TeMA

Journal of
Land Use, Mobility and Environment

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.

Tema is the Journal of Land use, Mobility and Environment and offers papers with a unified approach to planning and mobility. TeMA Journal has also received the Sparc Europe Seal of Open Access Journals released by Scholarly Publishing and Academic Resources Coalition (SPARC Europe) and the Directory of Open Access Journals (DOAJ).

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SMART CITY

PLANNING FOR ENERGY, TRANSPORTATION AND SUSTAINABILITY OF THE URBAN SYSTEM

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TeMA

Journal of
Land Use, Mobility and
Environment

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TeMA

Journal of
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Environment

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

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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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SPECIAL ISSUE

Eighth International Conference INPUT
Smart City - Planning for Energy, Transportation and Sustainability of the Urban System

Naples, 4-6 June 2014

ACHIEVING SMART ENERGY PLANNING OBJECTIVES

THE APPROACH OF THE TRANSFORM PROJECT

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ABSTRACT

Cities play a dual role in the field of energy and integrated planning. They function as institutional planning and decision making bodies and interfere as actors, e.g. as project developers or launching customers. In the first case their attempts at integrated plans are often unsuccessful in integrating vision, goals and instruments of all stakeholders so that waste, water, energy cycles, urban planning and budgets proceed with no connection to each other.

TRANSFORM Project "Transformation Agenda for Low Carbon Cities" (FP7) tries to improve the integrated energy policy and decision making process of cities, both at a strategic and operational level, by providing the cities with a framework based on overall planning experiences and on-the-field projects and qualitative and quantitative analysis support models.

The project intends also to make a step further in the quality of research, by providing a replicable and tested framework for the production of a strategic Transformation Agenda for the city as a whole, combined with district Implementation Plans.

KEYWORDS

Smart municipal agenda, Urban energy planning

1 INTRODUCTION

Urban areas are worldwide responsible of almost 80% of the total GHG emissions; but, at the same time, municipalities can be considered as favourite areas that play a crucial role in the safeguard of the environment and in the setting out of more resilient.

Energy targets set by the European Union for 2050 overcome the 20-20-20 goals, aiming at an 80% - 90% reduction in greenhouse gas emissions and a near-zero carbon energy system. These targets are as ambitious as they are necessary and will require fundamental transformation of our society. Urban areas, currently responsible for three-quarters of the global energy demand, are the logical starting point for intervention to transform urban areas into resource efficient, low carbon places. Places that use their energy in an optimal way.

Such a fundamental transformation necessitates disruptive change in planning, development and decision making. That means a change towards real integration of planning and energy and more flexible decision making processes. Cities need to combine long term strategy and vision with practical, tangible and financially robust plans for implementation in surroundings which are open to new and integrated ways of working. The TRANSFORM project, this paper deals with, tries to support cities willing to take this leap.

With the launch of the "Smart Cities and Communities" industrial initiative the European Commission has expressed its wish to see cities taking their responsibilities in tackling the issues central to the SET-Plan (climate change and energy security) and in meeting its 20-20-20 targets.

By aiming both at the operational and strategic level, and focusing on replication both on a city level (district-to-district) as on a EU level (city-to-city) the project aims to have a maximum impact in reaching the 20-20-20 goals and beyond, while also staying practical and ensuring actual execution of energy efficiency projects. The cooperation in this consortium of commercial partners, research institutes, energy and grid companies and cities ensures both the dissemination and exploitation of the results.

As assumed in several recent documents, the approach carried on by the European Commission wishes to conjugate the environmental policy in a wider sense (struggle against pollution, re-forestation, waste treatment, sustainable mobility,..) with the topic of energy and climate changes, favouring synergic lines of actions, which permit to capitalize the interventions on the causes in parallel with the mitigation of the effects. In a general spirit of solidarity among Member States, the EU policy around the energy sector intends to guarantee the safety of the energy supply chain of the Union and the regular course of the market; this, promoting energy saving, efficiency and interconnection of energy networks, together with the development of the renewable sources. These could be considered as the first answer be implement in order to front the worst environmental challenges as the lasting carbon footprint and the reducing of greenhouse gas. This approach, consolidated as the years went by, was oriented to change radically the way Europe produces and consumes energy, setting up the basis of a new "industrial revolution", able to build up a high-level efficient and CO_2-low-emission economy.

European choices which characterized the economic and industrial policies in these first decades of this century are running straight along the Kyoto Protocol perspective (Hickman e Banister, 2007) which, as known, establishes that Industrialized and Transition Economy Countries must achieve different targets of atmospheric emissions' reducing. European Union wishes to pursue these objectives through the innovation in energy technologies and the proposal of market-and-finance instruments controlled at the EU level, also thanks to the involvement of the world of research.

Cities play a dual role in the field of energy and integrated planning. They function as institutional planning and decision making bodies and interfere as actors, e.g. as project developers or launching customers. In the first case their attempts at integrated plans are often unsuccessful in integrating vision, goals and instruments of all stakeholders so that waste, water, energy cycles, urban planning and budgets proceed with no connection to each other. As actors they have difficulties at choosing cost effective, low carbon, financially feasible actions over business as usual scenarios. Implementation plans fail to choose life cycle approaches over short term payback periods, avoid high risk investments, and lever upfront costs over longer payback periods.

Furthermore, for most cities, making full use of the potential of analyzing the existing datasets of relevant stakeholders, combining them, and including possible new applications in search for better economics is a new step towards smart planning. We have some related examples in the pushing strategy towards the smart approach in governing cities and communities: energy efficiency and resilience are requirements new urban paradigms are centered on. Nevertheless, this innovative approach, more related to city's dynamics and shape than to the large-scale energy supply, needs tested experiences able to be capitalized, transferred and disseminated.

2 THE TRANSFORM PROJECT: AN APPROACH TO THE URBAN ENERGY PLANNING ISSUES

For decades, the attention paid to the urban recovery interventions is at the centre of the debate at the European scale: a certain similarity in the structuring of the urban and rural communities, a shared historical background and the overall objective of the communitarian cohesion helped, since the Nineties, a common cultural path which has been constituted by the outline of approaches, ways and instruments to face the matter. Starting from the insertion of the quality of life targets (requalification), as long as the following acknowledgement of lack of resources for the future generations (sustainability), it is clear that the town planning design has been widened in terms of contents and meanings.

Nowadays, going on along the path, the measure/assessment of the urban initiatives' effectiveness seems to be a further element of reflection. The soundness of these actions –realized in the metropolitan areas of the most of the European cities- would be showed thanks to their capacity to reach goals, improve standards of liveability and answering, in the meantime, to the above-cited principles.

It is the new paradigm that associates the requirements of *smartness* to the city, which aim to present itself as attractive towards the territories also distant, as competitive in terms of obtained investments, fast in the material and immaterial connections, able to exploit its potentials from the energy point of view and, therefore, maximizes results and benefits in the ecological perspective.

Evidently, such an urban organism shall shape physically and communication-ally in a efficient, effective, fast and intuitive way, *smart* in a word.

The Seventh Framework Program of Research addressed to the smartness in urban planning a call for projects in 2011, issued by the Energy General Direction, with the title "Smart planning".

This new openness towards urban themes linked with energy, if seen in a multi-decades overview, can ebe considered as the latest initiative of a overall strategy on the urban matters, faced during the years by the EU. This could be helpful in not seeing the smart planning field in terms of slogan, only.

This bore in continuity with what was accomplished in the last twenty years about the urban requalification debate in the European metropolitan contexts, enriched furthermore of new contents and of "other" subjects in respect of the original nucleus of architecture sciences.

The energy efficiency of plants and networks and the interoperability of data derived from different sources constitutes the surplus of a already well-spatially-organised city, which would like to improve its consumption performances; moreover, with a contained effort of networking and coordination activity, it intends to set up its resources for upgrading the levels of offered services, thanks to the technological opportunities at disposal. In such organisation, spatial planning is not more than a card of the mosaic: nevertheless is fundamental, not only because it is the "mother" of the other initiatives to be settled down locally (land use planning and management), but also because it, differently from other technical approaches (typically of the engineering area), for its intrinsic nature, opens a dialogue with the social and political dynamics as long as building with them the real governance of the urban settlements.

Meaningful in this regard is the Transform Project- "Transformation Agenda for low carbon cities".

Within the project tasks, the 6 sample involved cities deal with the definition of a transformation path of their own contexts, by means of key performance indicators (KPIs) which permit a rigorous monitoring of the urban development, in terms of governance and the general outcomes in the sustainability field.

Key elements of the achieving goals are aligned with the 20-20-20 Directive and proposing something more, according to the recent targets reached by soome of the partners cities; moreover are crucial the participation of stakeholders and the use of ICT (Information Communication Technologies) as enabler factors of the incoming *smart communities.*

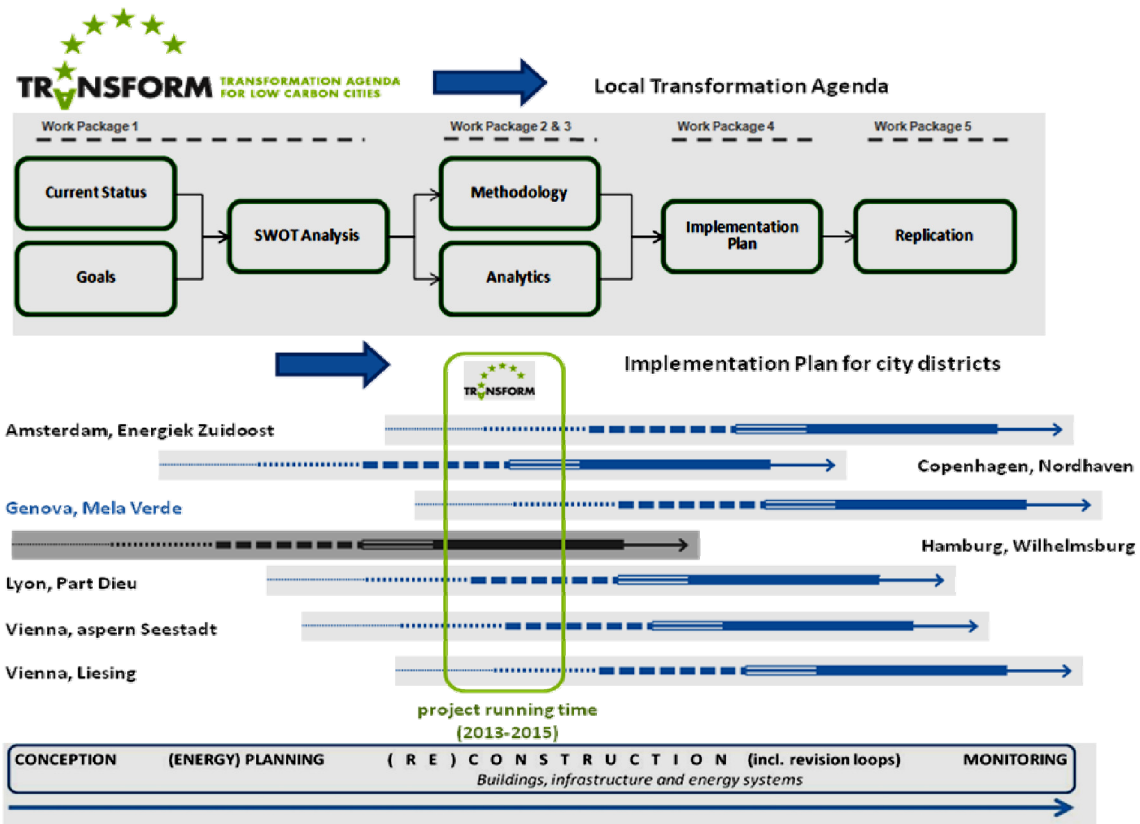

Fig. 1 Concept scheme of the phases of the Proiect TRANSFORM-8Transformation Agenda for Low Carbon Cities)

The project has the overall objective to draw up a transformation agenda which may be useful to address, firstly the partners and secondly the other interested urban contexts, in the process of transition towards a smarter way in planning, designing and living cities. The particular focus, in this case, regards the energy sector as a qualifier of the smart paradigm. The project starts form a very deepened analysis involved towns: this for two main reasons. On the first hand, because of the sharing of mutual knowledge and the building up of a computer science tool in support to the planning activity. On the other hand, the survey on

data had the scope of selecting those indicators which can take a picture of the city performance that is walking along an evolutionary scenario, from the "rough" level to a "smart" one.
This research activity was lead within the project not only for the partners cities but in benefit of all the network of European cities which will be interested in testing their own results, thanks to the make at disposal, most wide as possible, of a "handbook", a manual not exclusively technical, in support of urban realities that would like to set out on this process.

2.1 CONTENTS, METHODS: T.A., D.S.S. AND INDICATORS

TRANSFORM tries to improve the integrated energy policy and decision making process of cities, both at a strategic and operational level, by providing the cities with a framework based on overall planning experiences and on-the-field projects and qualitative and quantitative analysis support models. These models help local governments turn long term ambitions into tangible Implementation Plans within the context of metropolitan possibilities and conditions. The models should help stakeholders evaluate the economic feasibility of their plans by visualizing possibilities in terms of energy efficiency and production, rhythms of flows (energy, waste, water, etc), their interrelation and possible measures and costs, all of which will be based on quantitative and qualitative analysis.
The *main objectives* of TRANSFORM are:

- Support cities in their strive for integrated energy planning, through the combination of strategy and operations. By making Transformation Agenda's for the city as a whole, urban strategy is combined with the operational level of tangible implementation plans for city districts, embedded in urban planning and the local city specific context.
- Improve insight in successful stakeholder processes by innovating the way of working throughout the TRANSFORM project through design thinking methods, and bundling experiences for replication in other cities.
- Improve strategic financial strategies for low carbon cities, by bringing the current state of the art a step further and implement all insights in strategic Transformation Agenda's
- Improve insight in the generation and use of quantitative data, the role of analytics for scenario making, and the possibility to find better economics through the use of analytics.
- Ensure replication and dissemination of the TRANSFORM outcomes through a replication and exploitation campaign aiming at both the professional level as well as the political level of cities.

Cities differ in their context, e.g. their financial, juridical, regulatory and cultural contexts. That's why TRANSFORM focuses on outcomes both on the city level, ensuring impact in the participating cities and in their metropolitan surroundings, and on the European level, by distilling generic conclusions from local experience, and by pin pointing process interventions, ready for replication.
City *specific outcomes* of TRANSFORM are:

- *Local Transformation Agenda for each of the participating cities*

  To meet the 2020 and 2050 targets, a strategic Transformation Agenda is needed for the city as a whole. The Transformation Agenda should have the flexibility to look beyond the political borders of cities to the functional 'energy' borders, thus including the metropolitan hinterland of the core cities. The Transformation Agenda addresses the main components influencing the chain of energy production and consumption at city level: main infrastructure and sources of energy (thermal energy, electricity, gas) and efficiency potentials. It also addresses the possible energy efficiency in flows of water, waste, IT and mobility. It includes urban planning & regulation and the participation of end users. It is based on qualitative and quantitative insights and contains a strategic financial strategy. Each city develops a Transformation Agenda, containing energy efficiency measures and actions that need to be taken by stakeholders, in order to make a city smart. The process concerns city regulators and decision makers, private companies, and other relevant stakeholders.

