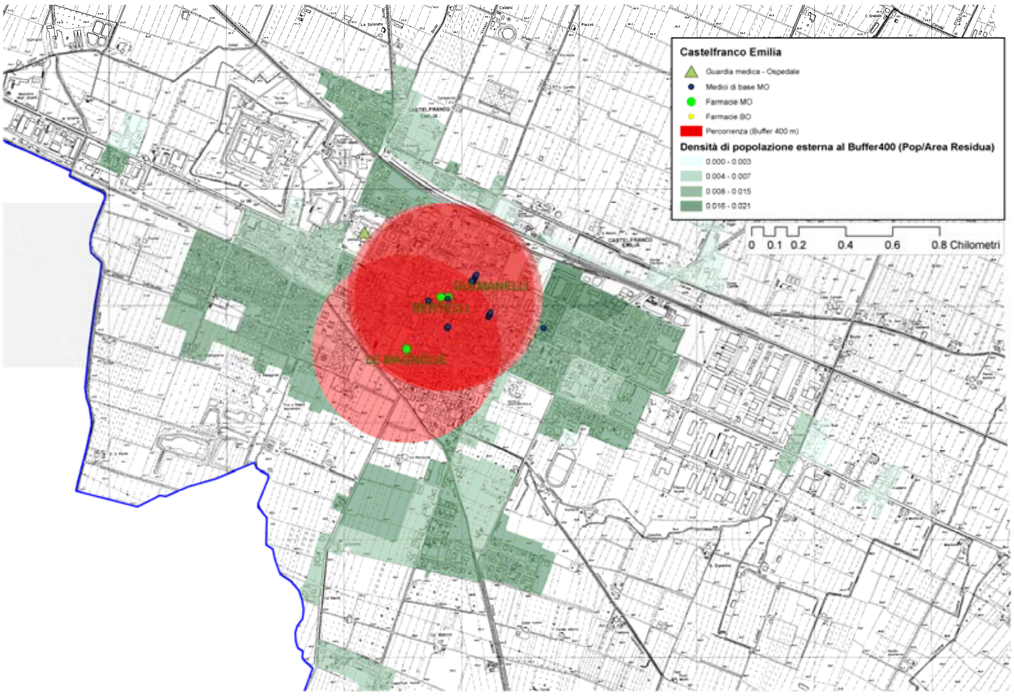
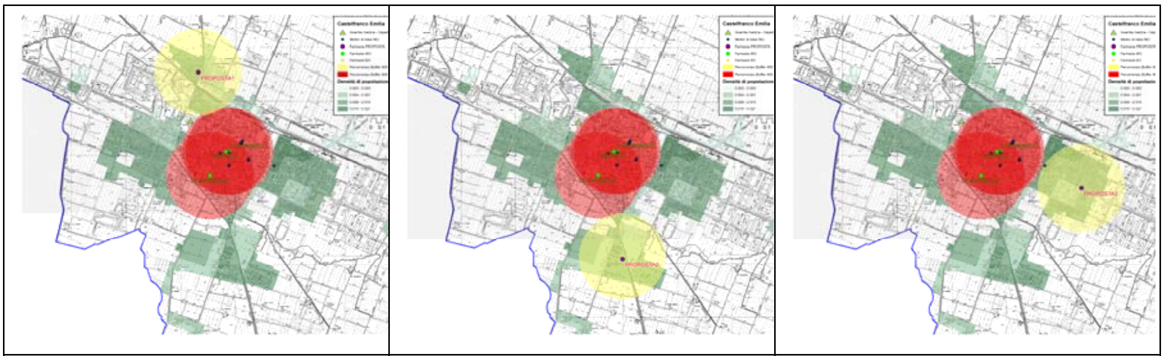


Fig. 4 The distribution of population density in the main town, and 400 meters buffers (red)

Due to the high service coverage in the center, there are also areas with a high population density that are "unserved" within pedestrian accessibility on the edge of the town: these are the east and west parts along the Via Emilia, but also in the northwest, where the Hospital is located, and to the south, where there is a recent urban development.

In summary, from the analysis of these "residual areas", the following 3 cases of location of a new pharmaceutical seat arise:



1 2 3

The 3 hypothesis intercept the following catchment areas:

	BUFFER 400 METERS		BUFFER 2.000 METERS	
	Tot inhabitants	**Over 65**	**Tot inhabitants**	**Over 65**
1	1.530	350	18.180	3.770
2	2.400	320	18.160	3.750
3	2.710	657	18.400	3.810

Numerically, the location to the east (hypothesis 3) seems the most useful and helpful; however, it should be noted that the criteria defined by the Law refer to a standard population only to identify the number of new pharmacies to be set up, while their location can not be separated from respect of equal geographical distribution and widespread accessibility to the pharmaceutical service even to those who live in sparsely populated areas.

Based on these criteria, the most suitable location would refer to the hypothesis 1 (north) because it could serve a portion of the main town, separated from the center by the railway line, and so with limited accessibility to the existing pharmacies, and, furthermore, it would intercept within about 2 km also some neighboring villages and widespread houses (Pioppa and Panzano), and then would fully satisfy the goal to provide a service even to sparsely populated areas.

4 CONCLUSIONS

As is clear from the carried out analysis, placing a service, such as pharmaceuticals, in an area more than another of the city may significantly affect the potential catching area: it may shift territorial balances, in terms of mobility and utility, and, and the more or less equal distribution of the service, from the point of view of seller, could also generate economic competitiveness.

Thinking in terms of territorial dimensions, the efficiency of the service, seen as widespread distribution of the pharmaceutical locations, is much efficient when it manages to balance spatial and regulatory sustainability with the economic one, so as to obtain a partition of the land allowing just not to penalize anyone but, at the same time, to allow everyone to have a social payback.

The effectiveness of the service, instead intended as the effective reachability of the locations from the inhabitants, is greater if it takes into account both the stratification of age and the effective accessibility of each single pharmacy, considering both paths and physical limits of the territory on these routes. These aspects obviously can not emerge from a only-regulatory approach, but need to be analyzed by means of spatial tools.

If the liberalization of pharmaceutical locations can lead to an increase in competitiveness for the pharmacies themselves, its territorialization can bring that competitiveness onto a spatial level/dimension and thus it requires the adoption of descriptive parameters, as the population density (from the user's perspective) and territorial/urban accessibility (from the point of view of the service).

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TRANSPORTATION INFRASTRUCTURE IMPACTS EVALUATION

THE CASE OF EGNATIA MOTORWAY IN GREECE

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ABSTRACT

To expand GIS abilities to the consideration of decision criteria, OR/MS researchers strongly pronounce in favor of developing synergies between GIS and multicriteria decision making tools. The rationale of this integration is the GIS ability to store and manage and visualize geographically referenced data and the efficiency of Operational Research tools for modeling decision problems. As a result, MultiCriteria Spatial Decision Support Systems (MC-SDSS) provide a consistent framework that allows alternatives' ranking combining both spatial data and DMs preferences according to a selected decision rule. Regarding to their applicability in situations that involve classification, multiattribute decision models are considered as a very attractive procedure in urban and regional planning concerning the appraisal of transportation infrastructure construction. In the present a spatial multicriteria evaluation of the impacts derived by the realization of Egnatia Motorway is performed. Egnatia Motorway is considered one of the most significant interventions that have taken place in Greece during the early pre-Olympic Games period and up to the year 2007. With a length of 670 km, it crosses 12 prefectures starting from the Igoumenitsa Port, which provides links by boat to Italy, ending to Kipi in Evros (Greek-Turkish borders). It is a dual carriageway with two traffic lanes per direction with an overall construction cost of about 6b€. Aiming to enrich Northern Greece's potential in transport industry and tourism, European Union has heavily invested in its construction. In the present paper an integration among GIS functionalities and multi-attribute decision making models such as Analytic Hierarchy Process (AHP) and Ideal Point Methods is proposed in order to estimate the impacts provoked by the construction and operation of Egnatia Motorway in regional level.

KEYWORDS

Multiattribute Decision Aid, AHP, Ideal Point Methods, GIS

1 INTRODUCTION

Land-use suitability mapping and analysis, that aim to identify appropriate spatial patterns for future land uses according to specific requirements, preferences, or predictors of some activity, have been widely accepted as one of major fields of interest between GIS analysts (Collins et al, 2001). The ability of the contemporary GIS software packages to support geoprocessing tools such as overlay procedures led both scientists and practitioners to refer to them as Spatial Decision Support Systems (SDSS). However, there is growing consensus about the limited role of GIS as SDSS (Pereira & Duckstein, 1993). This criticism is mainly addressed to the lack of adequate techniques that allow DMs preferences contribution to the final result; and to the fact that Boolean overlays identify as solutions only those that simultaneously satisfy all the analysis' criteria (Laaribi et al, 1996; Chakhar & Martel, 2003). Recent advances in both GIS technology and Multi Criteria Decision Making methods (MCDM) led many authors to recommend integrations between the two research areas. The rationale of this integration is the GIS ability to store and manage geographically referenced data and the efficiency of Operational Research tools for modeling decision problems. As a result, MultiCriteria Spatial Decision Support Systems (MC-SDSS) provide a consistent framework that allows alternatives' ranking combining spatial data and DMs preferences according to a selected decision rule (Anagnostopoulos et al, 2010).

Transport infrastructure is considered as a regional development project. The new European transport policy (EU–European Commission, 2002), has acquired a clear development dimension, and is directly linked to the policies for the social, economic and territorial cohesion of Europe. This is enhanced by evidence from numerous research studies (Vickerman, 1996; Faludi, 2006). European Spatial Development Perspective (ESDP) explicitly refers to the significance and the consequences of the European transport policy for the organization and development of the European area (EU–European Commission, 1999). It is suggested to assess the spatial impacts of European transport infrastructure on the basis of the following criteria: (a) impact on land use, (b) impact on productive systems of regions, (c) impact on spatial structure, (d) impact on the income and production, (e) impact through regional reinforcement measures, and (f) impact through the spatial differentiation of public intervention.

The Egnatia Motorway (Figure 1) is one of the largest transport projects constructed lately in Europe, and was included in the top priority projects of the Trans European Transport Networks (TENs-T). The motorway, 670km long, crosses Northern Greece horizontally from Igoumenitsa to Kipi on the Greek – Turkish border and is connected via vertical axes northwards to the Pan – European Corridors and via the PATHE (Patra-Athens-Thessaloniki) motorway and the western Ionian axis, to the rest of Greece. It is designed and built as a dual closed carriageway of international standards and comprises numerous long twin bridges, a large number of tunnels, 50 interchanges, 350 underpasses and overpasses, and 720 km of service roads. Moreover, it links all major urban centres, 4 ports and 6 airports (Egnatia Motorway Observatory, 2005).

At the national level, the Egnatia Motorway represents the backbone of the Northern Greek transport system, making it possible to break the isolation of remote Regions such as Epirus, Western Macedonia and Eastern Macedonia and Thrace. At the European level, it links Greece to Europe and the Middle East, while it operates simultaneously as a point of confluence for the merging transport flow from the Balkans and South-Eastern Europe. It is expected to operate as a zone of cooperation promoting selected economic activities, transport and energy networks, exchanges of technical knowledge, as well as the effective preservation of the environment and of cultural heritage. It is there that the Pan-European Corridors IV (Berlin-Sofia-

Thessaloniki), IX (Helsinki – terminating at Alexandroupoli) and X (Vienna- Belgrade-Thessaloniki) terminate (Spiekermann & Wegener, 2006).