- *Implementation Plan for city districts*

  The Transformation Agenda will be brought to the operational level in the form of an Implementation Plan, which will be drawn up for specific city districts. These districts are selected for this project under the name of 'Smart Urban Labs'. Morphology, urban density, functional mix, demographic aspects, (energy-) infrastructures vary from district to district. This requires more specific Implementation Plans to take them into account to find an optimal mix in terms of production of energy, storage, reduction and exchange, supported by feasible business plans. This integration of all elements will create win-win business models for stakeholders with initially different interests.

  The districts where the Smart Urban Labs are located are transformation areas undergoing redevelopment at the moment. This means the Smart Urban Labs can provide direct impact in the ongoing development processes through the implementation plan.

  Thus, each Implementation Plan is a product made in a joint effort by all relevant local stakeholders and includes for example renovation of the building stock, heating and cooling possibilities, use of intelligence on both electric and thermal networks, the potentials of existing water systems, innovative (electrical) transportation possibilities and urban green. The Implementation Plans relate district scale with the city and metropolitan scale to scan for possibilities, relate local developments with strategic choices made on the (energy) infrastructures. And lastly, each Implementation Plan will be feasible, by building achievable business plans taking into account the costs, pay-back periods, regulatory issues, and market conditions.

Both the Transformation Agenda and the Implementation Plan are the result of an exhaustive, innovative stakeholder process, and will be economically feasible and validated by experts. All stakeholders, from the highest political level to technical staff will be committed to the completion of the Transformation Agenda.

The *generic outcomes*, derived from the city specific outcomes, will be the following:

- *Qualitative decision support models*

  These qualitative decision support models are concrete solutions and process interventions, including innovative business models, financial strategy, participation and governance models and adapting planning processes. These models support cities in their strive towards integrated energy planning. The synthesis brings together the state of the art of transition thinking, derived from existing scientific knowledge and from the practical experience.

- *Quantitative decision support models*

  The purpose of the quantitative decision support model is to make use of available data sets to produce information stakeholders can use for energy planning and the production of low carbon scenarios. The model assesses the quantitative impact (relative to key performance indicators) and cost of implementing measures that will improve the city's or district's performance in terms of carbon and energy targets. This information will support stakeholders in deciding which measures need to be part of the city's transformation agenda and where and when they will need to be implemented.

- Both models should help the stakeholders by generating scenarios of possible economics of their strategies by visualizing possibilities in terms of energy efficiency and production, rhythms of flows (energy, waste, water, etc), their interrelation and possible measures and costs, all of which will be based on quantitative and qualitative analysis. By this, stakeholders will gain a better insight in economics of smart city plans, the interrelation of possible measures and costs. TRANSFORM delivers a prototype of a decision support tool, with recommendations for further development of the tool, or of components of the tool.

- Facilitate the decision makers with a Handbook for their journey towards implementation plans and a transformation agenda
  We create a thorough, lived through, process handbook that helps cities step by step with a strategic transformation agenda and related implementation plan. Cities and communities throughout Europe can use this handbook, in combination with the decision support models, to bring their visions or existing Strategic Energy Action Plans (SEAP) to tangible implementation plans. This handbook is both replicable and exploitable by consultancies.
- Political Memorandum of Understanding – the way towards implementation
  TRANSFORM will generate a strong political movement for the Smart City initiative, by the joined forces of the cities' politicians and through the networks the cities participate in. TRANSFORM will deliver a signed Memorandum of Understanding between participating cities, committed cities and relevant industries, knowledge institutes and commercial partners on the implementation of all TRANSFORM results.
  Stakeholders involvement at the city level will go from convincing the political level of the advantages and need for a commitment towards a smart city planning, to the introduction in municipalities and institutional staff of the concept, to integrating on-going labs and using feedbacks from the overall planning process directly on the field and, vice versa, using experiences to further improve the planning process. The involvement of companies and research institutions working together will consent practical and viable solutions to be found.

The TRANSFORM cities Amsterdam, Copenhagen, Genoa, Hamburg, Lyon and Vienna have a proven record of efforts to reduce energy consumption and increase sustainability. That includes ambitious targets and action plans, and political support for execution. They have experienced the limits of the current ways of planning and seen the need of integrative planning to tackle the challenge of the 20-20-20 targets.

Amsterdam formally endorsed its Energy Strategy 2040 in the year 2010. It is a formal part of the city's spatial structural vision, the political document that guides land use planning. The city's progressive policies on clean air and inner city traffic and parking, on electrical vehicles and waste/energy/water systems serve as successful examples. In 2011 the City was awarded the ISOCARP Award for Excellence 2011 for its Structural Vision 2040, mainly for the innovative stakeholder process and quality of the vision. Amsterdam's belief in the need for innovation in the field of energy provided the basis for the Amsterdam Smart City platform, a collaboration of KPN, grid operator Liander and the Amsterdam Innovation Motor and some 70 SME's. Amsterdam Smart city is the winner of the European "City Star Award 2011".

After the almost complete dismantling of the heavy industry, **Genoa** has started a transformation process moving towards technologies innovation and hosting several research institutions and companies, among them IIT. Genoa's SEAP, aiming to reach a 23,7% of CO2 reductions in 2020, the 1st to be approved by the EU, has been evaluated as an excellent tool, comprising more than 70 measures covering all city policy sectors such as buildings, transport, waste, RES plants, public lighting, CHP, district heating, domotics, smart grids, communication. Starting from the Covenant of Mayors initiative, Genoa set up a Smart City transformation process based on the strong involvement, through a specific Association of over sixty stakeholders, including small and big companies, research institutes, associations, public bodies and the energy company ENEL. Genoa's peculiar geographical position and shape, and its being at the same time an industrial, commercial, cultural city and the main Italian port, is promoting a new vision on urban, energy and development planning by integrating different needs and tools, such as PUC (Urban Plan), SEAP, PEAP (Port Authority's energy plan) and others.

Hamburg was awarded as the European Green Capital 2011. This was an incentive to go beyond a sectoral policy to an integrative approach of a long-term vision by 2050: a strategic, process-orientated sustainable planning regarding socio-economic frames (cost-benefit), comprehensive urban planning, technical efficiency as well as research and applied sciences.

In this way Hamburg will be able to cut CO2 emissions by 40% till 2020 and 80% by 2050. Over the last decades Hamburg has switched its growth policy away from greenfield development which creates urban sprawl and destroys landscapes. Instead, the city is on the one hand regenerating brownfield urban areas and on the other hand planning new quarters with excellent climate protection and environmental standards.

Copenhagen has increasingly focused on Sustainable Urban Development over the last decade. Copenhagen has also adopted the vision of becoming the Eco-Metropolis of the world in 2015 and is therefore focusing on four themes. These are to become: 1)the world's best city for bicycles 2)a Climate Capital 3)a green and blue capital city and 4)a clean and healthy big city.

In 2010 the City Council adopted the vision to become a Carbon Neutral Capital by 2025. This ambitious goal led to Copenhagen being awarded the title of #1 Cleantech City for 2011 by the leading online cleantech destination CleanTechies.com. As parts of the means to achieve the goals, Copenhagen has adopted a Green Growth Strategy which will turn the city into a leading testbed for new green solutions. The purpose is to use the city as a living lab for new green solutions in collaboration with private partners and research institutions.

Vienna holds great potential for a far-sighted and spatially focused transformation to a "smart city": The high share of apartments owned by the city and well-organized public utility companies (transport services and energy supplier, 'WSTW') enable the City of Vienna to implement strategies to improve the energy efficiency directly. Proposed demonstration projects will apply thermal renovation, smart infrastructure and urban re-development strategies to selected, major, mixed-use projects (residential, office and services). For selected areas in the built-up city, rehabilitation and densification strategies, energy production and supply planning as well as future mobility concepts will be elaborated and implemented. In a Vienna perspective it is most important to obtain citizens´ and investors support from the very beginning of the transformation processes. This leads to the inclusion of socio-economic questions, such as acceptance and affordability, as seen from various socio-economic groups.

In 2007, **Grand Lyon** signed the Covenant of Mayors and committed itself to a climate change plan: 20x20x20 by 2020 and factor 4 by 2050.To reach the target, Grand Lyon launched in 2010 a partnership approach with local stakeholders, to design a shared climate change action plan: Industry, energy production, housing, offices, transports, institutions, communities, associations, public and private research. In total, about 250 stakeholders took part to the elaboration of the Action Plan. This collaborative work lead to pragmatic actions plan in 26 fields of intervention. For all actions, CO_2 saving potential, costs, allocation of budgets between involved stakeholders and timeline, have been identified. Climate Action Plan, for which final budget will be voted by February 2012, already succeeds in bringing together all main stakeholders and combining their investment agendas in a win-win approach. In parallel, many research and development activities on Smart grids and networks are carried out, making Grand Lyon one of the most advanced city in France in this field and paving the way to Smart City.

The work is divided into 6 work packages (5 of acitivity and 1 of management and coordination):

- WP1 Becoming a Smart Energy City, state of the Art and Ambition starts with a clear outline of each of the participating cities. The WP describes the context in terms of climate, energy assets, ambitions, targets and main possibilities in terms of energy efficiency, flows, production. It describes at the same time the current status of city planning, energy planning tools, and existing energy data. The WP will draw largely on existing Strategic Energy Action Plans, Climate Action Plans and planning documents. After this first step, the WP focuses on the description of what a smart energy city is, what the main KPI's (Key Performance Indicators) are that should be met and how this relates to where the current cities and the living labs are. A SWOT analysis is used to create oversight on gaps and barriers before becoming a Smart Energy City both strategic and tactic level.

- WP2 Development of a Transformation Agenda will draw on the work of WP1, in terms of KPI's and definition of a smart energy city. This WP brings together existing methodologies, insights and governance issues to help decision makers with improved insight by generating models based on qualitative methodologies. It also draws on the city specific outlines for the drafting of a city specific Transformation Agenda, looking roughly at the main possibilities in terms of CO_2 reduction, investments made by main stakeholders, an overall financial strategy and the recommendations for transforming both the internal city workings and the stakeholder processes.
- WP3 Development of a Quantitative Decision Support Model will draw on the definition of KPIs and inventory of existing datasets produced in WP1. WP3 recognizes the information required by stakeholders to make decisions and the format within which it needs to be provided (e.g. GIS maps, financial parameters). It consolidates existing datasets and then processes them to make this information available to decision makers. This is used in combination with the methodologies developed in WP2 to assist cities in producing a Transformation Agenda. It can provide the cities with the knowledge of how to set up smart city analytics. The use of data, the possibility to bring in end users for the generation of data and the use in practical applications and the use of analytics to search for better economies in scenario's are an innovative step towards smart city planning. It is also used by local partners to support them in developing their Implementation Plan; the Smart urban Labs of WP4 offer the opportunity to validate the model and tune it to the needs of the local stakeholders.
- WP4 Implementation in Smart Urban Labs ensures the coordination of six Smart Urban Labs, in each of the participating cities, where Implementation Plans are being made. Through the Smart Urban Labs, including condensed working sessions using design thinking methods, Implementation Plans are drafted. The Implementation Plans include all aspects like energy systems, mobility, water, waste, building stock, including timelines and payback periods. The Smart Urban Labs will be organized by the city and its local partners, but coordinated and facilitated by TRANSFORM. An intensive Lab period will be organized in each city, to accelerate the making of the Implementation Plan and add additional expertise.
- WP5 Replication, Dissemination, Exploitation ensures that the main outcomes will be replicable for other European cities. The work package ensures that other European cities are willing to replicate and go through the same process – e.g. through political commitment of other European cities. A strong political movement will be organized to ensure this commitment. The replication plan also means a clear action/ Implementation Plan per city – outcome of WP 4. WP 5 ensures also the correct dissemination of all products to relevant stakeholders in Europe. Exploitation makes sure that the results of the project will be commercialized by the industrial partners.
- WP6 Management, Coordination, Validation ensures the overall management, coordination, the communication between partners, with the Commission and the communication of the overall project. At the same time this WP ensures the validation of the results by an international advisory board.

3 CONCLUSIONS

The project intends also to make a step further in the quality of reasearch, by providing a replicable and tested framework for the production of a strategic Transformation Agenda for the city as a whole, combined with district Implementation Plans. Key Performance Indicators for Smart energy cities are part of the framework. This framework can be adopted by any other city in the European Union.

It will do so by uniting six frontrunner cities with ambition in targets and proven capacity to implement to meet the 20-20-20 targets (see 1.2.4), their local energy or grid companies, as well as commercial, industrial and scientific partners active in offering solutions to cities and a wide span of influence. TRANSFORM brings these partners together to ensure the coordination of applied research, the link between research and execution at city and district level, and the exploitation by industry of research and practical solutions. TRANSFORM will be able to do so through a process of mutual learning, and the distillation of these learning to the European level.

Innovation is key in this project: by bringing together the best cities in Europe, local specialists and international thought leaders TRANSFORM will contribute substantial to new ways of planning. In this new way of planning, data is being used to come to joint investment agenda's. This data is being generated by smart energy grids, buildings, mobile telephones and other technologies. The Smartness of the Cities will be used to analyze (analytics) the situation and decided on actions.

An innovative contribution to the integrated planning will be the application of an integrated approach in urban planning. The city is no longer considered as the object of un-coordinated city planning, mobility planning and energy, water and waste planning; but is rather recognized as an urban energy system whose flows from production to consumption can be made more efficient by measures from each of these fields. For example city planning can convince citizens to adopt public transport, while providing energy utilities with load profiles adapted to the integration of decentralized renewable energy production; waste and waste water can be seen as sources for biogas and heat respectively an their networks integrated as part of a broader energy network. This integration of the layers of a city will create win-win business models for stakeholders with initially different interests.

The gap between city level strategy and the local implementation requires a close study of the processes taking place, the stakeholders involved, data available and business models successful at the various levels of a city and how they impact or depend on processes, stakeholders, data and business models at higher and lower scales. Understanding which methods and tools are required at what scale in order to assure the implementation of an integrated Implementation Plan will be a significant contribution to providing other cities as well as commercial, industrial and academic actors with insight into this field.