In the present paper, an integration among GIS functionalities and multi-attribute decision making models such as Analytic Hierarchy Process (AHP) (Saaty, 1977) and Ideal Point Methods (Hwang et al., 1993; Tkach and Simonovic, 1997) is proposed in order to estimate the impacts provoked by the construction and operation of Egnatia Motorway in regional level. For that reason the 12 prefectures crossed by the motorway, are evaluated with the use of socioeconomic, environmental and transportation indicators. The proposed framework can be used as a valuable tool that allows public investments' evaluation in regional level, as well as inter-regional inequalities' estimations.

Fig. 1 Egnatia Motorway horizontal axis

2 SPATIAL MULTICRITERIA DECISION ANALYSIS

Rational decision making is characterized by a coherent sequence of actions that ensures DMs from dubious results in the final outcome. The methodological framework, as it has been stated by H. Simon (1960), can be distinguished in three phases. In the intelligence phase, decision space is well stated by the objectives and sub-objectives identification, and constraints criterion maps determination. In the design phase, feasible alternative scenarios are determined performing Boolean overlays among the constraints criterion maps. After the analysis decision table formation, criterion maps relative importance is estimated and utilization procedures of the geographical data are performed. Finally, in the choice phase suitability index maps are derived as the synthesis result of the per criterion utilities under a certain decision rule implementation.

2.1 ANALYTIC HIERARCHY PROCESS

Developed in the late 70s, AHP is a scaling method for deriving priorities (weights) for a set of activities according to their importance (Saaty, 1977). Since its release, the method has been widely used because it elicits DMs' preferences in a friendly and easily understood manner. As a procedure, AHP belongs to the family of methods that use pairwise comparisons in order to estimate relative preferences among decision analysis parameters in semi-structured decision problems. The method is based on three principles: the decomposition of the decision space to its fundamental elements, the comparative judgments, and the composition or synthesis of priorities.

The first of these principles is accomplished by breaking down the decision problem to its components by developing decision hierarchies. In general, the objectives tree is defined exclusively by the DMs aiming to represent their experience and intuition over the problem. Comparative judgments principle has to do with the development of a solid base for establishing priorities among the decision parameters. Local priorities are obtained by comparing qualitatively each node against each of its peers with respect to its parent node using the nine levels of the fundamental scale of preferences (Saaty, 1995). Technically this is achieved by forming pairwise comparison matrices $A = (a_{ij})_{nxn}$, where the ratio a_{ij} assigned by the DMs expresses the dominance relation of the factor in row i when it is compared against the factor in column j. The measure of the dominance relation is determined by using the strict preference (A_iPA_j) and indifference (A_iIA_j) preference structures. Consequently pairwise comparison matrices are positive and reciprocals, and the elements in the diagonal equal to 1. Local (or relative) priorities or weights are then established as the principal eigenvalue λ_{max} of the pairwise comparison matrix solving the system of Equations 5. When the transitive property holds (Equation 6), the matrix is consistent and λ_{max} equals n. Since in real-life situations it is quite rare to obtain consistent judgments by the DMs, AHP provides measures of inconsistency as a function of the deviation between λ_{max} and n.

2.2 IDEAL POINT METHODS

Ideal point methods rank a set of alternatives A according to their separation from an ideal solution. They are based on an aggregating function that represents the relative closeness that originates in the compromise programming method (Zeleny, 1982). The principle of compromise is that the best alternative is closer to a hypothetical ideal solution (PIS: Positive Ideal Solution) $A^{PIS} = \{x_{i1}^{+}, x_{i2}^{+}, \ldots, x_{im}^{+}\}$ that maximizes the DM's preferential system and as far as possible from an anti-ideal solution (NIS: Negative Ideal Solution) $A^{NIS} = \{x_{i1}^{-}, x_{i2}^{-}, \ldots, x_{im}^{-}\}$ that minimizes it for each one of the analysis criteria (Hwang et al., 1993). f_j^{+} is defined as the performance of the ideal solution, $f_{\bar{j}}$ is defined as the corresponding performance benchmark of the anti-ideal solution alternative, and evaluation is performed via the separation measure, which is estimated in terms of distance metrics (Hwang et al., 1993; Tkach and Simonovic, 1997). The latter is achieved using Minkowski L_p measures. According to the physical property of the distance metrics, when p increases, the total is formed with greater emphasis given to the largest deviation (Lai et al., 1994).

In practice, particular interest presents the distance measures for p values equal to 1, 2 and ∞, corresponding to the well-known Manhattan (L_1), Euclidean (L_2) and Chebychev (L_∞) distances, respectively (DeMers, 2000). Given that the final ranking of the candidate locations is achieved by performing the addition operation of the per criterion DM's preferential system, criterion maps need to be standardized. Standardization (also known as normalization) enables criterion maps to be combined on the basis of a common reference scale, which most commonly ranges between 0 and 1. When ideal point methods are considered as the decision rule, the standardization process is usually linearly accomplished using the maximum score or the score range approaches (Zeleny, 1982; Hwang et al., 1993).

3 PROBLEM FORMATION AND EVALUATION CRITERIA

3.1 EGNATIA MOTORWAY OBSERVATORY INDICATORS SYSTEM

Egnatia Odos S.A. (EOSA) established and operates the Observatory of the Egnatia Motorway, which collects, processes, and provides valid and updated data regarding parameters in order to: (a) support the integrated management of the motorway, (b) contribute to the utilization of the project in the cohesion and development of a greater area, and (c) contribute to the harmonized assessment of TENs-T impacts on the cohesion of the European area (Vickerman, R., 2004). A central element for the operation of the

Observatory is the organization of the information system that provides a potential for recording, calculating, and monitoring of 50 various indicators. Among these indicators, twenty have been chosen for this particular application and have been subjected to the necessary changes and modifications in order to become suitable for the purposes of the research. The examined influence zone includes the transit route of the axis, which is directly influenced. For its definition, the spatial level which is represented by the Prefectures is considered more useful in operational terms. Therefore, the transit route from the West to the East consists of the following twelve Prefectures, which are part of five Regions: Thesprotia, Ioannina (Region of Epirus), Trikala (Region of Thessaly), Grevena, Kozani, (Region of of Western Macodonia), Imathia, Thessaloniki, Serres (Region of Central Macedonia), Xanthi, Rodopi and Evros (Region of Eastern Macedonia and Thrace). This area covers 32.000 Km2, representing 49% of the total surface of Regions and 24.5% of the national territory. According to the 2001 Census, the actual population adds up to 2.319.052 inhabitants. The Prefecture of Thessaloniki is the most populated of the Prefectures, since it concentrates 27% of the population.

Fig. 2 Egnatia Motorway and the examined alternatives

3.2 DECISION HIERARCHY FORMATION

The need for performing MCDA approaches in order to gauge the examined prefectures occurs given that there is no effective solution that dominates all the others in the analysis. Figure 3, shows the rankings of the alternatives to the examined indices. Granted that, it is rather difficult for both practitioners and researchers to handle effectively the amount of information. In order to avoid the above drawback AHP is used in the present paper aiming to establish a composite index of suitability enabling thus sufficient ranking of the alternatives.

In order to enable coherent evaluations among the analysis objectives and subobjectives a five level hierarchy is formed (Figure 5). The first level consists of the analysis goal which is the effective ranking of the examined prefectures while in the last level is occupied by the analysis alternatives. The twenty indices that are used for the alternatives evaluation are grouped under socioeconomic, environmental and transportation objectives that should be improved by the Egnatia Motorway realization. Moreover socioeconomic objective is further subdivided into socioeconomic and planning indicators in order to build clusters that ensure coherent evaluations during the process of deriving relative priorities i.e. the contribution of each objective to the final outcome. Finally the contribution of each alternative to the indices satisfaction is standardized using the maximum score method (Voogd, 1983).

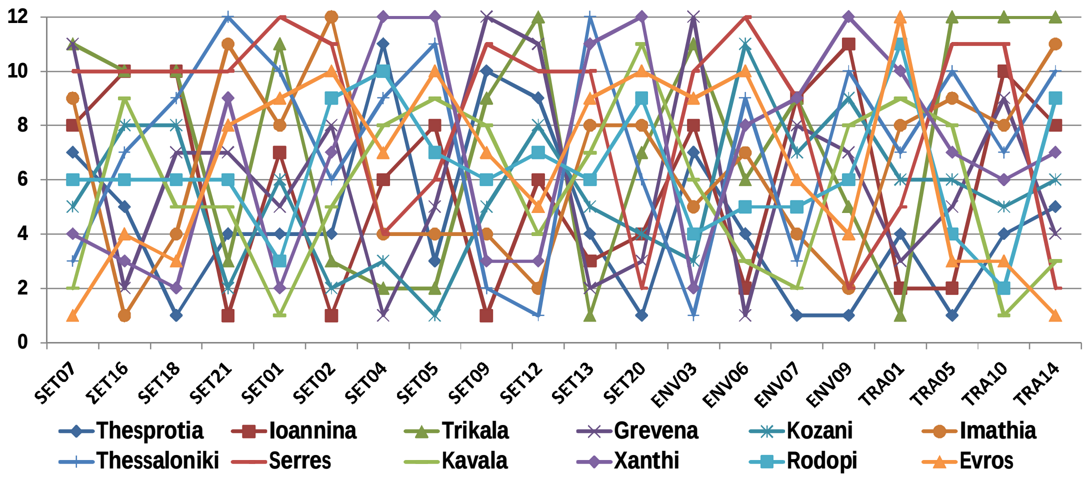

Fig. 3 Alternatives profile to the analysis criteria

3.3 SOCIOECONOMIC INDICATORS

SET01: It defines the percentage of 2011 population of every prefecture's municipalities which have the main axis of Egnatia Motorway passing within their boundaries comparing to the total population of the prefecture. The indicator's purpose is to assess the population which is potentially benefited directly from the road axis on the level of everyday trips.

SET02: It defines the Annual Average Domestic Product (GDP) 2000-2007 per prefecture. The improvement of transport infrastructure results in an increase of the production factors' mobility and markets' improvement of accessibility.

SET04: It records the average annual rate of change of the declared income per taxpayer 2002 – 2007 in constant prices 2000, per prefecture, as a factor of the area's level of development and prosperity.

SET05: It records the percentage of the unemployed change 2004-2008 per prefecture. The unemployment rate is considered to be one of the main indicators of the development status of a region.

SET09: It determines the population change 2001-2007, per prefecture. The objective of monitoring this indicator is the identification of the macroscopic effects of transport infrastructures improvement on the increase, retaining or decrease of a region's population.

SET12: It determines the change of density population 2001-2011 per Prefecture. Density is a basic indicator of the distribution of population in relation to the motorway's axis.

SET13: It records the Total Gross Value Added (GVA) Annual Rate Shift 2000-2007. The GVA is a basic structural characteristic of a regional economy and it is affected, among others, by the improvement of the movement of goods or the markets' accessibility.

SET20: It refers to the change of total work circle of the Enterprises 2000 – 2005, per prefecture. Entrepreneurship is potentially enhanced by the operation of transport infrastructure, as enterprises improve the accessibility and have an impact on increasing the production factors' mobility and on market integration.

3.4 SPATIAL INDICATORS

SET07: It records the distance (km) of the Industrial Areas and certain other productive infrastructure located in each prefecture from the closest intersection of the motorway. The optimum connection of the road network with the productive infrastructure is generally a basic development parameter of the productive activities.

SET16: It defines the percentage of change of urban land use (continuous, linear and un-continuous development) in the areas around the nodes of each prefecture.

SET18: It estimates the average change of land value 1998 – 2007 within the direct influence zone of the axis as well as in selected areas in each prefecture. The purpose of calculating this indicator is to examine the effects of the operation of the road axis on land value.

SET21: It records the change of attraction that takes place among the prefectures' capitals after the improvements in distance brought by the construction of Egnatia Motorway and depends on the exact distance from the road network before and after the operation of the Egnatia Motorway and on 2001 population.

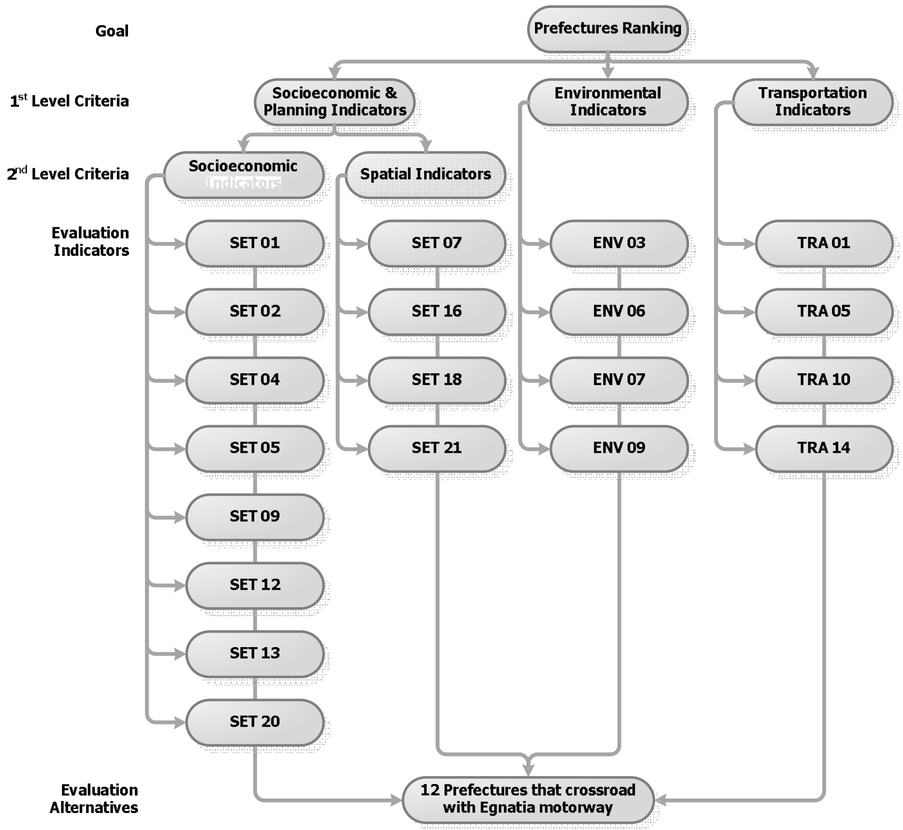

Fig. 4 Decision hierarchy

3.5 ENVIRONMENTAL INDICATORS

ENV03: It presents the change of fragmentation of organized settlements before and after the axis' operation per prefecture. The fragmentation of settlements is calculated as follows: [number of settlements] x [average permanent population] / [average area] x (1/100) and has important implications in their urban organization, proper operation as well as safety of their residents.

ENV07: It defines the change (%) of the technical surfaces along the Egnatia Motorway 1998 – 2007 per prefecture in the areas nearby the interchanges. The conversion of rural and natural land into technical surfaces is a cause of biodiversity loss and reduction of natural resources.

ENV08: It indicates the relation between the environmentally sensitive areas and the road network as well as the potential options that they would be affected by human activities.

ENV09: It captures the change in density of the crossings of the national road network with surface waters per prefecture (crossings/km), before and after the operation of the Egnatia Motorway and intents to identify the sensitive spots from the perspective of the potential impacts of the axis on water supply.

3.6 TRANSPORTATION INDICATORS

TRA01: It records the change (%) 2000 – 2005 in the average daily distance travelled (in km) per prefecture of the vehicles that travelled between two successive interchanges of the Egnatia Motorway during one year. The traffic volume is the basic indicator for the depiction and examination of the movement on the axis.

TRA05: It estimates the change of the average time distance between the capital cities of each prefecture after the operation of the Egnatia Motorway by road means of transport. The time distance between these cities is a basic indicator for the estimation of the transport cost of persons and goods.

TRA10: It estimates the change of the average time distance between the prefectures' capitals after the operation of the Egnatia Motorway by road transport modes. The time distance between these cities is a key indicator for assessing the accessibility and provides basic information for the calculation of the transport cost of persons and goods.

TRA14: It records the change (%) of the trips 1996 – 2006 before and after the operation of the axis within the boundaries of each prefecture. The impacts of the axis on the trips' characteristics are related to the change in mobility, the trips' extension and the operational linkage of the areas.

4 RESULTS ANALYSIS AND DISCUSSION

Socioeconomic and Spatial indicators present the strongest relative importance and in that manner their impact to the prefectures final rankings is strong. On the contrary transportation indicators derive the smallest relative importance. The derived improvement in terms of accessibility to the city of Thessaloniki by the surrounding residential areas consists the major factor that defines the importance of the environmental indicators to the formation of Thessaloniki Prefecture final ranking. With respect to the prefecture laying in the Northeastern part of Egnatia Axis it is noted that the significant improvement regarding the qualitative features of the road network and especially the obtained beneficiary role of the Egnatia Motorway to the reduction of the isolation factors to those areas. According to the prefectures rankings five classes are formed (1-2, 3-4, 5-7, 8-9, 10-12). Rankings spatial distribution for $p=1,2,\infty$ and TOPSIS method are presented in Figure 5.

Thesprotia is ranked to the first five places for all the examined decision models since the capital city of Igoumenitsa emerges as a combined transportation junction. Nevertheless, the new port of Igoumenitsa consists the major entrance gate to EU through the Mediterranean Sea. The high relative priorities that has been given to the factors that considers with the issues of isolation reduction and road network infrastructures improvement denotes the importance of Egnatia Motorway as major intervention that aims to enhance competitiveness. Egnatia Motorway intersects prefectures of Trikala and Serres only within a narrow piece of land and thus its impact to the local economies is indirect. The later provides a reasonable explanation for the fact that both these prefectures are ranked last for each one of the decision models. When Manhattan distance metric is considered as decision rule prefectures of Kavala, Kozani and Ioannina are ranked 2nd, 3rd and forth respectively since the average distance between the capital cities has been reduced the most in those prefectures by the construction of Egnatia Motorway. Thessaloniki is ranked 8th given the bad performance to all the environmental indicators and the existence of environmentally protected areas within its borders. Evros is ranked 10th even though it consists the entrance gate since the lack of the vertical axis limits the beneficiary role of Egnatia Motorway to the southern area of the prefecture.

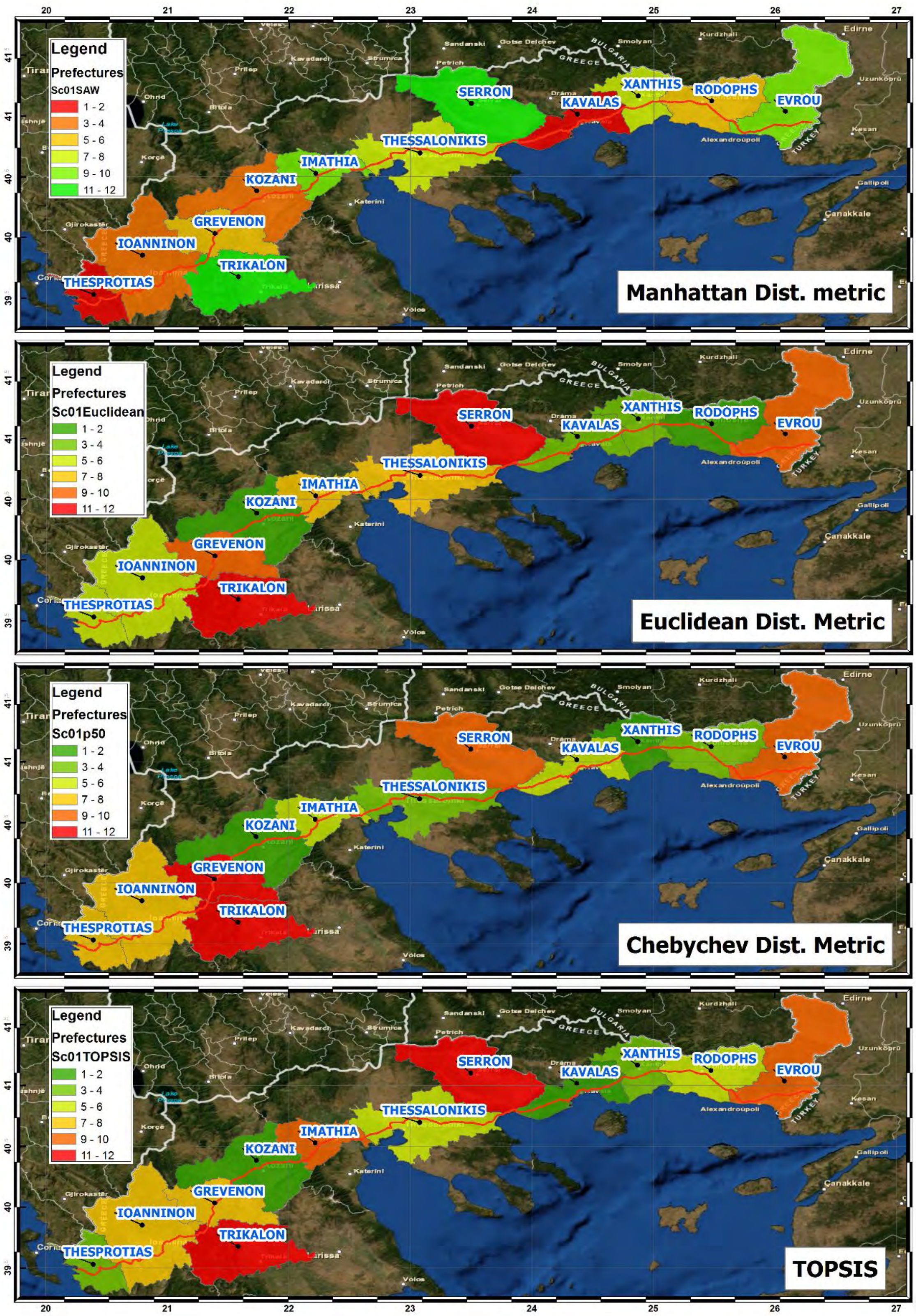

Fig. 5 Prefectures rankings for the examined decision models

The differences, occurred to the prefectures rankings that correspond to the performance of different distance metrics, for every one of the examined decision models are demonstrated in Figure 6. The first two columns present the prefectures rankings derived by the implementation of Manhattan and Euclidean distance metrics. The next columns refer to the obtained rankings by increasing the value of parameter p. Chebychev distance metric is derived for p=50 which results to the elimination of tradeoffs between the analysis criteria. As a result Trikala and Grevena are ranked to the last places given that their performance to the most important indicator (ENV03) of the analysis is the worst among the examined prefectures. Finally TOPSIS method provides evaluations taking into account the distance from the anti-ideal solution as well.