The participation within this consortium of commercial, industrial and academic players already active in this field will warrant that the methods and tools developed will be further used and researched yet the requirement that these outcomes developed be freely available will ensure that they can be quickly adopted by other market players and research institutes.

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IMAGES SOURCES

Fig. 1: Transform Project "Transformation Agenda for Low Carbon Cities", Grant Application Form

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FROM A SMART CITY TO A SMART UP-COUNTRY

THE NEW CITY-TERRITORY OF L'AQUILA

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ABSTRACT

Ever since it was founded in the Middle Ages, the city of L'Aquila has been known as a City-territory. This was because it was established through an original unification process involving approximately 70 minor centres, which transferred a number of their inhabitants into the new City, in an act that we today would call Territorial Cohesion, thereby forming a city that was inextricably linked to its territory. While it is now undergoing radical transformation with dedicated resources, it is within this context that the issue of Smart Cities has emerged, which has, however, focused its work solely on established urban systems and historic centres. By reflecting on L'Aquila's role as a City-territory, which falls within the disadvantaged inland areas, and by preparing the Project in the Junction 2 - Abruzzo Territories of the Ministry of Infrastructure and Transport and the Abruzzo Region, we are able to extend the objectives of the Smart-City to the L'Aquila City-territory and in particular to the Seismic Crater, a pertinent example of an "inland area" (or rather "Up-Country") that today has been increasingly deprived of its identified resources. With a view to the development of inland areas based on the "smart" concept and involving planned integration between the Macro-region, the Territory Project and the Urban Planning Project, this paper supports the need for immediate intervention in the L'Aquila City-territory, and more broadly speaking for the entire territorial settlement system that is a feature of inland areas in Abruzzo. Nowadays, it is not possible to prepare a development project for inland areas without providing them with suitable access to connectivity and other more general networks.

KEYWORDS

City-territory, Connectivity, Smart Up-Country, Smart Cities, Territory Project

1 L'AQUILA CITY-TERRITORY

L'Aquila was an autonomous city with a municipal constitutional system, located on the border of the Kingdom of Naples, across the only main road running down through the peninsula (the Via degli Abruzzi). In the Middle Ages, it became a major centre for commerce in the Centre-South, bringing in the thriving economy from the surrounding mountain areas that relied on trade and manufacturing (the Comitatus). This ran up until the forced enfeoffment of the Comitatus and the loss of freedom under the Spanish rule of the South, which can be seen in the construction of the fortress from 1531.

Founded in the mid-thirteenth century, the city's role was immediately highly dependent on its Comitatus, while its size had to cope with the durability and stability of the territory's town and peripheral settlements. Consequently, it was not a matter of synoecism but rather "territorial cohesion", which is similar to the Europe Union's current proposal. The success of the city of L'Aquila is based on this very territorial cohesion between external centres and inland "spaces", according to a completely original development model.

The city was founded as a result of the "territorial cohesion" process to overcome the fiscal and judicial conditions of the centres which helped to establish the city by creating a new development model. It was a major city located halfway along the "Via degli Abruzzi" at the heart of the most important mountain pasture system in Central Italy. It was an important link for North-South trade with two resources (wool and saffron) which allowed the city to accumulate capital very quickly, although at the same time it was a city-territory ever since it was founded. The baronial fortresses were demolished, although the *intra* and *extra moenia* parishes were unified in a highly original way. Each one re-established its own "space" within the resurrected city bearing the same name as its original castle and as such it remained a separate administrative body (hence the structure of a City-territory), which additionally had its own church (a place of worship and also used as a parliamentary building) and its own square with a fountain serving as the heart of the social life of each "space", surrounded by a built-up residential area separated by boundary markings from the adjoining districts (Properzi 2009).

In this historical view of L'Aquila, the City must be seen within the framework of its territory, an image that partly decreased over the following centuries, but which has now been brought back to the community's attention following natural disasters. And it is precisely the concept of the City-territory, which considers the city and its territory as a single system, to be the first keyword, from which flows the experimentation that proposes in the following text.

1.1 THE 2009 EARTHQUAKE, GENERAL PLAN AND URBAN PLANNING PROJECT

When the earthquake hit in 2009, most of the economic system was already in crisis. Overall, the local system economy in L'Aquila recorded a sudden decline in the period prior to the natural disaster. The value added per capita was the equivalent of €20,000 in 2001, which was the highest figure in the Abruzzo region. However, between 2001 and 2009 this value was reduced by over €1,000 compared to the increases recorded in almost every other area in the region. In the same period, the industrial value added fell by 23% compared to the growth, albeit modest, in the rest of the regional territory. The service dynamics were rather weak and saw a drop in employees' productivity (Cresa 2011).Even though the retail sector initially recorded a dramatic fall after the earthquake, some of these figures were shown to be extremely positive, partly due to what we would call a "distorted" situation, i.e. produced by generous capital injections from the Italian government.

The pre-earthquake crisis in the L'Aquila City-territory was characterised by a sluggish economy and urban development which over the last 20 years had been subject to post-urban structures (Choay 1992) that were difficult to understand and even more difficult to govern (Di Ludovico D., Properzi P. 2012). This crisis coincided with an ungoverned post-earthquake situation, when polycentrism was strengthened further by the creation of the so-called "New towns", the CASE projects (Anti-seismic, Sustainable and Eco-compatible Buildings) and MAP (Temporary housing units), which established a new City-territory context. Alongside this phenomenon, we find many dispersed settlements, unforeseen sprawl over the agricultural mosaic, rarefaction, high land consumption, fragmentation of the environmental continuity, as well as damage to urban and peri-urban landscapes.

The post-earthquake situation in L'Aquila, a post-urban city, requires intervention in the City's management and development model, and its context, to respond quickly and effectively to the needs of socio-economic development and environmental protection, but particularly to overcome the crisis of the modern city. An experimental activity that is carrying out the Antea Laboratory (spatial and environmental analysis) of the University of L'Aquila and the LAURAq (Laboratory for Reconstruction of L'Aquila) of the National Institute of Urban Planning (INU) and National Association of Historical Artistic Centers (ANCSA), identifies this tool in Urban Planning Project (Morandi 2009), the central theme of the Workshop organized by the two laboratories, from 7 to 12 April 2014 in L'Aquila. The need for a comprehensive view of development and a general project that can address and direct all the post-earthquake planning sessions, is flanked by the practice of an Urban Planning Project (a comprehensive Urban Planning Project) , or better, into multiple Urban Planning Projects. In fact, any reference to this project seems to be coherent with a desired governance model for the L'Aquila City-territory, which could resolve all the critical issues and contradictions inherently found in the current rigid, static planning systems (such as the general town plan) and in the new development models for cities based on the principles of negotiation and trading.

The Urban Planning Project, which looks at the City's major issues from what we would call a context perspective, does not have to define any spatial boundaries or a specific timeframe, while making comparisons with part of the urban complexity. It is a progressive project, which is strategically viable in its parts and in the structural coherence and environmental compatibility that an Urban Planning Project should be able to guarantee. It 'a project that arises as a reference the space of the problems to be solved, welcoming the spatial indeterminacy as vital component for the success of its strategies (Di Ludovico 2013). It does not replace the formal instruments but instead looks for an effective and common method to resolve specific, sometimes localised, problems and to develop specific strategic visions through planning, keeping the eye of designer on the entire territory staked by problems.

L'Aquila, such as sample of City-territory, characterized by a strong dynamism due to post-earthquake reconstruction (thanks to a huge injection of capital), today can certainly assume the role of City-network (neither Area, neither Region) (EU 2007), a paradigm capable of balancing the unbalancing effect induced by the Major urban centres (in this case the City of L'Aquila). In this vision, which has as reference the network and thus the Connectivity (a second keyword), the Urban Planning Project can be extended to the City-territory, in the context of a more general planning (in this text defined Territory Project) addressed to the Smart-territory (EU 2011) as spatial evolution of the Smart-city, and in particular, in a weak regional space as the inland areas of central Italy, the Smart Up-Country (the third keyword in this text), which stands as a needed post-modern innovation in the inland areas, like the City.

2 FROM A SMART CITY TO A SMART TERRITORY

Following the natural disaster, the City of L'Aquila and its territory became the scene for rapid and extensive transformations, which were unplanned, unassessed and produced through isolated and incoherent planning sessions that were set up in the absence of a comprehensive City and Territory project, and Urban Planning Projects. The Reconstruction Plans, the Urban Mobility Plan and the new Strategic Plan were prepared. However, these planning documents do not cover the specific issue of urban design, but rather they establish a series of uncoordinated projects.

Under the City-territory's chaotic governance condition (Innerarity 2013) , a condition that can be extended to other case studies not affected by the earthquake, in an urban system that was greatly affected by major reconstruction work equating to a certain extent to urban redesign and construction, the idea for a Smart City came to the fore, one which would also involve the entire "Seismic Crater" (the area hit by the earthquake in Abruzzo Region). In fact, in July 2013, the Municipality of L'Aquila and the other municipalities in the Crater signed a "Smart City Agreement" to promote and support their transformation process towards a Smart City.

In 2011, the ENEA proposed an initial Smart City test for L'Aquila as a pilot project (fig. 1), involving a Smart Ring, Smart Building Network, Smart Lighting, Smart Mobility, Smart Environment, Social Participation, Smart Node, Social Urban Network (SUN) and Smart Communities, a cultural Social Network featuring the creation of a cultural Hub.

The City of L'Aquila can rely on its University which carries out research on issues of digital agenda for Italy and Europe, covering a wide range of areas of interest. As such, it can and must set ambitious objectives on the subject of innovation in the urban and territorial environment. The City can at least reasonably aim to be a national leader on how an urban environment and its reference territory can best combine innovation, cultural activities and the quality of life of its citizens.

In light of these considerations, research initiatives in line with the vision described above have been put in place, which will be conducted directly by the University of L'Aquila through its own appointed staff and indirectly through the network of scientific contacts at the University's disposal.

The following activities are at the centre of initiatives to support this research:

1) the installation of wiring and any other infrastructural work needed to develop a metropolitan network (MAN – Metropolitan Area Network) to connect any civic institutions that fall within Public Administration (Municipal Administration, Provincial Administration, Regional Administration, Prefecture, Police Headquarters, University, etc), which would like to take advantage of this connectivity service to support a path of innovation within the digitalisation of Public Administration;
2) the installation of wiring and any other infrastructural work needed to develop an experimental optical network and a wireless extension available for the national and international scientific community (in coordination with the local University), which will develop new networking technologies and new services that can run on this infrastructure.
3) Regarding the issues of communication infrastructures as enabling factors of a Smart City, the University of L'Aquila is taking steps to consolidate the development of urban connectivity in line with the solution commonly used in countries that are most interested in the development of this specific issue (for example, Scandinavian countries). This approach involves the provision of a comprehensive fibre optic network which can reach every home (Fiber To The Home – FTTH). This solution finds the most favourable conditions in the historic centre of the city in which the simultaneous complete redevelopment of the sub-service network and the restructuring or reconstruction work of private buildings create the perfect conditions to work on the FTTH solution.
4) In December 2013, the Municipality of L'Aquila and ENEL signed a Programme Agreement to launch the project "The Smart Grids infrastructure for L'Aquila and its role in enabling technologies and services for the Smart City", which aimed to establish Smart Grids, i.e. bi-directional electrical grids that

are fitted with automation and remote control systems. This project also provides for the development of electrical mobility (eMobility) through the installation across the territory of charging systems that “interact” with the electrical grid.

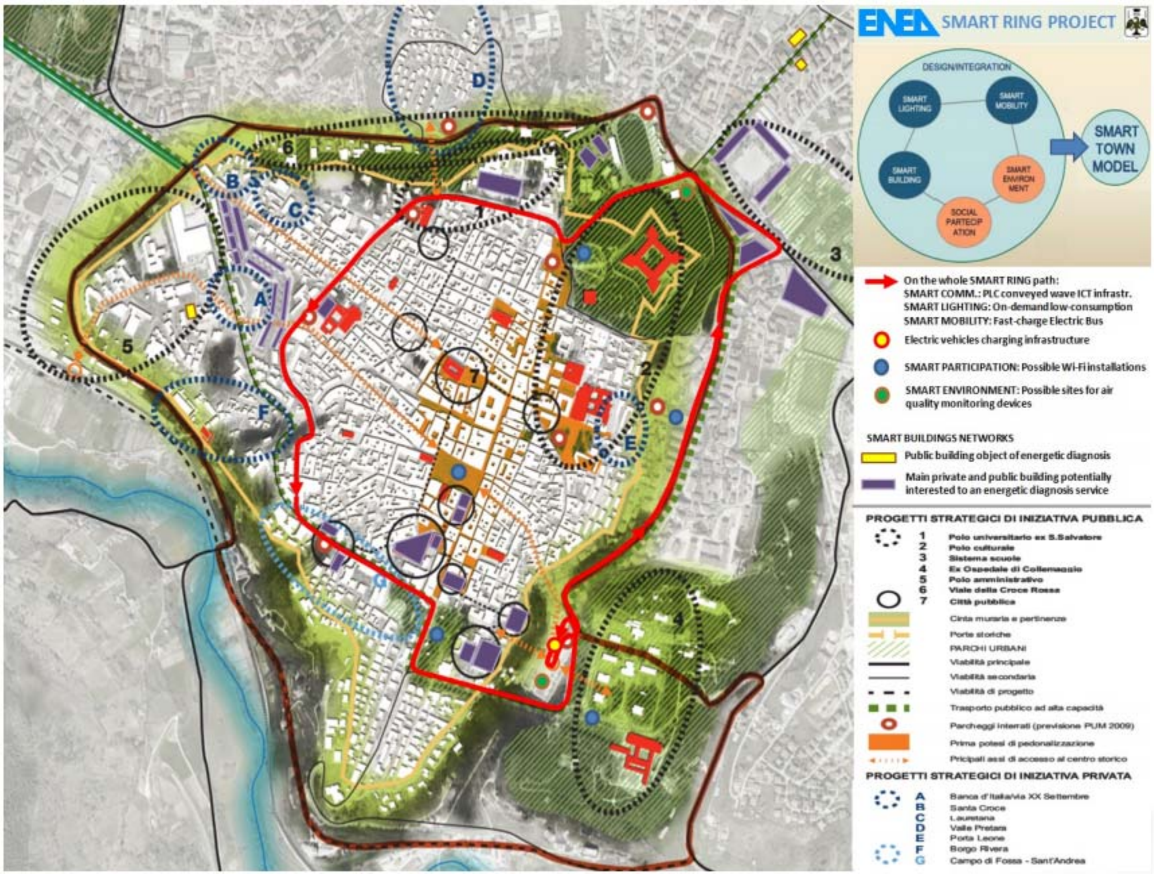

Fig. 1 ENEA’s Smart City proposal

These three proposals (ENEA, University of L’Aquila, ENEL), which have not been given by comprehensive Urban Planning Projects that would have rather integrated them and referred them to other necessarily related issues (i.e. those of urban development), mainly focus on the Historic Centre and, in the case of certain specific issues, on the established City, thereby excluding part of the identity that characterises L’Aquila, namely the City-territory. L’Aquila is a typical example of a Major urban centre that regulates the socio-economic development of an entire underused area. It is precisely because of this “territorial” and development-driving role, the research of the Antea Laboratory and LAURAq propose to extend the "L'Aquila Smart-City" strategies, through the Urban Planning Project and, more generally, the Territory Project (which will be discussed in the next few paragraphs), to the City-territory, thus converging towards strategies for "L'Aquila Smart-territory", but integrated with those of Smart City.

In a deeper insight into the territorial space of reference, one of central Italy, it is believed, however, that the strategy of "Smart-territory" does not achieve a breakthrough. In fact, in these areas, the concept of "Smart" must address and resolve critical issues more closely to the urban and territorial themes of areas still heavily under-utilized consisting of small and medium cities and sprawl, for example those related to the peri-urban agricultural system (Donadieu 2013), to the extensive cultural heritage network, to the territorial environmental and ecological networks, to the widespread networks. However, it also involves more general themes, such as the climate change relating to the "concept of 'climate-smart territories' – socio-geographical spaces where actors collaborate to optimize ecosystem services and agricultural production for the improvement of human well-being in the face of climate change" (Van Etten 2013). It is necessary, therefore, to speak of Smart Up-Country instead of Smart-Territory.

2.1 SMART UP-COUNTRIES AND TERRITORY PROJECTS

In the context of regional development and, in particular, in a greatly underused context like that of Abruzzo, the issue of the "L'Aquila Smart Territory" must be expanded to the so-called "inland areas" (or rather "Up-Country"). We therefore move, through subsequent generalisations, from the concept of a Smart-City to that of a Smart-Territory and finally to a Smart Up-Country. Forecasting instruments could deliver this level of planning, moving from the Urban Planning Project, in reference to the urban dimension, to the Territorial Project. In particular, the Smart-Territories and the Smart Up-Countries could become key actions of the so-called "Territory Projects" (Fabbro 2007), and consequently for the expansion, they could become objectives for European and national planning (for example, through specific Operational Programmes).
The new "smart" issues which need to be addressed, as has already partly been done, mainly concern the accessibility of resources. For the city, it means having an efficient network infrastructure involving efficient information services. For the territory, and specifically for the inland areas, it means shortening the supply chain between rural areas and urban centres and building a network of villages or, more generally, of cultural heritage. It means tourism, it means connecting local networks to widespread networks, bringing a territory that is rich in history and productive potential out from isolation.

2.1.1 RURAL SPACES IN A SMART UP-COUNTRY

Rural spaces in inland areas, for example those found in Central Italy, suffer greatly when in competition with the more productive areas located in the valleys or along the coastal sections. To some degree, these spaces have similar characteristics to those of peri-urban spaces, i.e. loss of fertility, agricultural land used for renaturation (in Abruzzo from 1990 to date, there has been a reduction of 18% in the use of agricultural land), destruction of the countryside, etc. However, these spaces would welcome the opportunities of a market selling fresh agricultural products, thereby benefitting from the economic advantages offered by a short supply chain and creating jobs for the entire sector, for example in terms of accommodation (Carabba *et al.* 2013).
The management of rural spaces in inland areas requires an integrated approach. It is particularly necessary to promote their multi-functionality in order to enhance their many non-agricultural uses as well. For example, a "Smart" approach would introduce options such as: Farmers' Markets or Hobby Farms, a network of farms linked to rural villages but also to major urban areas (to reach the objective of zero food miles, also through Rural Mobile Shopping and Markets); the formation and networking of agricultural Parks; Energy crops, which are grown to be turned into different forms of energy, e.g. heat production, electricity, cogeneration, biofuels and so on (this also takes into consideration the cost of energy in Italy); "climate-smart territories", i.e. geographical and social spaces where ecosystem services are maintained or restored, improving well-being of local people while continuously optimizing mitigation and adaptation to climate change (see http://web.catie.ac.cr/wallace2013/conferencia_ing.htm); "Rural tourism" which could be developed through the use of modern technologies (for education) based on local knowledge (wine, oil, etc, but also organic farming) and the promotion of local produce; "Smart Villages", rural villages which apply the same objectives as Smart Cities; "Agricultural Wellness", which involves strengthening the flow of

information between producers and consumers; the "Rural Traffic Network", which studies the flows and sustainability of infrastructures in rural areas that have often deteriorated considerably (motorways, railway lines and main roads also run through the inland areas in Central Italy); the "Smart Culture Heritage", broadening modern communication technologies to the cultural heritage of inland areas, such as archaeological sites, castles, historical rural buildings, but also historical agricultural landscapes, etc.

All these many issues highlight management models and techniques which aim to urge local communities to reappropriate rural spaces, to try to establish communication between rural societies and urban societies, and to constitute a substantial technological infrastructure project for inland areas. A project which is primarily based on the upgrading and expansion of networks across the surrounding territory for technological infrastructures that are already established along the main road infrastructures, such as those found in the smart channels of motorways or main roads. In this direction moves the experimentation of Urban Planning Projects of the Antea Lab and LAURAq, which seeks to combine the theme of Smart Up-Country (essentially technological infrastructure), with that of the Project and the Networks, but also with that of the reuse and enhancement (again, one could speak of regeneration, as for the City) of the rural area, the complex of environmental, landscape and cultural assets and tourism.

2.1.2 CONNECTIVITY FOR THE DEVELOPMENT OF INLAND AREAS

It goes without saying that nowadays we cannot prepare a development project for inland areas, as declined in the last few sentences of the previous paragraph, without providing them with suitable access to connectivity (DAE 2013, DAI 2014). This issue should duly be considered as a necessary condition for development, although for years now Italy has paid little attention to the matter, resulting in a lack of direction. In fact, there have been attempts to justify the lack of attention and, therefore investment, due to commercial operators not being able to find sustainable business models. In reality, inland areas that are an integral part of the L'Aquila system would merit public intervention purely due to their status as areas of "market failure" (as the European Union expects and recommends). We could therefore argue that, by virtue of the desired attention on the development of inland areas, investment should be put in place to provide widespread state-of-the-art connectivity to small municipalities, often formed of many different communities, without succumbing to the temptation of assessing the cost per capita of the work immediately after it has been carried out. Instead it should be valued in terms of the medium-long term social budget. By limiting the attention for now on inland areas that see the City-territory of L'Aquila as a barycentre, predominately corresponding to the Seismic Crater, the reconstruction process underway will create conditions that, if properly used, could form the requirements for comprehensive connectivity in these areas. Very briefly, in terms of technological connectivity, the proposed activities at the experimental level with Urban Planning Projects for the City-territory, the results of the research of Antea Lab and LAURAq, can be summarized as follows:

1) to provide fibre optic connectivity to the public network and private buildings in municipalities planning to redevelop their sub-service network or carry out major restructuring/reconstruction work;
2) to upgrade old public networks/channels built by the Abruzzo Region and by local administrations, which are now unused but could provide coverage that would be able to guarantee connectivity to a significant number of municipalities in the Seismic Crater (15 out of 56);
3) to offer the Seismic Crater as a location to initiate extensive backhauling in inland areas as a second-tier activity by Infratel (a public company working to reduce the digital divide in Italy), which would certainly have a greater impact than a first-tier activity resulting in a series of individual backbone connectivity operations spread across the whole country that do not offer support for a genuine step

change for inland areas, instead only allowing access to a minimum level of connectivity from which it is difficult to imagine any development project.

In the inland areas, these operations have become a matter of extreme importance. It is clear that development inland areas is not possible without this particular issue being properly taken into consideration. On the other hand, the general socio-economic climate does not allow us to believe that the rest of the country has any more time on its hands to improve connectivity conditions compared to areas where the infrastructure level of seems to be a theme forgotten. In other words, under these precise circumstances, the definition of an ambitious and socially sustainable development model for communication infrastructures in inland areas, starting from areas hit by the earthquake in 2009 and more generally from possible City-territory of the inland territorial system, could become a reference model for the entire national landscape, where inland areas play an essential role.

3 TERRITORY PROJECTS FOR A SMART UP-COUNTRY

New communication technologies and expert knowledge of sustainability and reuse, which were described in the previous paragraphs, are still interesting subjects to develop in the conceptual field. However, without support from implementation instruments (such as territorial programming or planning), they cannot have a concrete impact across the territory. On the other hand the experimental instrument of the proposed Urban Planning Project, there must be an overview of the Territory.

One possible instrument, which is deemed suitable to express and achieve "Smart" objectives in the City-territory and the connected Up-Countries, comes from a study conducted on the entire Abruzzo Region (Italy), still under development, concerning the so-called "Junction 2 Territories" identified by the Ministry of Infrastructure and Transport. It serves as a suitable benchmark, including in relation to scale, to develop the idea and objectives of the Urban Planning Projects and the Smart Up-Countries up to the Abruzzo 2009 Seismic Crater.

The Abruzzo Region has established its own Project in the Junction 2 Territories (from now on "PdT2 Abruzzo") (RegAbr 2013) as a coherent and integrated intervention system for the development of the regional territory, in the context of the Lazio-Abruzzo Strategic Territorial Platform, while identifying the "Central Abruzzo Quadrangle" in the framework of the "Median Macro-region", as well as the development project of the relative Settlement, Cultural, Natural and Environmental System (fig. 2).

When the regional Settlement System is seen as a whole in all its complexity, it should be interpreted in relation to the demographic features of the centres, the morphological aspects of the systems or in its interaction with rural, natural and cultural landscapes. However, it is particularly pertinent to take into account its relationships with other systems and cities. In particular, the Central Abruzzo Quadrangle covers a rather large part of the inland areas in Central Italy, and in particular the Seismic Crater, most of which are characterised by critical issues with the rural, natural and cultural system, but also the settlement/productive and tourism systems.

In line with new trends for interpreting the European area, the Quadrangle has been placed in relation to the "Median Macro-region", which is interpreted in terms of its relationships through the city network and positioned within widespread networks that represent its potential and role in the European and Mediterranean dimension. The identified infrastructural Frameworks support average loads of about 100,000-200,000 inhabitants and cover the whole of Central Italy, although they are not yet complete and capable therefore of stimulating the flows determined by the productive and tourist sectors across the regional and macro-regional territory. The main objective of the "PdT2 Abruzzo" is to reinterpret and complete the infrastructural fabric to stimulate these flows and to connect weak Territorial Settlement Systems with stronger ones and, on a larger scale, Median Italy with the Euro-Mediterranean area.

The features and potential of the Territorial Settlement Systems from this interpretation based on the Frameworks and networks of the city, as well as the connected Tourist Systems with their landscape and cultural qualities, have helped to identify fundamentally different development policies (priorities) as well as complementary development policies (useful for the full implementation of the first policies), both in terms of tangible and intangible aspects (strengthening/completing the connections, reinforcing/consolidating the services, recovery/redevelopment). These policies are suitable for the development of this context, intrinsically establishing its scalability over time to facilitate and accelerate its implementation.

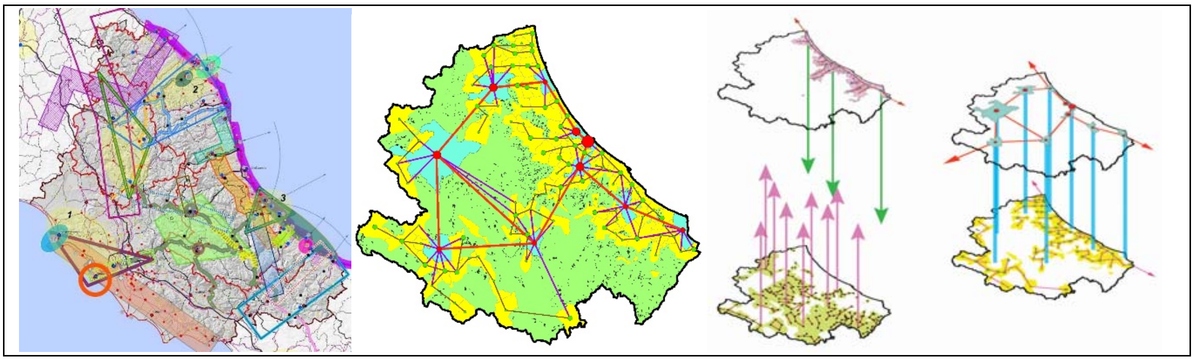

Fig. 2 To the left: the Median Macro-region and Territory Project (in green the Central Abruzzo Quadrangle); in the centre: a deepening of Territorial Settlement Systems in Abruzzo Region; to the right: Territorial Settlement Systems and City Networks (top left: Linear coastal cities; bottom left: Inhabited countryside areas; top right: Major urban centres; bottom right: Networks of villages or minor Urban centres)

Through the definition of a structured Strategic Agenda for certain Issues (reorganisation of a Territory, Environment or Landscape) and Systems (Settlement or Tourist),the "PdT2 Abruzzo" pays particular attention to the characterisation of tourism. This can also involve the development of key policies for the Smart Territories and the Smart Up-Countries, in accordance with detailed Urban Planning Projects. The settlement Systems affected by these specific policies are the "Network of villages and Minor centres" and the "Inhabited countryside areas". These territorial sectors of the Up-Country affect the L'Aquila City-territory and have always been considered underused. They are subject to a substantial relational deficit with the "Major centres" (major urban areas, including L'Aquila) and the "Linear coastal city", a deficit which could be recovered by integrating structural strategies with "Smart" objectives for inland areas, applied to contexts such as those found in the L'Aquila City-territory and coordinated (or made coherent) with the proposed Urban Planning Project through a process of sharing in the framework of Smart Communities.

Experimental research suggests, as a reference to the socio-economic development, the tool of the Project ("Urban Planning Project" at local level, "Territory Project" at regional level), which interprets the regional space with a new model of integrated territorial settlement systems and networks of cities, which recognizes in the local context a not urban-centric model but relating to the identification of the City-territory, which extends the strategies of the Smart-City to inland areas highlighting the role of Rural Space-Smart and its innovative themes. The experiments proposed with the Joint Territory 2 Project - Abruzzo, structured on the Central Abruzzo Quadrangle, and the consistency of these experiments with those of Urban Planning Projects on the local level, introduce a set of alternative tools to classical planning (which generated the post-urban city mentioned in the first introductory paragraphs) based on the concept of strategic planning, effective for the achievement of the objectives summarized in this text, tools that in the particular case of central Italy, lead the Up-Country at the center of development projects.