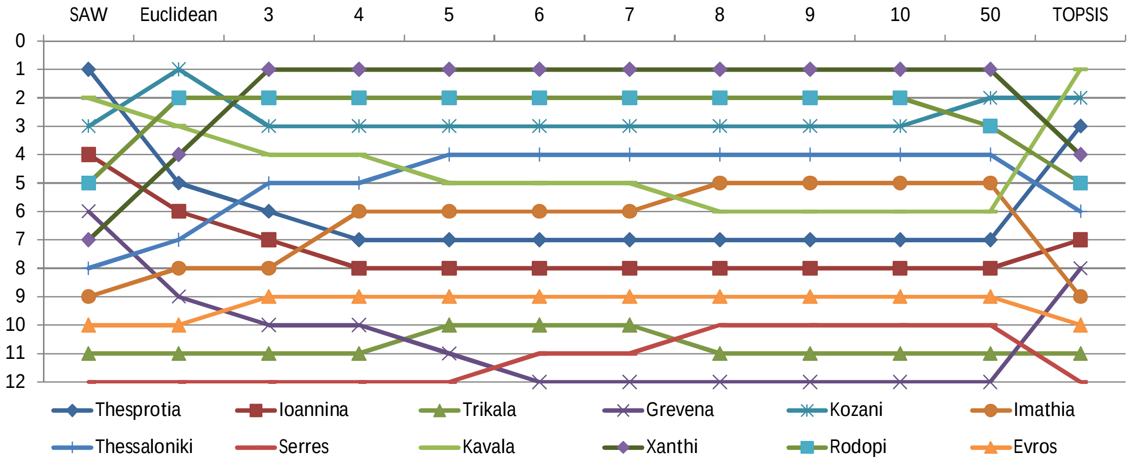

Fig.6 Prefectures rankings differences

5 CONCLUSIONS

The realization of Egnatia Motorway consists one of the most important interventions that have been utilized in northern Greece during that last two decades aiming to enrich connectivity among the capital cities and with the major international transportation axes. Since the establishment of the Observatory services by the Egnatia Odos S.A., a variety of socioeconomic, environmental and transportation indices have been developed with the aim to monitor and assess the spatial impacts of the motorway. In the present, twenty of these indices are combined in order to derive a composite index for ranking the prefecture that crossroad with the horizontal axis of the motorway. Technically this is achieved combining GIS technology and Multicriteria Decision Analysis methods. The approach combines GIS abilities for managing and visualizing spatial data while AHP provides a consistent framework for the integration of decision makers' preferences to the planning of future interventions. The above synergy allows practitioners and policy makers to identify and visualize the impacts provoked by the operation of significant public works and in the same time to identify the presence of intraregional inequalities. Thus, the proposed approach can be proved significant in order to support future decision related with the planning of future interventions in the examined area. Finally, an up to date edition with the performance of the examined indices is expected in order to estimate the impacts of the recent economic crisis with respect to the examined prefectures.

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DESIGNING MOBILITY IN A CITY IN TRANSITION

CHALLENGES FROM THE CASE OF PALERMO

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ABSTRACT

Transport policy is one of the most crucial sectors in the process of adaptation of contemporary cities to the challenge of sustainable development. For its close relation with social habits and people behaviors, in fact, innovation in transports play a strategic role both in the decreasing of the environmental impact of mobility and in the improvement of the quality of the built environment. To do so, however, cities need to reach a more effective integration between transport policy and land-use planning, as well as taking full advantage by the spreading of new technologies.

In this context, this paper discusses the challenges provided by the reshaping of the transport system in the metropolitan area of Palermo, the second larger city in Southern Italy. It attempts to explore, particularly, the potential connections between the future "hard factors" of the transport policy – as a result of the programme of infrastructural improvement under realization in the urban area –, with other "soft factors", such as the practices of social innovation in the field of mobility with the help of ICTs and other opportunities for urban regeneration linked to the reshaping of the transport system.

KEYWORDS

Urban planning, Smart mobility, Urban regeneration

1 INTRODUCTION

A common character in the most recent debate on sustainability is not only recognising cities and urban communities as crucial scales to adapt our pattern of development to the challenge of reducing the impact on the environment of human activities, but also the strategic role in this process given to technological and organisational innovation (UN-Habitat, 2011; World Bank, 2011). In fact, while the human settlements are still recognised as the places of greater consumption of non-renewable resources, it is also recognised that a fundamental step towards sustainability is removing the dysfunctions and increasing the "network effect" between existing and planned infrastructures. It means, in other words, conceiving every single transformations in a given urban areas as part of a complex process of adaptation in which every change in the factors composing the system can provide a broader range of resources and opportunities for the urban system as a whole[1].

It is widely agreed that a modern conception of transport policy can constitute a fundamental ingredient in the process of cities' adaptation to the challenges of sustainability. On the one hand, transport planning has been increasingly influenced by the goals of reducing the impact on the environment together with the aim of making urban areas (through diversified transport networks and policies) better and more livable places. On the other, the spreading of "transit oriented" planning experiments in several western countries – to be intended as a paradigm to rethink urban development under the impulse of the creation of sustainable transport networks (Cervero, 1998; Curtis et al., 2009; Bertolini, 2012; Suzuky et al., 2013) – is providing new basis for the integration of different planning rationales towards in the perspective of combining efficiency of the networks with the quality of environment.

The relation between transport policy and urban development, however, is highly differentiated on the basis of several factors, including the adaptivity of urban form, the extent and efficiency of the existing transport networks, the capacity of local governance to create links between different visions of urban development. Beside to the urban areas whose development has been historically thought in relation to the development of public transit, in fact, there is a much larger group of cases including still car-dependent metropolis and cities with consolidated divergences between urban growth, functional structure and transport system. This reality makes the application of a transport oriented approach to urban planning and design an experimental field in which infrastructural development must be combined with a broader range of policies and interventions, not necessarily with material impact on the built environment, marked by flexibility and creativity. For example, the diffusion of smart technologies (including GPS applications) in the everyday life of people and communities is giving a new set of opportunities for the transport policy within urban areas and providing new bases for a convergence between conventional planning practices and processes of social innovation[2].

With this conceptual framework on the background, this paper discusses the challenges given by the reshaping of the transport system in the metropolitan area of Palermo, the second larger city in Southern Italy. In particular, it attempts to explore the potential connection between the "hard factors" of the transport policy – mainly given by the huge programme of infrastructure redevelopment under realisation in the city –, with some "soft factors" provided by the ongoing projects in the field of social innovation and

1 See, for example, the recent concept of "urban retrofit" as an approach that look at urban areas as contexts requested to systemically reengineer their built environment and urban infrastructure in response to climate change and resource constraints (Eames et al., 2013).

2 For the impact of new technologies on mobility and social innovation see, among others, Urry, 2007; Kingsley and Urry, 2009; Grieco and Urry, 2012.

mobility with the help of smart applications. Beside that, it tries to highlight the impact of the transport redevelopment on the built environment, with a critical discussion on the planning and governance conditions required in order to make it an opportunity for urban regeneration.

The paper, whose approach is mainly descriptive and proposes to constitute the cognitive base for further analysis, is structured as follows: in the following section the main infrastructural projects in progress at the urban scale will be described for their impact on the transport system and the built environment; in the third section it is made an overview of the attempts to innovate the practice and policy of mobility both from public and private initiatives; in the conclusive paragraphs it is attempted to draw some future challenges for the city given by the interaction of the “hard” and “soft” factors described in the previous sections.

2 THE CHANGING LANDSCAPE OF THE TRANSPORT SYSTEM

Despite the demographic size of the city and the metropolitan area (inhabitated respectively by around 700,000 and 1 millions of resident) Palermo has been affected for decades by underdeveloped transit system and a cronic lack of investments on infrastructures. Public transport has been mainly based on the road system, while the rail system – conceived in the XIX century to serve primarily regional connections – has been only marginally reshaped to support urban and metropolitan mobility. In contrast, as it is better explained in the next paragraph, private movements by cars have assumed a dominant role with growing impact on city’s environment in terms of congestion and pollution.

A sharp change of direction is given in 2002 with the approval of the “Integrated Plan for Mass Public Transport”[3], which provided a wide programme of redevelopment of the transit system mainly based on the rail networks. This Plan, which can be considered an integration of pre-existing projects promoted by several public authorities including RFI (the national owner of the rail system), the province of Palermo and the municipality, was based on the interconnection of four major infrastructural projects:

- the completion of the Railway ByPass (Passante ferroviario);
- the completion of the Railway Ring (Anello ferroviario);
- the realisation of a Tram system and;
- the realisation of a Light Underground (Metropolitana leggera automatica).

The Railway ByPass is expected to be the project with greater impact on the metropolitan area. It consists on the redevelopment of around 30 kilometers of existing rail lines between the South-East gate of the city (Roccella) and the international airport (Punta Raisi) that is located 25 kilometers North-West the city centre. The logic of the intervention is to transform the existing line into an urban rail to serve the city’s major functional nodes and commuting in the metro area. For this purpose the project includes the doubling of the line for its entire route, the undergrounding of 7 kilometers in order to avoid conflicts with the built environment and the creation of 10 new stations, most of which in underground. Some of this new stations are about to be opened in proximity of places and urban functions that catalyse a huge amounts of workers and city-users, such as the hospital district “Civico-Policlinico”, the University campus, the historic centre, the district of regional government and the courthouse. For two sections of its route the completion of the Railway ByPass (started in 2008) is scheduled for 2015, while the whole infrastructure is expected to enter in service in 2018.

The Railway Ring, as well as the Railway ByPass, is a reconfiguration of an existing – partly underground – rail line that linked the Central station and the harbour area. After being dedicated for decades exclusively to the freight traffic, in 1990 the line has been reconverted to metropolitan service with the opening of four

[3] The original name is “Piano Integrato del Trasporto Pubblico di Massa” (2002) (Romano, 2006).

new stations. The project under realisation (started at the beginning of 2014) provides the extension of the line up to 6,5 kilometers with the closure of its route until the rail hub of Palermo Notarbartolo. It includes the opening of three new underground stations (Libertà, Porto and Piazza Politeama) which will cover central areas up to now touched only by bus routes. The Piazza Politeama station, particularly, will bring the rail system within the commercial and touristic core of the city, connecting it (through the link with the station Palermo Notarbartolo) with the Railway ByPass and the airport. This extension, together with the opening of the new stations, is expected to enter in service in 2018.