4 CONCLUSIONS

Moving from the objective of a Smart-City to that of a Smart Up-Country essentially means highlighting the underuse of areas of "market failure", which have only been brought to the attention, albeit in weak forms, of the new 2014-2020 programming by the last few government study documents (see the partnership agreement on inland areas), without a structured program, but especially without a thorough reflection on the tools of implementation and the unresolved issue of governance (too many stakeholders and decision-makers uncertain), factors that determine today a substantial block of territorial changes, but also urban changes.

To date, the inland areas of Central Italy, and in particular the areas in Abruzzo and the Seismic Crater, formed by an inefficient network of towns and cities of small-medium dimension (such as L'Aquila) from the critical peculiarities of the post-urbanism, today still have the characteristics of underutilization, in the face of a very important urban, rural, landscape and environmental heritage, further compounded by incomplete infrastructural frameworks, tangible and intangible, that effectively exclude the same areas from local and global networks.

Intervene on the failure of urban and territorial policies of the last decades in the inland area, whose past development was based on the European polycentric model, mainly means to overcome the model of the modern city still characterizing, and in particular the governance model of the Italian territory in the last 20-30 years (zoning), that has basically crippled territorial development and that of the related networks. In this sense, is under construction an experimental activity conducted by AnTeA Lab (University of L'Aquila) and LAURAq (National Institute of Urban Planning (INU) and National Association of Historical Artistic Centers (ANCSA)), which focuses on the potential of the Project tool: a Territory Project, an Urban Planning Project but also a Knowledge Project; a Project based on a reticular interpretation of the space addressed to the integration through Territorial settlement systems and Networks of cities, end not to the revival of the dual interpretation coast-mountain that has always characterized the policies of central Italy. The experimental activity means the reticularity as an extension to the territory (and thus to the inland areas) of the connective nature of the Smart-City (in fact we're talking about City-territory), innovating its meaning and redefining itself as Smart-Up Country, and use the tool of "Project" implemented through new and streamlined governance tools, to deal effectively the urban and territorial issues and renewal the City-territory in Smart sense, where the word "Smart" is associated with a broader meaning related to a new model of the City, also in planning terms and not just technology.

Territorial projects and Urban Planning Projects, geared on the interpretation model (which might be called macro-regional) consisting of the Territorial settlement systems and Networks of cities, are able to show a relational view of the area concerned, where the Smart Up-Country (extension of the Smart City to inland areas) are connected by projecting their own territory in the European space, a result that the classical tools of planning are no longer able to achieve for a long time.

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Fig. 1: taken from the presentation entitled "Workshop – Smart, sostenibile e sicuro: il futuro dei centri storici 2, Lucca 18 October 2012, Claudia Meloni - ENEA researcher.

Fig. 2: taken from "*Median Italy: territorial diversity as the cornerstone of regional development*", di D. Di Ludovico, P. Properzi, A. Santarelli, in: The 1st International Symposium "NEW METROPOLITAN PERSPECTIVES. The integrated approach of Urban Sustainable Development through the implementation of Horizon/Europe2020".

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GEOVISUALIZATION TOOL ON URBAN QUALITY

INTERACTIVE TOOL FOR URBAN PLANNING

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ABSTRACT

This paper describes the implementation of a tool that enables to gather and compare data from different sources for the benefit of urban planners. The tool is easy to access on different types of devices (personal computers, tablet, smartphones) thus being easily available in many various situations from urban planners and decision makers. It may also be used to find correlations between different phenomena in different time frames, so that solutions to possible problems can be rapidly suggested. The paper shows the process of implementation of the tool and some examples of application to the city of Torino in Northern Italy, a city who dealt with several urban transformation in the last two decades.

KEYWORDS

urban quality, geovisualization, planning tools, gis

1 INTRODUCTION: GEOVISUALIZATION

The term geovisualization indicates the ability of a GIS program to visualize geographical information according to various applications, including interactive maps, tridimensional models, maps and synthesis tables, representation of temporal events and schematic view of the internal relations of a network. It allows reproducing basic geographical representations as well as advanced representations (maps) of the data contained in geographical database. Maps are the main tool for presenting geographical information to users and allow the interaction.

Maps created through GIS are different from static printed maps because it is possible to interact with them. An interactive map can be explored or widened and the information layers which are represented may be switched on and off with appropriate visualization scales.

Even more interesting is Web GIS, a geographic information system published on the web that is the web extension of applications born and developed to manage digital cartography. A web GIS project differentiates itself from a GIS project for the specific aims of communication and information sharing with other users. Through GIS, GIS applications traditionally developed for standalone users or in LAN environments may be implemented on a web server (also called map server) allowing the interaction with cartography and associated data through internet.

The next step could be to have the same data always handy especially during a survey, travelling, etc. Web GIS used on a desktop pc does not provide this capability. A handy cartography that interfaces with the position of the consulting person is necessary; this is called web mobile GIS.

Being GIS one of the most performing tools among all technologies related to information, it is used more and more frequently as a decision support tool. Many are the fields of application based on geospatial information technology, in particular those who are related with territorial and urban planning, that is the discipline that studies and regulates territory management processes, evaluating the consequent evolutionary dynamics. It is the activity through which territory overall structures are assessed. In this field the need of a common information data base shared anytime by different operators is fundamental. By means of GIS systems it is possible to share, manage and represent several territorial data.

2 A NEW TOOL TO VISUALIZE URBAN QUALITY

Territorial planning requires more and more access availability to various types of georeferenced data; to answer this question, a specific research was carried out in order to identify the most adequate tools to gather and manage such significant data.

Data typologies gathered with this tool are essentially two: georeferenced data of urban transformation (perimeters and data describing transformations) and data on the quality of life in the city of Torino (georeferenced indicators on urban structures and services).

The development of the tool raises from the idea of gathering all available data on a unique platform as user friendly as possible. Many people do not know how to use or don’t have Arc map and then they cannot interact with the data.

To overcome this limitation we found the answer in the Google beta application “Fusion Table” that exactly allows to load data previously processed by ArcMap on a web platform accessible to all with the possibility to be interactive and interrogated by using filters and selections.

Google Fusion Tables is a specialized program very interesting for database management. The service, always free and completely on line, has a very precise aim: it helps large database and multiple tables distributed database managers to use their own data, filter them, implement graphical representations that can be distributed in the simplest possible way.

The georeferenced interactive map on life quality in the cities is, therefore, a tool that gathers various georefernced data (indicators) regarding a town (in this case Torino) giving the possibility to visualize them in different graphical shapes.

A very interesting feature of the tool is its interactivity that is the possibility to personalize the map through various filters available for each indicator. All this is accessible not only through a pc connected to the internet, but it is also possible to visualize and actively interact using a tablet or a smartphone, thus making this tool available in several different situations.

2.1 URBAN QUALITY DATABASE

In order to study the indicators related to urban life quality, the 92 statistical zones of the “Comune di Torino” are taken as cartographical basis to represented and gather data.

The choice was made in this way because statistical zones represent a good compromise both for number of areas and size, thus originating more clearly readable maps.

The indicators taken into account and processed were divided into two large categories:

- Structural data: they describe how the public town is organized at a structural layer: urban density, functional mix, green areas, pedestrian areas, public lighting;
- Services and facilities data: that measure public services that the town offers to its inhabitants: average accessibility in origin by public transport, cultural and leisure facilities, nurseries, sport facilities,.

2.2 URBAN TRANSFORMATION DATABASE

To produce the database related to urban transformation, the first operation has been to draw and georeferenced through ArcMap the various perimeters of urban transformation the map of the town of Torino.

To build this map only large transformations (>50.000 sqm) have been taken into account.

For each transformation a file describing the intervention was produced with all the info that it was possible to find, such as the planning instrument, period, start and end of the intervention, the surface related and the population involved.

Finally the transformations were gathered and grouped into four families: urban requalification (physical interventions), infrastructures (physical intervention for streets a d transport), urban regeneration (physical intervention with social contribution) and social contribution interventions (without direct material implications).

3 TOOL IMPLEMENTATION

The tool design was divided into practically three large steps, both for urban transformation and for urban life quality indicators.

For urban transformation:

- The first step was to draw the perimeters of transformation areas and subsequently fill the various descriptive files gathering the information.

- The second step consisted in integrating geographical information (perimeters) with the descriptive files to get a large database with both types of information. Four different maps were produced from the categories in which transformations were gathered.
- The third step, that determines the passage of the information from the GIS to the Web GIS form, required a reasonable organization of the database that was subsequently loaded on the web through the Fusion Tables application, previously described. Geographical information and the database containing the information of every single transformation were loaded separately and joined together through a table merge step. Subsequent steps were only aimed to the representation of data by applying filters and interactive maps.

For urban quality indicators:

- The first step was shared with some experts in order to select and gather the indicators in order to produce the status of urban quality in Torino. Following the research of the various data sources, we processed several analyses of the previously described indicators.
- The second step was mainly characterized by the preparation of the database on ArcMap and Excel by georeferencing all gathered data and organizing them to build the representation on the statistical zones of Torino.
- Also for urban quality the third step was the one that led the transition of geographical and informative data to the web, with the same previously described methods.

4 EXAMPLES OF POSSIBLE APPLICATIONS

In order to demonstrate the effectiveness of the tool in decision making processes, in following paragraphs some examples of maps, created through the correlation of indicators, are illustrated.

The first four applications just take into consideration one family of indicators (i.e. urban quality, urban transformation, demography, real estate market) while the last two examples simultaneously display indicators from different families (urban transformation/real estate market and accessibility/public services) thus providing an example of the potentiality of this tool in combining different kinds of data. Real estate market and demographic data, not described in the initial data bases, were added in a second time in order to increase the potentiality of the instrument.

4.1 URBAN QUALITY

Geovisualization on urban life quality gathers all the indicators listed before. In addition also resident population with foreign citizenship were included. Such elements allowed to perform some analysis related to urban transformations, dating between 1991 and 2012 were available. This allowed to monitor the behaviors of residents before, during and after urban transformations.

With the use of this single map, analysis per statistical zone may be performed on the main characteristics of the public town, through the interactive reading of data that allows to create, in few simple steps, maps that represent the behavior of an indicator.

As show in the following pictures, it is possible to “query” each single zone on one or more values (Fig. 1). By selecting the appropriate filters (Fig. 2) it is possible to visualize specific zones on the basis of the values of the single indicators. In the example, an urban quality indicator was selected with a rather high value range between 61 and 100 (aggregated index), that show on the map only the areas with the level of urban quality included in the selected range.

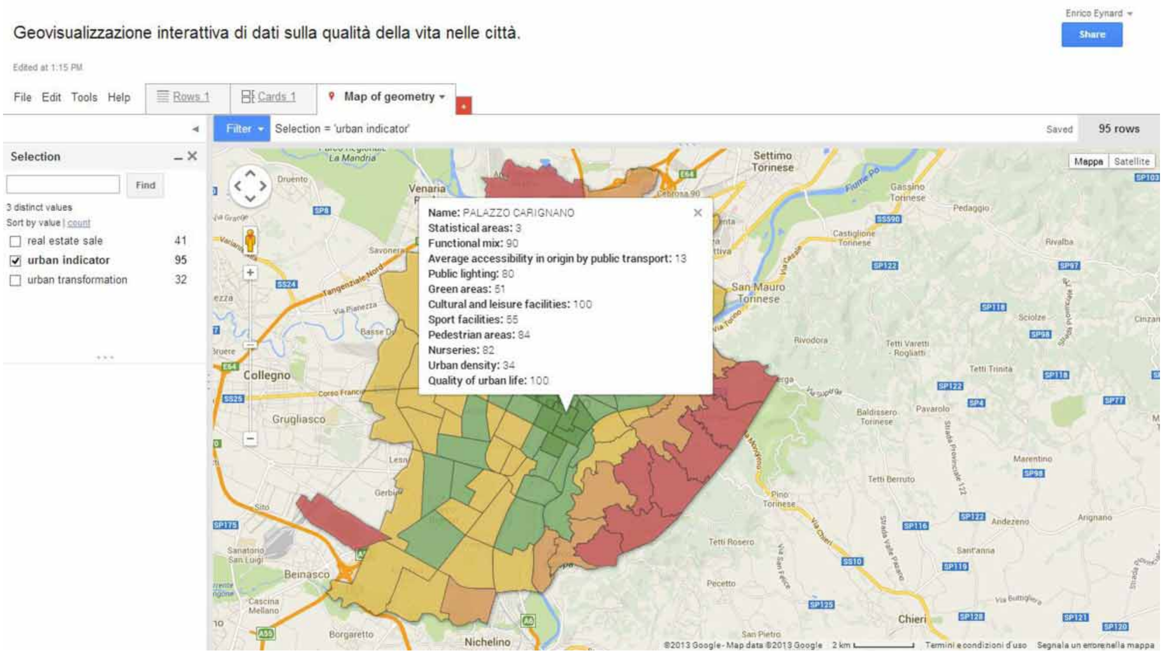

Fig. 1 Querying data of each statistical area

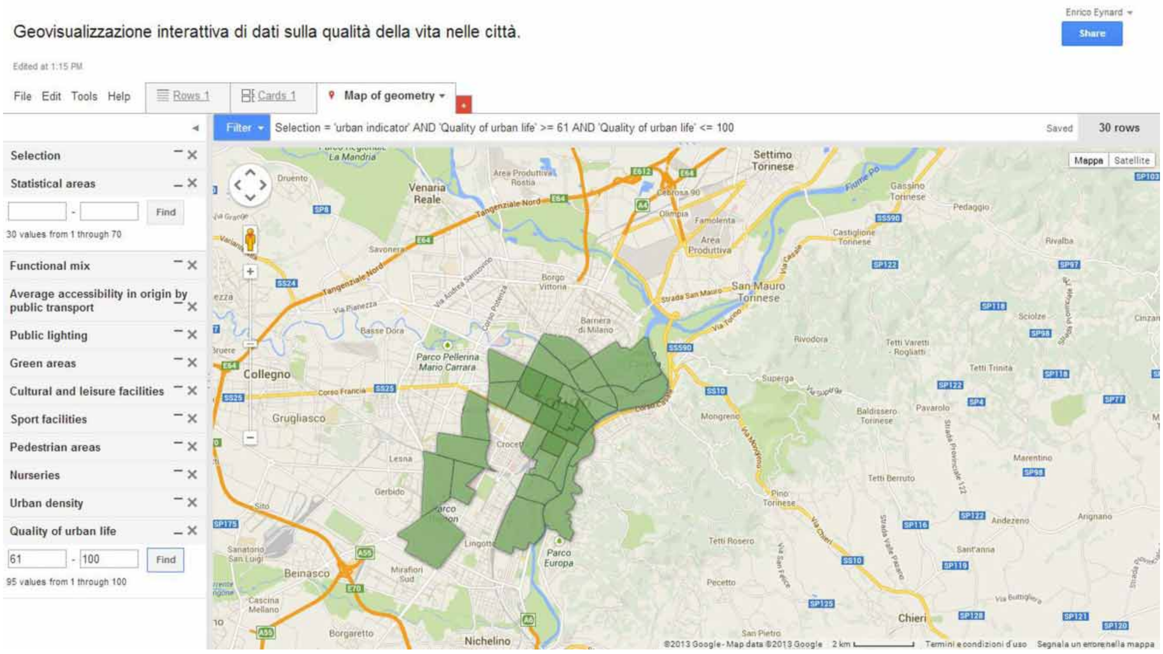

Fig. 2 Available filters

4.2 URBAN TRANSFORMATIONS

The map of urban transformations contains all the perimeters and the information previously illustrated. Mainly it consists of a georeferenced database of transformations that may be consulted to produce the representations related to the interventions that the user wants to visualize. The most interesting aspect consists in the possibility to overlay these layers with others in order to compare the transformations with the indicators of the various loaded maps. This allows to deeply analyse urban dynamics in order to evaluate whether the transformations had positive or negative effects on the town and its population.

As shown in the following pictures, differently from previous examples, colors are related to different families of interventions, rather than to the value of indicators.

In this case (Fig. 3) filters can be configured to select some typologies of intervention through the characteristics such as typology, work start and end year, time period, planning instrument, surface. In the chosen example, only regeneration and urban requalification interventions were selected.

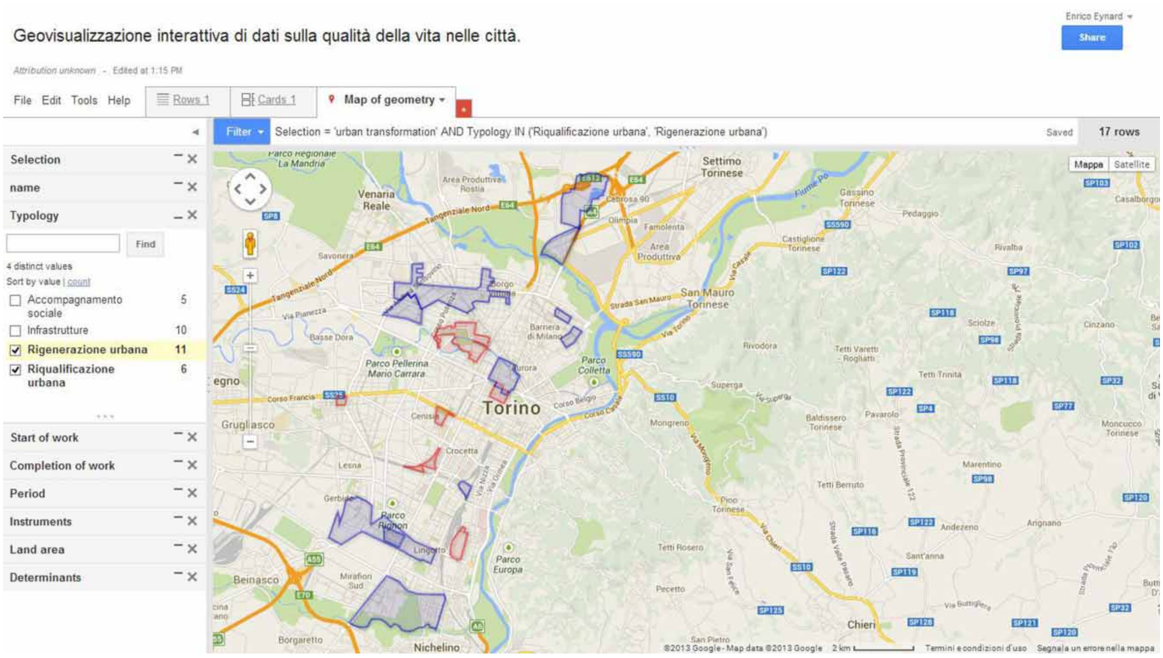

Fig. 3 Application of filters

4.3 DEMOGRAPHIC DATA

In the map on statistical zones, demographic data were also included; in particular the total resident population between 1991 and 2012 and residents with foreign citizenship.

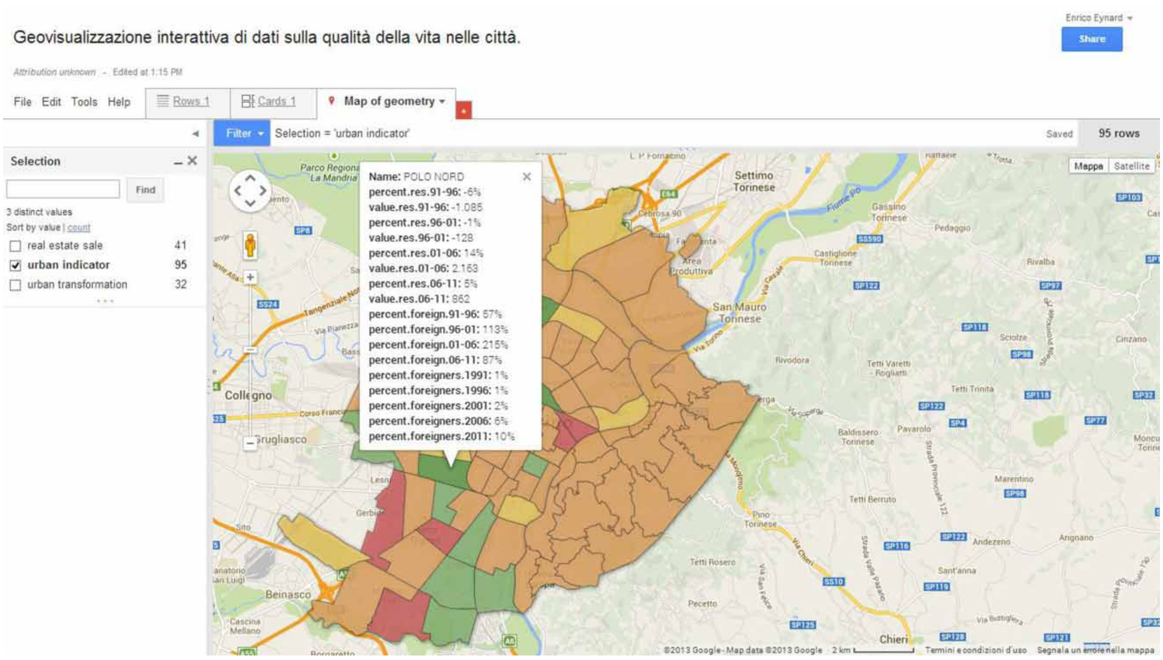

Fig. 4 Querying data of each statistical area

Having a significant historic series, it is also possible to connect these data with urban interventions, in order to show possible correlations with urban quality indicators.

As for demography, some pictures are reported in the text: figure 4 shows the statistical areas in a semaphore scale, that represents with the red color the areas where population decreased and with green color the areas where the resident number increased.

In the following figure (Fig. 4) an example of interrogation on a statistical area of demographic data is reported. Finally the various available filters were included and the filter related to the percentage of residents with foreign citizenship was activated on a statistical area. The value included >20% allows to visualize only the zones with more than 20% of foreign residents (Fig. 5).

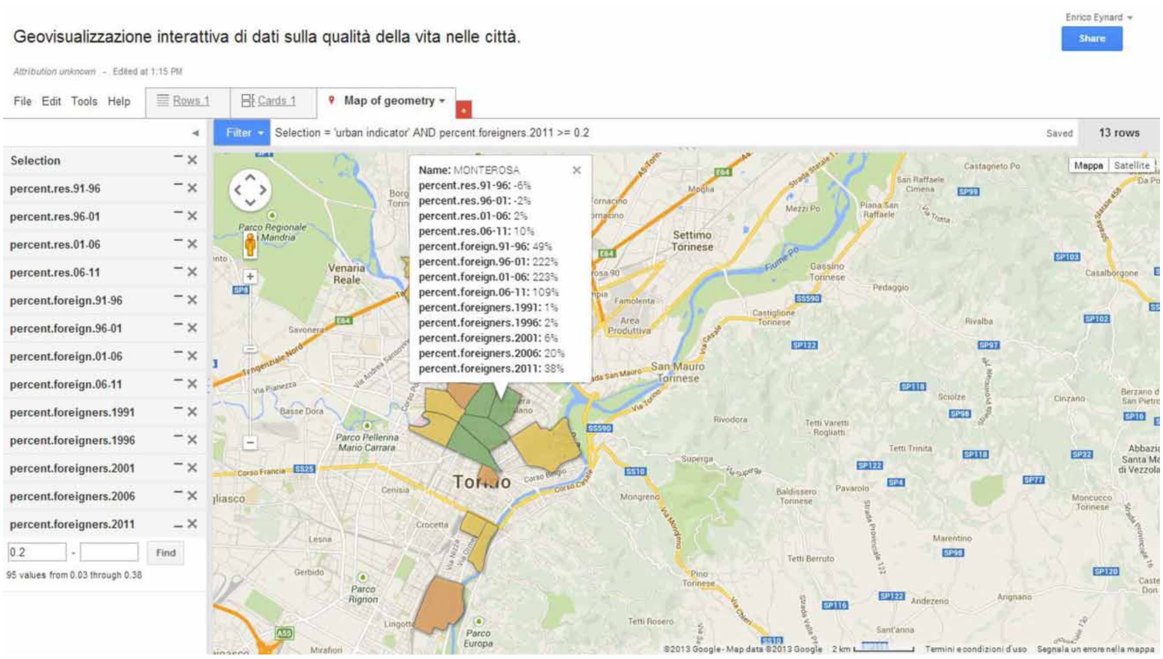

Fig. 5 The available filters

4.4 REAL ESTATE MARKET

In order to make this research more complete, we decided to include also data on real estate market. The data source is the real estate observatory of the town of Torino. Data area are related to real estate values for the 40 censuary microzones of the town: such values are expressed in euro/sqm and represent the average unit prices of the offer.

The micro zone is a portion of the municipal area, that presents homogeneity in the characteristics of location, urban, historical and environmental values and is representative of a segment of the real estate market.

The subdivision in micro zones, in this case, has been classified with respect to the real estate value (2013). The darker red color represents the areas with higher average selling price.

As in the case of the other maps, it is possible to interrogate the single zone on the various real estate values, percentages of variation and variation values.

Finally different filters may be selected: in figure 6 for example a filter has been activated on the basis of the variation between 2008 and 2013. A range of values between -900 €/sqm and 1 €/sqm was inserted, so as to visualize only the zones that showed a decrease in average selling prices in that period.

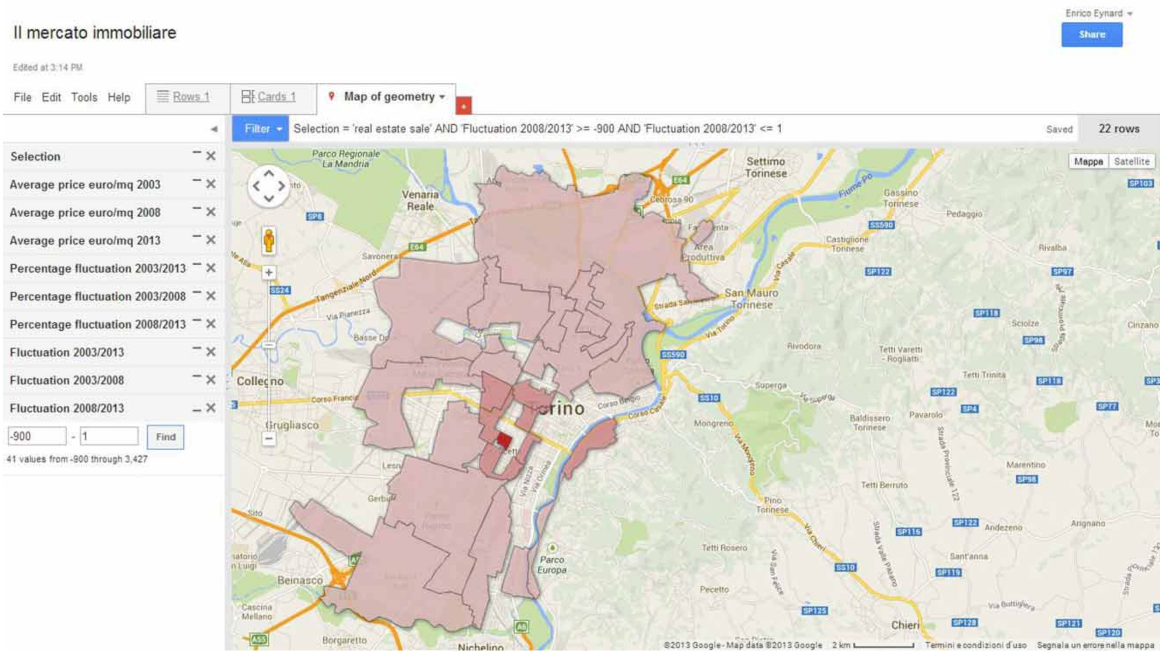

Fig. 6 The available filters

4.5 URBAN TRANSFORMATIONS AND REAL ESTATE MARKET

This example and the following one are related to specific applications of the tool on items that are interesting for urban planners, in order to show some of the capabilities of the proposed interactive geovisualization tool.