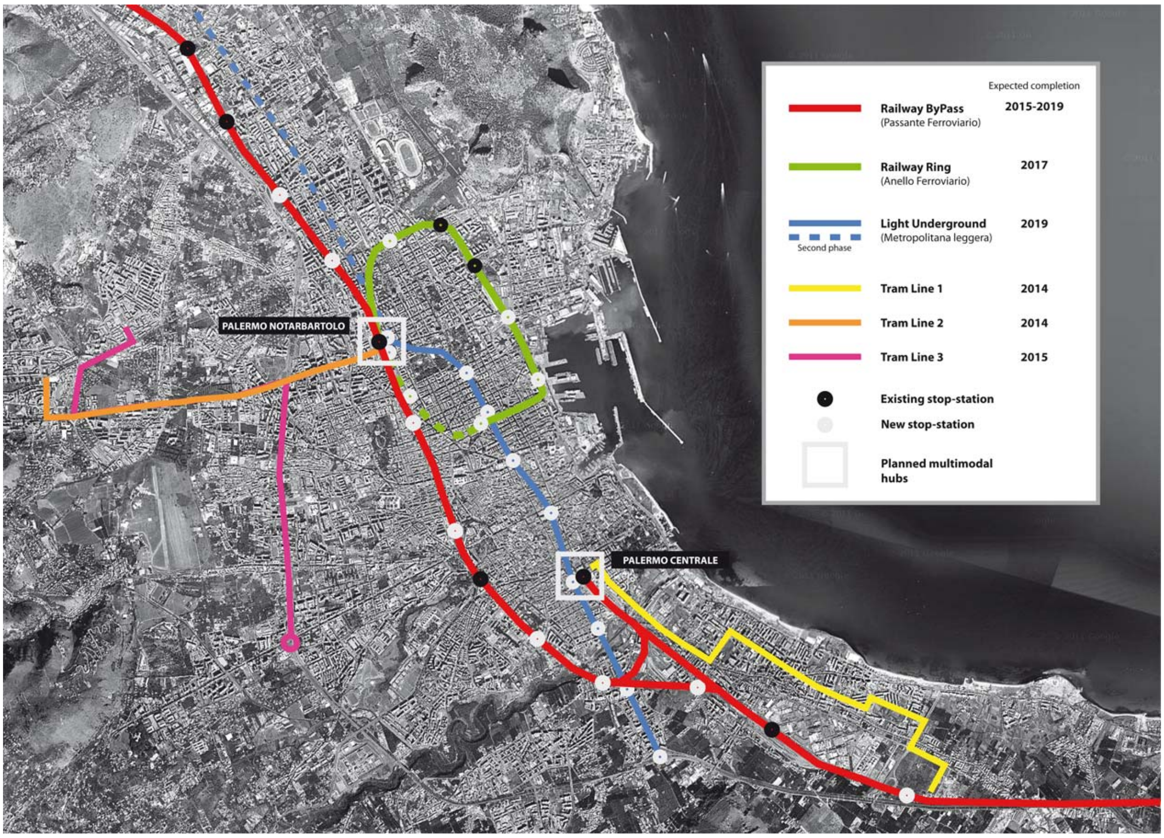

Fig. 1 Transport networks under construction in the core area of Palermo

The Tram system is a project launched at the beginning of the nineties which has faced several problem of financing before its implementation started in 2007. It is composed of three lines for a total extension of around 15,5 kilometers in response to the general aim of connecting the most remote and populated suburbs with the central area of the city in coincidence with the two rail hubs of Palermo Centrale e and Palermo Notarbartolo. The line 1, through 16 stops, connects the Central Station with the industrial suburb of Brancaccio, with a termination in correspondence of the ByPass station of Roccella and a major shopping districts (the Forum) opened in 2010. The lines 2 and 3 (with 12 and 26 stops, respectively) run between the popular neighborhoods of Borgo Nuovo and CEP and the north-western transit hub of Palermo Notarbartolo. A section of the line 3 departs from the common route with the line 2 to touch several neighborhoods along the highway (Circonvallazione) surrounding the urban area in the west side. There is a project (currently without funding) to extend the line 3 until the University campus and the Central station in order to better link the Tram system with the rail system.

The fourth project, the Light Underground, is currently that with less technical and financial definition. The broader and most ambitious version of the project provides a line running from the southern gate of the city

(Svincolo Oreto) to the coastal district of Mondello, a touristic attraction located north to the urban area. It is extended for approximately 17 kilometers, with 23 stations touching all the central districts along the main axis of urban development (south-north). The adopted technology is that of driverless trains, with a capacity of around 210 persons in the peak hours and a travel time of around 12 minutes among the two terminals (Romano, 2006). The lack of a full coverage of costs has pushed the municipality to develop an update of the project only for a first section between the south terminal and the rail hub of Palermo Notarbartolo. This section – including 10 stations for an extension of around 7 kilometers – is expected anyway to cover the busiest area of the city ensuring the links with the two rail hubs and the other modes of transport under implementation (Railway ByPass, Railway Ring and Tram system).

The above described four project in a few years will completely reshape the city's transport system at different territorial scales. On the one hand, they will impact significantly on the mobility of all users attracted for various reasons by the core city, currently served only by an inefficient and outdated bus network; on the other, the new network will ensure a linkage between the main transport nodes at metropolitan level, such as the airport, the port and the two rail hubs within the urban area. Moreover, the new linkages between the suburbs and the main metropolitan functions located in the core city should increasingly shift the mode of transport of commuters towards public transit.

In this context, however, what it is worth to highlight is also the impact of these massive infrastructural interventions on the physical and functional shape of the city.

The Tram system is changing the face of several kilometers of urban roads, most of which characterised by urban decay and low economic activity. The route of the line 1, particularly, which is aimed to reduce the remoteness of one of the most deprived district of the city (Brancaccio), is littered of abandoned urban spaces. The sites interested by the construction of the Railway ByPass with its stations cover several hectares of spaces which were, before intervention, largely underused despite their closeness to the core city. Most of these spaces are places without any consolidated identity or function, whose role, however, is going to change rapidly under the impulse of the reshaping of urban mobility. Until now, there is no deliberate strategy to design the future development of these new urban centralities: infrastructural interventions are carried out by operators (RFI, AMAT[4]) with no interest/competence towards the quality of the built environment; the municipality still lacks of an updated strategy of urban development (a new master plan is expected for the next year) which considers the local impact of infrastructural change.

3 INNOVATING MOBILITY THROUGH PLANNING AND SOCIAL INNOVATION

3.1 THE STARTING POINT

According to the TomTom *Traffic Index* (2013) – computed upon the percent of time spent in car for a same length trip – Palermo is the 5th city in the world for traffic issues (the former are, in order, Moscow, Istambul, Rio de Janeiro, Warsaw). Furthermore, according to the 2012 ISTAT data, Palermo has almost 3500 cars per squared km, the fourth vehicle density in Italy after Naples, Milan, and Turin (Aosta, the first with 4050 vehicles per square km, is an improper confrontation for its size). Almost 5 times over the italian average (725,9) and considering that the emission standards average of those vehicles is the one of the

4 RFI – Rete Ferroviaria Italiana is the state-owned operator of the national rail network. In the case of Palermo it is responsible for the implementation of the Railway ByPass and the Railway Ring and it will be the transit operator of the new networks once they will be completed. AMAT - Azienda Municipalizzata Auto Trasporti is owned by the muncipality of Palermo. It is the operator of the urban bus network and will be the operator of the future Tram system.

worst in Italy and it records bad performances mainly regarding particulate matter concentration although it's a well ventilated sea shore city. This data are probably enough to draw a first sketch of the complex scenario we are dealing with.

	Rome	Milan	Turin	Naples	Palermo	Genova
Vehicular density (cars per sqm)	1.964,7	5.313,5	5.248,0	6.323,2	3.488,0	1.879,4
Euro 0,1,2,3 cars per 1000 inhabitants	333,9	256,5	294,9	411,0	358,2	234,8
Euro 0,1,2,3 motorbikes per 1000 inhabitants	97,3	75,8	58,5	97,6	130,3	148,9
Days of PM10 limits overcoming due to vehicles traffic	69,0	132,0	158,0	53,0	66,0	13,0

Tab. 1 Private vehicles impact (source: ISTAT, 2012)

The Palermo public transport system consists mainly in the bus service. The city, is covered by 341 km bus network (AMAT 2010) and served by one of the oldest bus float in Italy. The city has a good distribution of bus stations (14,7 stations per squared km – 3,6 points more than the 15 biggest cities average) but the offer (sits km per inhabitants) is broadly under the italian average. According to AMAT's data, recently released as "open data", the busses float on road is only the 51% of the busses available (in the 2010 only 287 busses circulated among 560 available) and by the way in the 2010 the number of passengers is +18% increased (the data is related to the previous year). Moreover it is significant to underline how besides those huge limitations, the monthly and the yearly subscription cost for the public bus service is still the most expensive in Italy.

	Rome	Milan	Turin	Naples	Palermo	Genova
Bus lanes km (2009)	2208	415	600	418	335	744
Metro lanes km (2012)	41,6	87,4	13,4	34,8	-	7,1
Bus/tram stops distribution per squared km (2007)	6,5	16,3	29,1	22,4	14,4	10,6
Euro 0,1 busses (2007)	28,5%	27,1%	43,0%	45,3%	51,3%	33,3%
LPT passengers per inhabitants 2012	528,2	699,2	217,3	227,3	46,0	254,8

Tab. 2 Public transport impact (source: elaboration on ISTAT 2012 and Comune di Palermo)

Palermo, according to the other mobility systems opportunities given by the administration, is experimenting only the car sharing system (the bike sharing is expected for the next year). The data available show how this policy should be considered more as a showcase attempt than a real and concrete investment for the city transport management. After five years, with just 35 cars, 29 parking areas and 755 users is one of the less impacting in Italy.

The other policies to improve private sustainable mobility systems were never concretely pushed by the city government. Although the city is warm at least for nine months per year and also orographically flat Palermo is below the italian average (15,4) and stays still since 2009.

	Rome	Milan	Turin	Naples	Palermo	Genova
Bike lanes (km per 100 skm)	9,6	41	134	-	13,3	-
TLA (sqkm per 100 sqkm)	0,6	4,9	2,1	3,1	4,8	3,1
Pedestrians areas (sqm per 100 inh.)	14,4	27,2	44	28,5	7,3	5,1
Payable parking lots on streets (n. per 1000 vehicles on road)	38,4	43,9	89	39,7	46,7	71

Tab. 3 No-oil areas (source: ISTAT, 2012)

Until the 2007 the city was the worst (among the 15 metropolitan cities) in Italy for territorial density of traffic limited and no-cars zones. Recent data show a very quick increase of the square metres of the TLA but, effectively, the limitations, are really few (for example for the commercial vehicles there are no restrictions). Civic administrators are using the parking lots' pricing policies as a tool to face the mobility problems. Actually parking lots pricing seem to be the only tool administrators adopted in these last ten years. As shown by data, the number of payable lots increase vertically (the variation from 2007 to 2010 was higher than 1500%) with the double clear aim: calming the use of car and bring some money to the city wallet. But this strategy seems not working, the payable parking areas are mainly inside the congested city center, and interchange modality parkings are few and far to be effective. This situation, obviously, doesn't foster people to use other public transport services.

This scenario helps to explain one of the evidence of the Palermo urban condition. Years and years of no local transport policies pushed the city in a worrying paradox: although daily distances traveled are short (one of the shortest in Italy) and horrible traffic jams are daily routine, citizens still prefer moving by cars and they dream a future with more parking lots and less public transports. This means that urban traffic, besides being an infrastructural problem, is, primarily, a big social and cultural issue.

	Rome	Milan	Naples	Turin	Palermo	Genova
Cars	28%	17%	19%	27%	37%	21%
Urbano bus/tram/filobus	14%	16%	14%	16%	9%	19%
Metro	13%	16%	15%	7%	-	5%
Extraurban bus	2%	3%	6%	3%	2%	3%
Motorbikes/scooter	8%	6%	10%	3%	12%	12%
Bicycles	2%	8%	3%	7%	3%	2%
Taxi	2%	2%	3%	3%	2%	1%
Train	4%	3%	5%	3%	4%	6%
Walking	27%	27%	25%	31%	31%	33%

Tab. 4 Modal split (source: Cittalia, 2009, elaborated by the authors)[5]

[5] Palermo hasn't a metro transport system yet, a train lane is now working as a metro service provided by Ferrovie dello Stato.

3.2 ATTEMPTS OF INNOVATION

For many years, the cities of Palermo and Catania were the only cities among the major Italian metropolitan areas without an urban mobility plan. This gap has been overcome only in March 2013, when the municipality adopted a new general urban traffic plan (the original name is Piano Generale del Traffico Urbano, PGTU). This tool, whose process of implementation is still ongoing, is based on four main strategic objectives: (a) improving of the traffic conditions (moving and parking); (b) improving of the street safety (a reduction of incidents); (c) reduction of GHG substances in atmosphere and the caustic noise; (d) energy saving. The PGTU also defined four action plans that will focus on specific mobility issues:

- plan to improve the pedestrian mobility (it foresees the definition of squares, streets, itineraries, pedestrian areas and traffic limited areas);
- plan to improve urban and suburban local public transport (it provides the definition of specific lanes, interchange nodes, existing lines and frequency reorganization);
- plan to re-organize urban and suburban private transport circulation (it will focus on a general traffic scheme, the issues due to the city crossing and the road types priorities);
- plan for the rationalization of parking areas (it will point out the parking streets also defining the fare system).

The planning process has been stimulated over time by a set of bottom-up initiatives in the wake of well known experiments made at international level, such as Nuride, Zimride in the USA or Moovel, Mo-bility, Moovit in Europe. “B.I.C. Bici in città” and iMove, for example, are local examples of smart community projects that encourage and organise people to be critical mass in terms of sustainable transports. A very popular web portal called “Mobilita Palermo” allows people to share informations about ongoing projects and policies focused on mobility, as well as sharing information about the traffic conditions via the most followed social networks.

The most relevant ongoing initiatives in this direction are probably the three innovative projects on Palermo funded with almost 4 millions euros by the Italian Ministry of University and Research in the framework of the competition "Smart Cities and Communities and Social Innovation”. The projects aim to stimulate local communities to change their habits fostering more responsible mobility behaviours with the help of smartphone applications. The three groups that won the fellowship are young multidisciplinary teams with a “social entrepreneurs” approach to the theme. They are working on different softwares – Muovity, CityFree and TrafficO2 – that will provide services of carpooling logistic (mostly focused on short distance commuters) and inter modality logistic to foster sustainable mobility values.

Muovity aims to give a contribution to the empowerment of the social and technological networks to improve sustainable and energy efficient transports in the sicilian territory. The mobile application offers a platform where is possible to easily plan carpooling trips and having real time information about the city mobility. The team – who is currently testing the main features of the application – is mostly the same who is leading the urban mobility blog “Mobilita Palermo” and is working inside Palermo University incubator “ARKA”.

Cityfree is developing an application which main feature will be an easy way to plan dates to reach the Universities facilities through the local public transport system. The application will not give to the user another social network platform but instead wants to be a mobility information system that supports the already exited social networks. The main goal is reaching the critical mass able to change college students behaviors. Currently the group activities are focused on the creation of the mobile application and on disseminating actions of carpooling concepts to the Palermo University community.

TrafficO2 is an info mobility decision supporting system that tries to foster a modal split through gaming policies and giving tangible incentives for each sustainable choice. The idea is to match the interests of two complementary actors on the city traffic scene: communities workers (communities that already need a mobility manager) and local business communities (places on the community workers daily-paths). The goal is to decrease traffic and pollution creating an equal agreement for both communities: prizes in exchange for a respectful behaviour towards the environment. So, all of the local businesses that belongs to platform (as sponsors) became the stations of a new kind of transport system that foresee only moving by foot, by bicycle, by local public transport and by carpooling. Each trip from station to station gives O2 points to the user, those points are the system virtual money users can collect to get prizes from the sponsors. The aim of the project is to generate a "win-win" situation that creates new city development opportunities just matching the right needs. A first test of the mobile application (an alpha version) has started during December 2013 with 30 students selected through a workshop from three different Palermo University departments: computer science, design and marketing.

Regarding this last project, a first survey of the testers behaviors confirms widely the 2009 ISTAT data about the modal split. It also shows how most of the times, despite over the 75% of the interviewed are less then 10 km far from the University, they prefer use the car to get there and just the 20% carpool regularly. Moreover it's interesting to underline that just the 10% of the interviewed has a local public transport subscription and no one joined the car sharing project.

	Cityfree	Muovity	TrafficO2
Events logistic management	x	x	-
Intermodality system logistic	-	-	x
Infomobility	x	x	-
Extra-urban scale	x	x	-
Payment service	x	x	-
Benefits for users	-	x	x
Sponsors	x	x	x
Social network	-	x	x
Feedbacks	x	x	-
Gaming	-	x	x
Testing	x	x	x

Tab. 5 Comparative analysis of the main features of the mobility social innovation projects

All of the funded projects, as we see, will involve firstly the big urban community of the Palermo University. This decision, taken individually by the teams, is motivated by the target selected to address their products: young and curious students are probably the first best social community where experiment behaviors' changing project driven by social media technologies. But all of these proposals, than the difficulties given by controversial structural, social and cultural aspects of the city itself, have also to overcome other constrains that belong broadly to all these kind of projects. Probably the bigger limits of those approaches are the constraints given by the chosen technologies itself. These kind of apps need powerful smartphones always connected to the web and this means an high consume of the battery and of the personal band connectivity (Palermo has not yet a public service for internet connectivity). All of those factors (with many others) could discourage users to use one of the systems they're delivering and, moreover, the presence of the three could be confusing for the little target they're approaching.

4 FUTURE CHALLENGES: TOWARDS A TRANSIT ORIENTED URBAN COMMUNITY?

As we have described in sections 2 and 3 of this paper, the physical and functional context of transport in Palermo is going towards a rapid process of change under the impulse of infrastructural projects, a new phase of planning and the spreading of social innovation practices. The city resulting from this process will be the outcome of the interaction between some "hard factors" for mobility – infrastructures with their material impact on the built environment – and a much more flexible and uncertain group of "soft factors" including the management of the networks, the interaction between transport policy and urban policy as whole, a better governance and a new propensity of people to change.

In this paragraph we try to focus on a series of open questions related to this interaction, in order to explore the potential benefits for city's development of an increased integration between transport policy and urban regeneration. These questions can be summarised into the following three challenges:

- a challenge of effectiveness of the transport system;
- an urban regeneration challenge;
- a governance challenge.

The first challenge arises from the basic step to complete the ongoing projects and provide the city of the first potentially integrated transport system. Its future effectiveness derives from the capacity to create functional connections between the different modes of transport, which are based on networks that have been planned separately and will be under the management by different operators. The creation of a new governance of the transport system, consequently, seems to be a first problem to be solved in on order to overcame the gap of effectiveness that could be given by the different rationales of the transit operators. An investment on the ICT resources, in the short term, could significantly help to increase the added value given by the intersections of the different modes of transport, as well as in reducing the negative impact of the missing links existing in the networks.

The challenge of urban regeneration derives by the broader objective of making the nodes of the new transport system as parts of future city's development. There are some obstacles to this perspective depending by the different planning rationales of which the projects under implementation are expression. A first obstacle is the approach to design of the operators responsible for the implementation of the transport projects: in the case of the Railway ByPass, particularly, the new stations have been placed in the urban areas with less constrains to infrastructural development in order to reduce the conflicts with the built environment and to lower the construction costs. The poor design of the new stations, together with the state of decay characterising several of these empty urban spaces, will apparently provide no direct contribution to the regeneration of the interested districts in the short term. As a consequence, an additional challenge for the future of urban policy will be, on the one hand, to improve urban design around the transport nodes and think them as places fully integrated in the surrounding urban environment and, on the other, to target on these urban spaces additional policies (i.e. direct or indirect incentives to the private sectors, new public functions) in order to revitalise them as new epicenters of urban development.

The two previous challenges are intimately bound by the need of a new and more effective governance at different scales and dimensions of urban development. Firstly, from a more sectorial perspective, it will be required a convergence in the planning and management activities of the two main operators of the transport system: the municipal corporation AMAT, which will be required to manage the future Tram System (together with the bus system and the parking system); the national operator RFI, which is responsible of the rail network, including the new and redeveloped Railway ByPass and Railway Ring. An other relevant player in this new governance framework is the regional authority, if not for the relevant role it exercises as the main financial provider in the field of local public transport. A more effective convergence between the strategies of these players (together with others such as the Airport and the Port authorities) appears as a crucial step, particularly, in the creation of an integrated transit system at the metropolitan level.

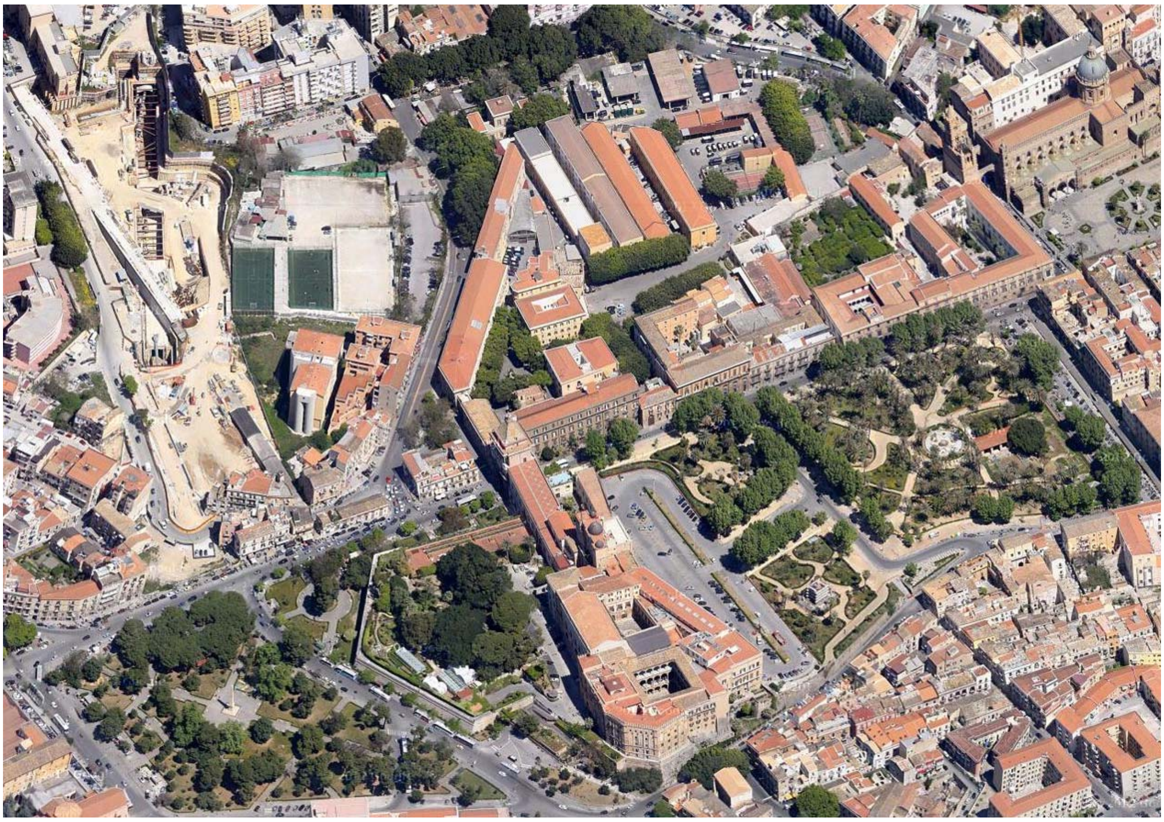

Fig. 2 The redevelopment area of Imera-Tribunale, near the Cathedral and the Regional Government Palace

In this evolutionary context for local governance, an important stimulus might come from the innovative projects on mobility under implementation at the urban and metropolitan scale. In fact, since the environmental impact of transport and mobility is intimately related to social habits and people behaviours, the networks established by bottom up initiatives like those described in this paper is a potential a resource to improve the awareness on mobility issues, as well as establishing new forms of public-private cooperation. This last, particularly, via the technological resources on which the social networks are based (GPS, primarily), could help to better match demand and offer of transport and overcome the gaps of missing modal integration due to governance problems. The municipality, in this process, is expected to play a "melting role" between the different expectation of citizens and stakeholders, with the broader objectives to anchor the immaterial resources in operation on a processes of urban regeneration which requires, in the case in question, also drastic material changes and reshaping of urban places.