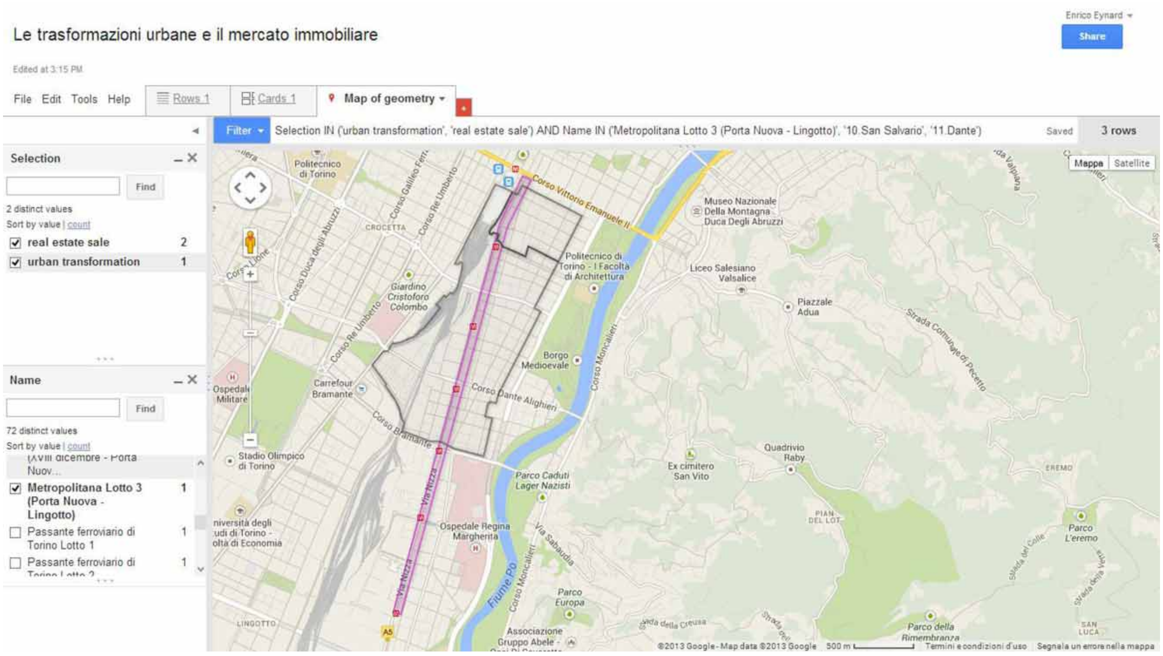

Fig. 7 View of Lot 3 of the metro highlighting the microzones investigation

The first test was performed using the data of the urban transformations and of the real estate market. Data are referred to the city of Torino. For each intervention there are various descriptive information. The period taken into consideration ranges between 1991 and 2001 and only the transformations related to areas larger than 30.000 square meters were selected. The data of real estate market are related to values of the 40 census micro zones of the city of Torino. The values are expressed in euro per square meter and represent the average offer unitary prices.

A real demonstration is related to the three lots of the underground that generated an expected rise in the prices of the areas along the line. For the third lot of the underground the price increased been 10 to 20 % compared to the values of the zone.

In particular lot 3 of the underground, implemented between 2007 and 2011, may be compared with the indicator of real estate values (2003-2013). From the analyses carried out on the 2 main micro zones crossed by the line, namely San Salvario and Dante, the result appears to be an average increase in the prices of 56% from 2003 till 2013 and of 31% in the years of the construction of line 3 from 2007 until 2011. This value is slightly different from the average increase given by real estate companies, because also other factors contribute to the 31% increase.

Only two of the four micro zones crossed by the line of the underground have been selected, because the other two, Carducci and Lingotto, are too large to be influenced in a significant manner by a price variation uniquely due to this transformation.

4.6 ACCESSIBILITY AND PUBLIC SERVICES

The second application that combines two different types of indicators consists in the use of accessibility data (in origin) in 2008, namely the average measured in minutes of travelling time by public transport between the area considered and all the remaining zones of Torino.

As a first operation it was decided to map the data of the average accessibility per statistical areas, so as to visualize the average level of accessibility of each area and, in particular, to identify the most disadvantaged areas. Once this operation was performed it’s possible, for decision makers, to evaluate different mobility scenarios on the base of present accessibility and of the attractors of the different areas.

Comparing the areas through these data, the zone it’s possible to identify the areas offering the stronger availability of services and, as a consequence, with a higher accessibility potential demand.

In the first figure (Fig. 8) the map has been referred on the basis of the accessibility time in semaphore scale, where green represents the areas with the lower travelling time towards all other areas and the red color shows the less accessible areas. Those are the areas needing interventions in order to increase the transportation services.

5 CONCLUSIONS

The interactive data geovisualization presented, provides a mapping of the different indicators, related to some aspects of urban quality and urban transformations.

The possibilities of interactions with maps and data are several and can be use to analyze the town of Torino and compare urban transformations with resident population and the other indicators.

The tool presented is first example and can be further developed. New indicators may be implemented and a personalization may be introduced by the inclusion of Application Programming Interface (API fusion tables) in order to improve table formatting and of a programming language to improve the graphical man machine interface, making the use of the tool easier for all. Through the implementation of new indicators, new analyses will be possible. As an example crossing data on urban transformation with data related to health or air pollution it will be possible to investigate whether and how urban transformations may have influenced the rise of problems related the health of citizens.

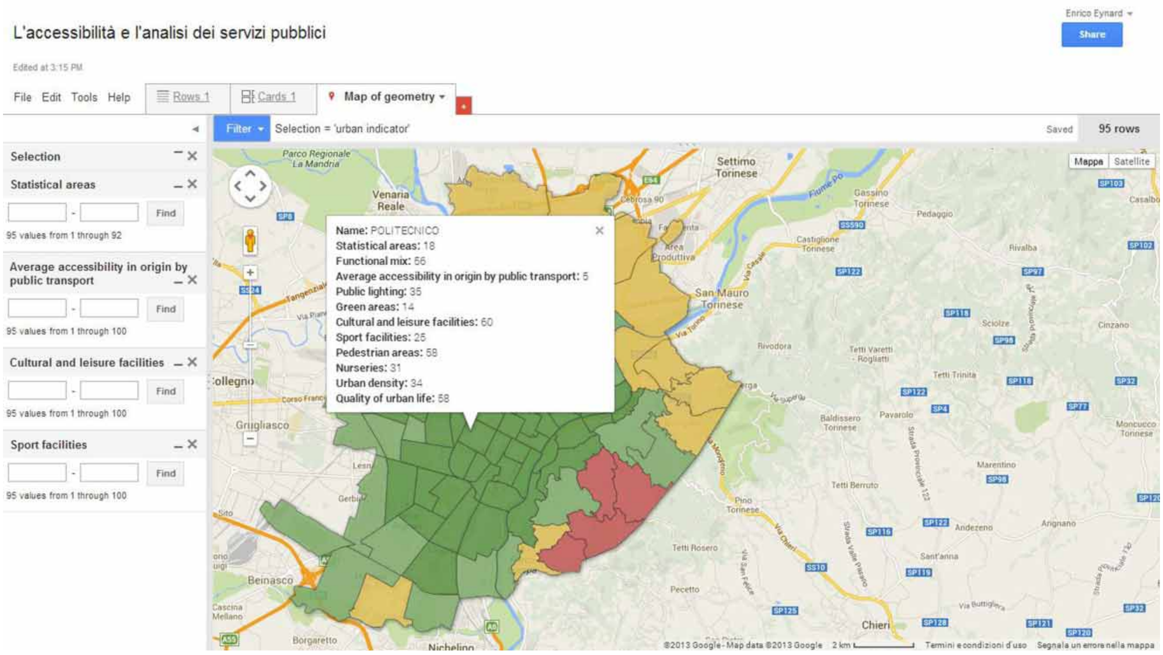

Fig. 8 Viewing the map themed to the level of accessibility

For example a possible relationship could be verified between asthma or breathing problems and period of transformations that may have produced dusts dangerous to breathing.

Another example referred to sociologic indicators could be related to criminal acts in streets and vandal acts. Such data could be compared with data related to public lighting to check whether less lightened areas may have a higher number of criminal events and soon. The use of this tool may be useful for urban planners or decision makers can provide them further information to evaluate new interventions or to identify possible problems to be solved. One of the most interesting possibilities, that also represents the aim of the project from where we started, consists in following the effects of urban transformation along their development (pre-intervention, during the intervention, post-intervention) in the town and the health of the inhabitants involved. It is possible to create a further function, similar to an "alarm bell" that can automatically detect critical areas for one or two indicators, in order to identify zones that require some intervention. Having the possibility to verify the results of previous interventions, it could also be possible to suggest the implementation of strategies that showed to be successful in other areas with similar starting conditions so to improve the quality of life in such areas.

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IMAGES SOURCES

Figg. 1 to 8: own production.

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VISUAL IMPACT IN THE URBAN ENVIRONMENT

THE CASE OF OUT-OF-SCALE BUILDINGS

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ABSTRACT

Recently, there has been an increasing need to apply methods for the estimation of the visual impact of buildings that are out-of-scale on its surrounding urban space, such as skyscrapers. In this paper, a method developed by the authors for the visual impact of buildings based on the viewshed analysis is applied to the out-of-scale buildings of the city of Turin. The method goes beyond the sole information if a cell is visible or not, which is typical of viewshed analyses, and also takes into account the various factors that cause the visual attenuation with the distance such as the visual acuity, the contrast between the target and the surrounding, the atmospheric visibility and the recognition process of the subject. The application of this methodology is done on two out-of scale buildings of the city of Turin – Italy (two skyscrapers, one of which is under construction, located in different areas of the city). From the visibility maps, in various conditions, it can be noted how the new buildings are or will recently be major landmarks not for the entire city but also for the surrounding municipalities.

KEYWORDS

urban environment; viewshed analysis; skyscrapers; visual perception;

1 INTRODUCTION

Usually visual impact refers to the modifications that a new development has on the viewing conditions of a landscape, however it is seldom an easy task to determine the effect of the view obstructions and the re-shaping of the skyline, both in urban (Moser et al., 2010; Guney et al.,2012) and rural areas.. For an urban visibility study, it is necessary to take into account, besides the topography, the building elevations and the urban atmospheric visibility. Visibility studies for rural and forest landscape are well established in the scientific literature in the last years, while there are not many visibility studies for the urban space, and most of them are based on a 2D representation (e.g. isovist) due to the difficulty to take into account building heights and other factors. Otherwise, it is possible to concentrate only on a small parts of a city, as some recent studies have done (Bartie et al., 2013). Among the factors that can modify the viewing conditions in a city there are certainly the out-of-scale buildings like skyscrapers, especially in urban environments characterized by uniform building heights like many European cities.

In the design of a skyscraper, the most important modifications on the urban landscape that should be studied are the variation of the skyline of the city, the visibility of the building from visual corridors of the main streets and the compatibility with the surrounding architecture, especially when such projects are developed in traditional Italian cities that are characterized by building height low and where buildings are comfortably seen by people on streets (Minucciani and Garnero, 2013). In such cases, there is the need to estimate the visual impact of a building on its surrounding, in order not only to redesign the city skyline from some representative viewpoints, but also to understand where this building can be seen from and how much of it can be seen. Urban landscape studies can answer these questions.

The city of Turin has been thinking about the construction of new out-of-scale buildings for a long time. First, in 1995 the new land-use planning instrument of the city allowed the construction of two tower buildings in an area near the historical city centre and in correspondence of a new main street that covered the railways. These towers had a maximum number of floors equal to 21 and a total height of 75 m maximum. Later on, through various modifications, the maximum height went beyond the value of 75 m up to 150 and finally in 2008 to 210 m for a second skyscraper. From the first idea of two towers, many new projects have been designed and by now two main skyscrapers are under construction (one in the original location of the first tower, the second one in a different location) and various projects for new skyscrapers are under development. This has also been generating a vast debate on the opportunity of building such new out-of-scale buildings in a city like Turin which is characterized by building height lower than 20 m (De Rossi and Durbiano, 2006). The present paper intends to give a quantitative and objective contribution about the estimation of the visual impact of such new out-of-scale buildings.

2 OBJECTIVES

In order to study the visibility of an out-of-scale building within a urban environment it is necessary to use GIS procedures that consider together both terrain and built environment representations and model the interaction between humans and the space.

In this work, a visibility study on the two new out-of-scale buildings of the city of Turin is conducted by means of a method, sufficiently simple but accurate, to generate visibility maps of symbolic buildings that applies not only the standard binary approach that is used in visibility analysis (an integer result to identify if the cell of a raster is visible or not), but also takes into account more realistic factors that depend on the human vision and on the outdoor environment like the visual acuity, the atmospheric extinction and a visual psychological threshold. The detailed discussion of this method can be found on Garnero and Fabrizio (in press). Finally, it should be noted that the visibility analysis performed in this study were developed on the area of the entire city of Turin, which counts 130 km^2, and it is one of the largest cities in Italy.

3 MATERIALS AND METHODS

Visibility studies in urban space were conducted in the past by means of isovists (Benedikt, 1979). An isovist is the visual field that is wholly visible from a certain single point that is the feature of interest and it is mapped as the continuous area of a two dimension polygon. With the creation of isovist generating computer applications (Daltonand Dalton, 2001), there has been the possibility of moving the point of interest. The concept of isovist (Batty, 2001) has been later employed for the study of spatial properties of indoor spaces (Turner et al., 2001; Franz and Wiener, 2005; Wiener et al., 2007; Arabacioglu, 2010) rather than urban spaces.

A viewshed is a binary representation of the visibility of a location from a certain viewpoint and is usually computed by means of standard functions of GIS software tools from the DTM. The result is a Boolean variable that identifies if each cell is visible (value 1) or not (value 0) from a certain viewpoint.

When the results of various viewsheds from different viewpoints are added up using raster algebra of GIS tool, the result is called cumulative viewshed and is characterized by an integer result: in this way how many viewpoints are seen at cell can be identified.

Viewsheds and cumulative viewsheds can be easily calculated by means of standard GIS tools, however they suffer from the limitation due to the lack of the visual attenuation with distance, so that when the distance increases the results of a viewsheds analysis are merely theoretical. The method that will be applied is based on a raster representation of the built environment and on the use of viewshed analyses that is described into Garnero and Fabrizio (in press). This method calculates three different limit visibility distances based on the visual acuity (Eq. 1), on the atmospheric visibility and on the possibility of detection of an object.

The limit visibility distance due to visual acuity, indicated hereinafter as $d_{l,v}$, is equal to

$$d_{l,v} = \frac{D}{\tan\left(a\frac{\pi}{60\cdot180}\right)} \cong D\frac{60\cdot180}{a\,\pi} \qquad (2)$$

where a is the visual acuity in minutes of arc and D the object size. Considering an object that has a size of 20 m (that may be, for example, one of the two dimensions of a building plan), the maximum distance at which it can be seen is 69 km with a visual acuity of 1.

Even though visual acuity sets a physical limit to the mutual view distance between two points in a GIS model, in practice in many cases the atmospheric visibility may limit the maximum visibility distance rather than the visual acuity. Values of visibility distance can be obtained from weather registration stations where usually the visibility is measured in km. Rather then specific weather registrations, a typical behaviour of this parameter can be found on the test reference years[1] (TRY) used for example for the energy performance calculations, and will be adopted later. The mean monthly values of the hourly values of visibility for the Torino location are reported in Figure 1, where it can be found that the lower values of visibility occurs in September and October, while the greater values occurs in August and January. Between the lower and the

[1] A Test Reference Year (TRY) is a file that contains the 8760 hourly values of the various weather quantities representative of the mean climatic conditions of a location, see for example the TRY computed by the ASHRAE within the International Weather for Energy Calculation programme. They were initially developed to be used in order to determine the heating and cooling energy needs of buildings.

greater visibility there is a difference of 7 km. Atmospheric visibility sets therefore a time variable limit visibility distance that is indicated hereinafter as dl,a.