This case witnesses once again the "systematic nature" of urban mobility (Bertolini, 2012) and the problematic role of urban planning when asked to cope with the integration of different (sectoral and individual) views on city's development. Adapting the rigidity of urban form to the changing pattern of the transport networks and, by contrast, make mobility as flexible as the process of social change within urban areas is a challenge that requires the recognition of a broad range of technical and political variables. The extent of this challenge in several urban areas has meant a rapid change in the perception of the traditional feedback between transport and land-use planning and a shift of urban policy towards a more strategic and holistic approach to city's development. Reorienting the urban agenda to this perspective seems an obvious choice for a city in transition like Palermo.

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IMAGES SOURCES

Figg. 1 and 2: Elaboration by the authors on Google Earth data.

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CONSIDERATIONS ON THE USE OF VISUAL TOOLS IN PLANNING PROCESSES

A BRAZILIAN EXPERIENCE

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ABSTRACT

This paper assumes that citizen participation does not really happen in relation to current urban planning practice for a number of reasons. First of all, many planning processes do not involve citizens as ideally they should. Secondly, although if they involve citizens, many planning processes are not able to communicate them the actual questions to deal with. Thirdly, many citizens have not a sufficient knowledge or ability to understand the planning issues. Therefore, the paper supposes that the use of visual interfaces can collaborate to organize data and improve the involvement of citizens within planning processes. Focusing on the Brazilian reality, the case study present two selected areas with great relevance for the Metropolitan Region of Belo Horizonte's (MRBH): Santa Lúcia, within the municipality of Belo Horizonte, and the neighborhood Vale do Sereno, in the Nova Lima municipality. The areas result under a great pressure and intensification of anthropic interventions, containing consolidated occupancy. The example on the two areas shows how urban planning still lacks a systematization of data. This also implies that the two municipalities not consider the communication of information as a priority for developing cities. Although current information technology can offer advantages for implementing the planning processes though visual languages, harder efforts are required to build the communication process between people, including communication as part of the planning process.

KEYWORDS

PSS, sDSS, visualization, communication, participation

1 INTRODUCTION

This paper assumes that citizen participation does not really happen in relation to current urban planning practice for a number of reasons. First of all, many planning processes do not involve citizens as ideally they should. Secondly, although if they involve citizens, many planning processes are not able to communicate them the actual questions to deal with. Thirdly, many citizens have not a sufficient knowledge or ability to understand the planning issues. Therefore, the paper supposes that the use of visual interfaces can collaborate to improve the involvement of citizens within planning processes.

The communication of values and urban parameters that shape the urban landscapes should preferably be the result of a community consensus, while they are actually the outcome of a sum of variegate interpretations by citizens. In this context, the key question focuses on investigating firstly how investments in communication and visualization for knowledge building can actually be an answer to extend the understanding and perception of citizens about urban landscape and, secondly, how visualization can improve the communication so that the urban landscape shaped by urban parameters can deal with the idea of city given by citizens.

As shown by van Wijk (2005), the visualization enables a process of dialogue between users and data, thus increasing the possibilities of approval with maximized consensus and the establishment of collective responsibility (fig. 1). A better communication and visualization of spatial data can be an answer to extend the understanding and perception of citizens on their landscape vision. Meanwhile, this also improve the awareness of users about possible scenarios and future landscapes, so that the management of the designed landscape can be the outcome of a reasoned and shared discussion.

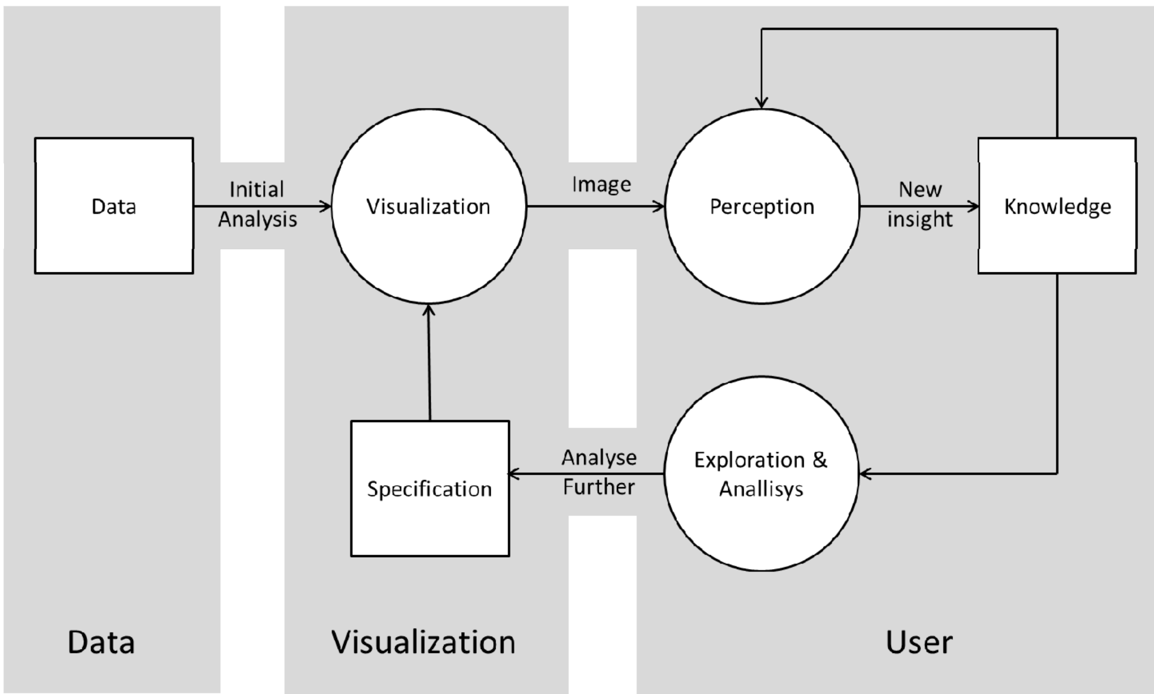

Fig. 1 Visualization model and its components

At the moment, planning actions and urban management are characterized by a general lack of information being replaced by data overload. However, *data* and *information* are not interchangeable concepts. In fact, data becomes information only when it is structured, systematized and made available for the interpretation of users (Moura, 2003). Thus, the availability of Land Use Policies texts or shapefiles in the Web is not enough to promote the real understanding of a community. Although the media is open, in these cases the information is encrypted and accessible only to technicians who are able to interpret and understand the data. Focusing on the Brazilian reality, this paper considers how urban planning still lacks a systematization of data. Despite the use of GIS (Geographic Information System) is already fully capable of being distributed and used at national level, despite some data collections have open access and many softwares have free and/or Portuguese translations, the country does not make use of Planning or spatial Decision Support Systems (PSS / sDSS).

PSS and SDSS promote the handling of information in a systemic way and have significant potential for communication. Thus, considering the visualization as a visual framework for the organization of data (Masala, 2014), the paper aims at highlighting how the combination of support systems with visual tools can improve the communication among people, increasing the possibilities for interoperability, enabling the dialogue among stakeholders and favoring the orchestration of planning processes.

2 THE USE OF A VISUAL LANGUAGE FOR IMPROVING THE COMMUNICATION VALUE OF PSS AND SDSS

This paper considers that Planning and spatial Decision Support Systems (PSS and sDSS) outputs can deal with the purpose of communication within planning processes. However, PSS and SDSS present a multitude of definitions so that, after a kaleidoscopic review, Geertman and Stillwell (2003, 2009) indicates that although there is not a rigorously definition of PSS at the time – conclusion also reached by Klosterman and Pettit (2005) – all settings tend to coincide with or addressing the same kind of functionality required within this category of support instruments.

In fact, on the one hand the term Planning Support Systems dates back to the 1950s, specifically to the approach presented by Britton Harris, in which planning and sketch planning were combined to allow rapid and partial description of alternatives (Geertman and Stillwell, 2003). On the other hand, the PSS is a relatively recent phenomenon, emerging in the planning stage in the mid-1990s as presented in the works of Batty (1995) and Klosterman (1997) and resumed in Geertman and Stillwell (2009). In fact, during the last decade, the PSS emerged as an extension technology, information and communication for Geographic Information Systems in planning, combining geospatial tools and information structures to support planning processes or sub-processes in spatial scales and planning contexts specifically defined.

PSS are capable of rationalizing, systematizing and supporting the decision-making processes, both as a structure and a method of holistic view. PSS are also models that manage and allocate data, tasks and actors, allowing, for example: the evaluation of models and impacts; the building of a methodological plan that can be viewed generally or in parts; the view of scenarios and levels of concordance. They are able to generate reports that give feedbacks when there is interoperability between subsets to the system and a responsive interaction (Sharifi and Rodriguez, 2002). One important contribution of the use of PSS is metaplanning (Campagna, 2013), which can be defined as the explicit design of the planning process. According to this concept, the key benefits of PSS are: to promote a better dialogue between planners and systems integrators; to help fully exploit of the GIS resources for more informed decision making and the promotion of a system that tracks the process from beginning to end supporting the cycle as a whole.

Several authors, as indicated by Geertman and Stillwell (2009), consider the PSS as a process able to improve the handling of knowledge and information on the actions of planning, a function that provides great assistance to those who are involved in handling the complexity ever-increasing task of territorial government.

PSS can both support planning processes and parts of the planning system. PSS allows “macro” visualization when displaying the allocation of actors and actions of urban planning. On the other hand it includes a more detailed visualization of components.

However, as Batty (2007) indicates, visualization “is now all important” and PSS can be a key in this way once this systems enable the access (even remotely) to the increasing data and number of stakeholders involved in planning process.

As Ramasubramania and Quinn (2006) points out, a successful visualization is an intentional design intended to evoke the cognitive relations and perceptions of the viewer. So, visualization has to be intended as an organized framework of data and information which can provide insights of planning problems by means of an intuitive language (Pensa, Masala & Lami, 2013). This language is defines by each visualization and, depending on its effectiveness, it can overcome cultural barriers, thus being more accessible also to non-expert people.

Furthermore, visualization can improve planning process also by mean of the anticipation of *possible landscapes* (Zyngier, 2012) providing structured visions for planning future development which are also shared between the different actors such as policy-makers, citizens, stakeholders and professionals involved in the planning actions. In this sense, visualization can increase the ability of citizens to make mental simulations, offering them the visual support for collecting ideas and solutions. In addition, visualization can enhance the transparency of the planning process, showing the effects of some specific choices on spatial configuration, policies or activities.

Urban planning tools that include visualization can benefit the public accessibility to information, bringing transparency within the decision process and combining the intuitive knowledge of participants with the information brought by staff and consultants. This generous availability of comprehensive and decoded information allow the public to make informed and confident decisions and enhance the planning process in a broader citizenship (Kwartler & Longo, 2008).

In conclusion, PSS and sDSS can really benefit from the use of visualization in the communication process. They show to be very important in shaping a city vision, but the use of a visual language proved to be essential for creating common perspectives and sharing information between a group of variegate people. Therefore, more efforts in including visual outputs in planning and decision support tools are recommended in order to increase the opportunities for creating awareness and knowledge building on stakeholders and citizens before choices are made.

3 SANTA LÚCIA AND VALE DO SERENO: THE COMPARISON OF TWO BRAZILIAN URBAN AREAS

The case study present great relevance for the Metropolitan Region of Belo Horizonte’s (MRBH) environment in different and even contradictory levels. The selected areas are contiguous to woods and springs and they present relative conflicts regarding their use and legislation versus real-estate interests. The areas result under a great pressure and intensification of anthropic interventions, containing consolidated occupancy as well as areas in urban transition process, which are targets for entrepreneurs and environmental interest, in different proportions and distinct moments.

Two study areas are selected: Santa Lúcia, within the municipality of Belo Horizonte, and the neighborhood Vale do Sereno, in the Nova Lima municipality (figure 2). Once they correspond to different municipalities, their urban landscape is the result of different urban parameters and forms of land occupancy, presenting distinct histories and experiences of community participation in urban management and planning. Despite all differences in physical terms, the neighborhoods selected are very similar. Firstly, their shape can be compared because they are morphologically located in valleys which resemble amphitheaters and are situated along the fringes of the Curral mountain range. Secondly, they are both characterized by a variegate amount of different functions and building typologies.

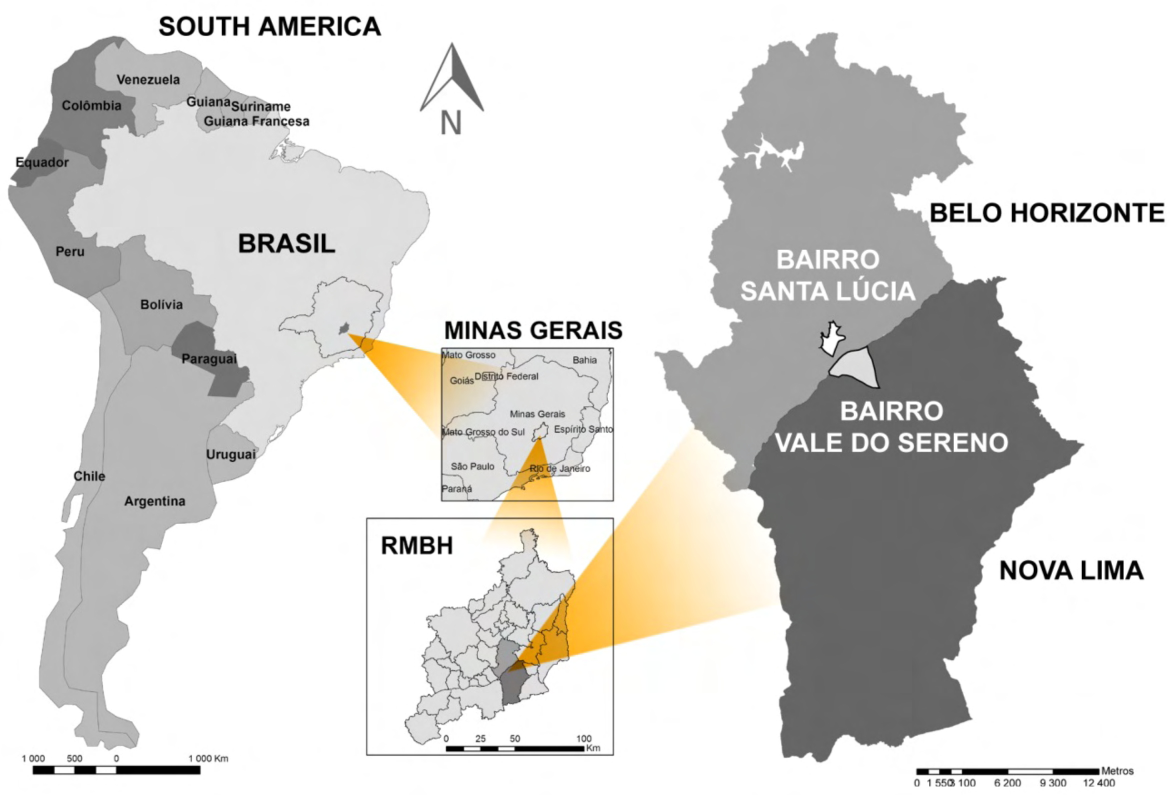

Fig. 2 Location of the pilot areas

In Santa Lúcia neighborhood, landscape is mainly constituted by:

- vacant areas and incomplete street layouts, mainly belonging to the neighborhood's original layout;
- buildings of 3 to 4 floors, with some exception reaching up to 10 floors, constructed before 1976, when Laws of Land Use and Occupancy (LLUO) have been established;
- single family residences of several typologies from the period previous to 1976's LLUO and up to present day, since there are constructions of this category ongoing in 2012;
- horizontal multifamily residences of recent construction;
- vertical multifamily buildings with several floors, implemented in several joint plots and resulting from LLUO of 1996;
- mixed and diverse use edifications, such as offices and galleries, resulting from 1996`s LLUO;
- consolidated verticalization throughout the Raja Gabáglia Avenue track and in parts of road BR356;
- areas undergoing approval evaluations for hotels and edifications related to municipal permits of 2010 - 2011, which are related to the World Cup which will take place in Brazil, 2014 (fig. 3).

Fig. 3 Partial view of Santa Lúcia neighborhood, 2011

Meanwhile, the landscape of Vale do Sereno neighborhood is shaped by (figures 4 and 5):

- vacant areas covered by extensive vegetation;
- large towers of mixed use, commercial and residential, in models of occupancy derived mainly from alterations promoted by 1993 to 1996 norms;
- single family residential buildings, probably built between 1993-1996 and with characteristics compatible with the original land plot division approved in the 1980's;
- a few examples of edifications originally intended as single family residences, but with current other functions;
- other outnumbered typologies, such as children schools or foundation head office.

The two areas have been studied to compare how norms have been communicated in order to build the urban landscapes.

Fig. 4 Neighborhood of Vale do Sereno and its surroundings, 2010

In the case of Santa Lúcia neighborhood, the first land plot division has marked the period 1928-1976, during which norms were communicated using simple texts, mainly available as decrees and laws issued by the municipality of Belo Horizonte. Nevertheless, a map made by Aarão Reis in 1895 guided the overall urban pattern, thus providing a visual expression to the city layout concept. However, over time, the content of the map has been altered by textual corrections which re-draft the boundaries of urban contours. The introduction in 1976 of the Laws of Land Use and Occupancy changed the approach to the planning of the city, implementing also communication methods.

Fig.5 Standard template pattern, permitted in 2007's Master Plan (illustration on the right) and the blind walls on the resulting buildings (pictures on the left)

The norms for Belo Horizonte, and consequently for Santa Lúcia neighborhood, was formatted as single volumes, containing parameters sketched in zoning maps for each area of the city. Some tables were also annexed in these volumes as a synthetic way of translating these parameters. Thanks to the development of Information Technology (IT), the municipality of Belo Horizonte implemented the accessibility to its normative documents, creating at the beginning of 2000's a digital version of the LLUO's printed version. However, although the distribution vehicle has been changed, the normative contents remain the same. No communication tools have been created for facilitating the access to the information included in the documents, so that no particular improvements can be noticed in promoting the awareness of both citizens and stakeholders on city's norms. On the other hand, some changes can be appreciated on data availability, due to internet promoting more visibility and accessibility to documentations.

For the area of Vale do Sereno, which is located in the municipality of Nova Lima, the first law on land use dates back to 1983 and it is completely textual, made by descriptions and annexed tables which resume all the urban parameters without providing any explanatory image. From the law of 1983 to the Master Plan of 2007, at least three others changes in normative have been established. In particular, in 1990 configuration, an expressive amount of overlaying alterations was observed, so that its decoding resulted very complex. These difficulties in reading normative made the creation of a vision for the growth of Vale do Sereno a hard challenge for both experts and non-experts. In 2007, the Municipality of Nova Lima released a Master Plan which included also a map and a table. This new documentation has been made available on the City Hall's webpage. However, as for the previous area in Belo Horizonte, the advance regarding the distribution vehicle has not been followed by any advance on the content or graphic information of the documentation.

To summarize the outcomes of this comparison, a small but sensible difference in information conveying, communicating and superposing is noted. However, for Vale do Sereno neighborhood, the superposition and subdivision are clearly more expressive. This area suffered several changes regarding zoning in a short period of time, and without public audience's approval, reducing population ability to understand and follow up alterations. This type of conduction makes norm conveying difficult and provokes low accessibility to its content, thus restricting comprehension and democratic participation. Processes of devaluing private property – such as a house surrounded by tall buildings – as well as public property – such as landscape superposed by buildings, are not managed so that scenarios can constantly be changed without follow an overall and shared vision of the urban landscape (Zyngier, 2012).

In both areas, the urban fabric expands itself in a way that, not only its physical grids are superimposed (and contrasted), but also the resulting possible landscapes (Zyngier, 2012). This study confirms that the communication about urban parameters is still very limited and, consequently, also the landscape management by a community results very difficult. The lack of images showing an overall vision of the city, explaining the use of urban parameters and illustrating the combinations between urban indicators, functions and forms, causes hard difficulties in interpreting the normative and laws which should shape the city itself. The understanding of meaning of normative is for sure a starting point for investigating what is legally foreseen, but it is also a way for stakeholder to have a shared vision of the city they can commonly shape or re-shape.

In those areas, communication barriers are really intense yet, also because of misunderstandings from the community reinforce the conflict within neighborhood while, in some cases, reach opposition between different neighborhoods. Consequently, the atmosphere shifts from pressure inside the area, for instance, to ignorance regarding advancements made by vicinity neighborhoods when it comes to norms. The lack of dialogue regarding urban parameters communication to communities becomes a general issue which involves not only economic differences, but also social and cultural inequities.

4 CONCLUSIONS

The urban planning is considered a complex disciplines because it involves not only the physical three-dimensional space, but it aims at combining and integrating different quantitative and qualitative aspects which have strong consequences on the quality of life of citizens. Supporting urban planning is therefore a duty to achieve a better general quality in everyday activities.

The analysis of two different areas showed that the use of visual support can improve the accessibility of both experts and non-experts people to the information included within the normative documentation which should give a form to our cities. Visual outputs help in overcoming cultural, social and geographical barriers providing a common vision for sharing ideas, perspectives and targets. In this sense, PSS and sDSS should be a support for the cognitive process of individuals, offering not solutions as a crystal ball for forecasting a future will never come, but visions of a common future. Although PSS and sDSS are not used yet in the case study areas, the analysis shows that the lack of communication between official planning and citizens is a question which needs a quick and effective answer. Cities are knowing a very fast growth which should be controlled, not only to preserve landscape quality, but to offer an adequate, sustainable and smart living to their citizens.

Information technology currently offers many tools for sharing opinions, so PSS and sDSS can take many advantages in their use. The use of visual languages is open enough to be understood by communities, including the group of technical and non-technical people. Nevertheless, although IT can provide adequate instruments , many improvements are required to build the communication process between people, so to generate interaction among the different involved actors, such as public, private or professional stakeholders. In particular, the planning process needs to shift up its communication value, intending communication no more as a mere presentation of a project, but as a strong part of the process itself. The massive use of visual language could enhance the participation and knowledge building for all the people who is interested in taking part to the planning process.

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IMAGES SOURCES

Fig. 1: Adapted from van Wijk (2005).

Fig. 2: Zyngier (2012).

Fig. 3: Author's archive.

Fig. 4: Author's archive.

Fig.5: Zyngier (2012) (to the right) and Ana Clara Moura´s personal archive (to the left)

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