Finally, not only the physical aspects of the vision (visual acuity, contrast, etc.) but also the psychophysical effect of perception should be considered, because visual acuity regards only the possibility that an object is seen from a certain distance but does not assure that the subject detects and recognizes the object. To take into account this perceptive side of the vision, visual thresholds were introduced in psychopysics: a visual threshold is the minimal stimulus that can be perceived, a sort of a boundary between detecting and not detecting (Shang and Bishop, 2000).

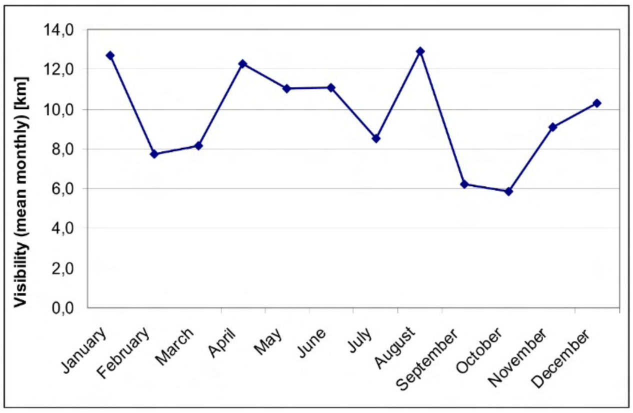


FiG. 1

Having defined the visual size (or magnitude) S as the portion of the field of view that is occupied by the object and measured in square minutes, the limit visibility distance for the psychological perception $d_{l,p}$ can be determined as

$$d_{l,p} = \frac{180 \cdot 60}{\pi} \sqrt{\frac{DH}{S}} \qquad (2)$$

where D and H are the horizontal and vertical target dimensions. Shang and Bishop (2000) have plotted on graphs which have visual size (in square minutes) and visual contrast as axes, thresholds curves that express the trade-off between threshold visual size and the threshold visual contrast for the informed recognition, the uninformed recognition and the uniformed detection. These curves, and the related logistic regression equations also derived, can be used in landscape studies to determine the visual impact on object introduced on the landscape and were adopted in this work.

For example, considering the uninformed recognition of a target characterized by object sizes equal to 20 m and 70 m, for a visual contrast of 30% the threshold visual size is equal to 50 square minutes and the limit visibility distance for the psychological perception is 18,19 km. If the contrast falls to 13% the threshold visual size is 100 and the limit distance becomes 12,26 km, while at the lowest value of contrast (7 %) considered by Shang and Bishop (2000), the threshold visual size is 250 and the limit distance becomes 8 km.

4 IMPLEMENTATION ON CASE STUDIES

The visibility analysis was conducted on the study area of the city of Turin, one of the largest cities of the North-West of Italy, and on the two new out-of-scale buildings, two skyscrapers (one under construction and one at the end of its construction stage). The general specifications concerning the study area are reported in the following paragraph, and then the analyses are conducted for each case study building.

4.1 TERRAIN MODEL

The terrain height is the new DTM of the Piedmont Region which has a cell size of 5 m x 5m. Data for the present work have been provided by Regione Piemonte survey aimed to the production of a digital orthoimage at 1:5000 scale and a digital terrain model at Level 4 in accordance with Intesa specifications (CISIS, 2011) as reported in Table 1 (Godone and Garnero, 2013).

Type	DEM or DSM
Accuracy: bare ground *PH(a)*	0.30
Height accuracy: with tree cover > 70% *PH(b)* (DEM)	0.60
Height accuracy: buildings (DSM) *PH(c)*	0.40
Height tolerance: bare ground *TH(a)*	0.60
Height tolerance: with tree cover > 70% *TH(b)* (DEM)	1.20
Height tolerance: buildings (DSM) *TH(c)*	0.80
Planimetric accuracy: *PEN*	0.30
Planimetric tolerance: *TEN*	0.60
Cellsize:	5

Table 1. Specifications of the DTM level 4 - CISIS document "*Ortoimmagini e modelli altimetrici a grande scala - Linee Guida* (Large scale orthoimagery and elevation models – Guidelines)" shows Level values (meters)

A LIDAR survey was carried out by the employment of ALS 50 II sensor (Leica Geosystems) with MPIA (Multiple Pulse In Air) technology with the following features:

- Maximum Pulse Rate: 150000 Hz (150.000 points/second);
- Maximum scanning frequency: 90 Hz (90 lines/second);
- 4 echoes (1º, 2º, 3ºand last);
- Flying height: 200 - 6000 m above ground;
- Field Of View (FOV): 10º – 75 º;
- Side overlap: 200 - 600 m;
- Intensity measured each echo.

In addition to the ordinary survey, in a portion of Regione Piemonte, a more detailed one has been required. It was characterized by the following parameters:

- FOV (Field Of View): 58º;
- LPR (Laser Pulse Rate): 66.400 Hz;
- Scan Rate: 21.4 Hz;
- Average Point Density:0.22 pts/m²;
- Average Point Spacing: 2.12 m;

The study area is the city of Turin and counts 9 sections at a scale of 1: 10.000 which were jointed on a single DTM resampled at a cell size of 0.5x0.5 m. This resampling obviously does not add any improvement in the quality of information, but was done in order to operate the following calculations. The representation of this DTM is reported in Figure 2 where it can be noted that from west to east there is a slow slope up to the Po river, then there are the hills on the south-east part of the DTM.

4.2 BUILDINGS MODEL

As regards the buildings, the information was taken from Technical City Map of Turin, a cartography on a scale of 1:1000, updated each 6 months with topographic measures. It was obtained as a shape file and with the eaves height of each building. In particular, the 3D model of the city is subdivided into primary (main) and secondary (small) buildings, and every height is derived from aereophotogrammetry techniques.

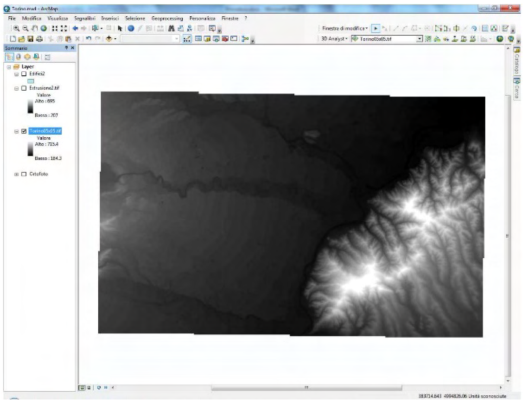


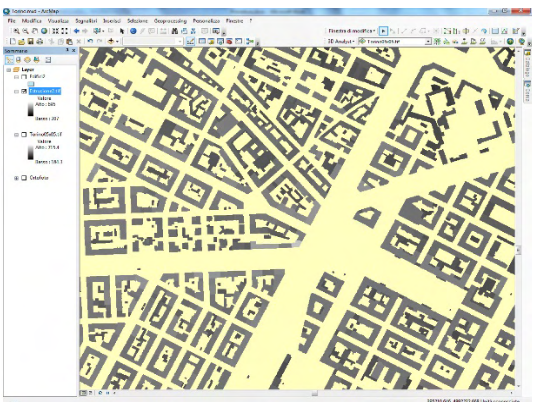
Fig. 2

There are:

- 64,679 main buildings, of which 3,515 have the eaves height equal to zero. In order to retrieve, at least approximately, the heights for these buildings, for which the information on the number of floors above ground was in any case available, the eaves height was estimated summing up the building height (as number of floors by 3 meters) to the ground level.
- 65,334 smaller buildings, of which 28,870 have the eaves height equal to zero; these are mostly low buildings and were deleted.

4.3 GIS PROCESSING

The ArcGIS 10.1 tool was used in all the processing. In order to obtain an information consistent between the two bases of data available, the vectorial data were transported into raster data using the GIS “Polygon to raster” command, which produces a raster with a cell size of 0.5 m, that reports all eaves height of the buildings, and *nodata* where there are not buildings.



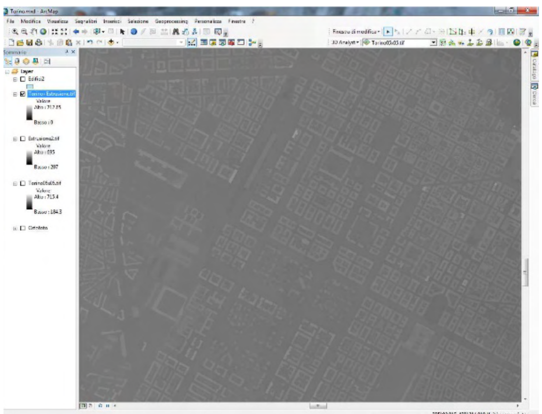


Fig. 3 and Fig. 4

At this point, the two models (DTM and buildings) were merged using the raster calculator and generating a new raster that has the value of the regional DTM if the building raster is null, otherwise it has the value of the building eaves height. In practice, this is a sum of the buildings DTM and of the terrain DTM that produces a DTM where buildings are "extruded" with a cell size of 0.5 m.

A 3D view of the city model (where the height of the buildings was not emphasized) is reported in figure 5. All buildings are coloured in brown while the skyscrapers under consideration in the following paragraphs are coloured in green.

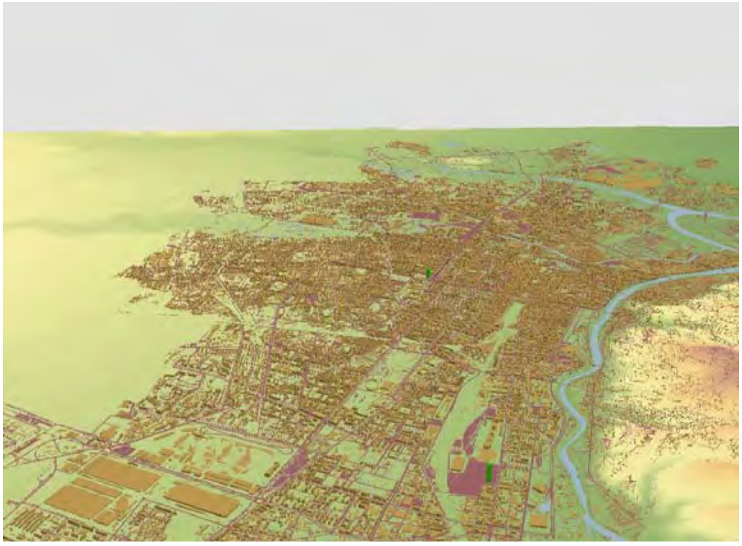


Fig. 5

4.4 THE LIMIT VISIBILITY DISTANCE FOR THE ATMOSPHERIC EXTINCTION

In order to consider two different conditions characterized by a different behaviour, the two months with the greater and the lowest visibility values were selected. These are August, with a mean monthly visibility of 12.9 km, and October with a value of 5.8 km (Figure 1). In Figures 6 and 7 the frequency distributions of the hourly values of visibility for those two months are reported. It is easily seen that the frequency distribution of the month with the lower visibility is centred on low values with a maximum at 2 km, while for the month with the highest visibility there is not only one maximum and the distribution presents values spread from 4 km to 35 km.

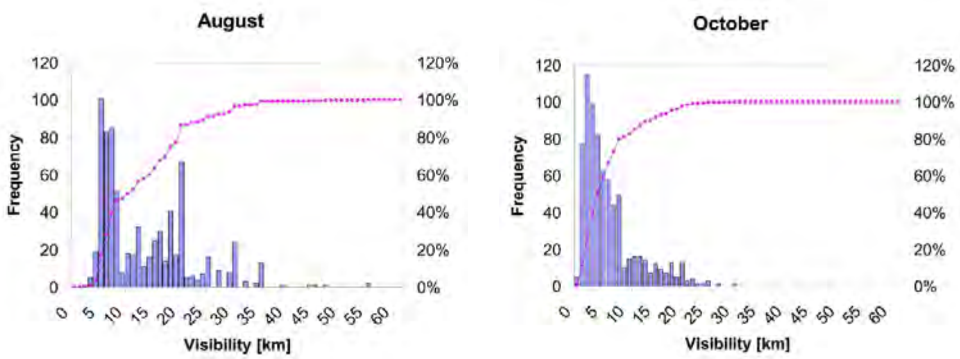


Fig. 6 and Fig. 7

In order to set the maximum value of the atmospheric visibility as the $d_{l,a}$ distance to be used in the following analyses, the visibility value that is surpassed for the 80% of the time was selected. These values are 5,2 km for the August month and 1,6 km for the October month. In particular, it is the value of October that will be used as a lower limit of visibility distance.

5 THE SKYSCRAPER # 1

5.1 DESCRIPTION OF THE TARGET

This new building is the first skyscraper of the city of Turin and is located near the historical city centre where two main streets are crossing and in correspondence of one of the main train station of the city (Porta Susa). The tower has a rectangular shape of 36 x 60 m, with a larger basement. The building is under construction since 2009 and it is now completed at least as regards the building structure and the envelope.
The building envelope is mainly glazed (more than 50,000 m2 of glazed envelope area).
The terrain height of the DTM is equal to the value of 244.80 m; the building height was set to 166 m, thus giving the four upper vertexes of the building at a value of 410.80 m. The skyscraper is indicated by four points (the four vertexes) placed at a height of 410.80 m

Fig. 9

5.2 CALCULATION OF THE VISIBILITY DISTANCES

For the calculations of the limit visibility distances, the following parameters were selected:

- object size D equal to 79.2 m;
- object size H equal to 146 m;
- visual acuity of 1;
- threshold visual size S of 100 square minutes (uninformed recognition with a contrast of 13%).

The object size D was taken as the diagonal of the rectangular shape, while the object size H is equal to the building height reduced of the height of the surrounding buildings equal to 20 m.

The previous assumptions give a limit visibility distance for the visual acuity $d_{l,v}$ of 272 km and a limit visibility distance for the psychological perception $d_{l,p}$ of 37.0 km. Since the lower of these distances is greater than most of the visibility distances for atmospheric extinction (see Figure 7), for such building it is merely always the atmospheric visibility that limits the visual detection.

5.3 VISIBILITY MAPS

In the following Figures 10 and 11 the visibility maps obtained with a visibility distance of 20 km and with a visibility distance of 1,6 km are reported. These visibility maps are cumulative viewsheds, determined using raster algebra and summing up the results of the visibility for each of the four points of visibility into which the skyscraper was discretized.

It can be seen that in the clear air best case condition, the building will be seen from the vast majority of the city, especially in the neighborhood where green parks areas alternate to blocks of development. This may be already verified today by a specific survey because the building is completed.

In order to give a quantitative evaluation of the visibility of the skyscraper, from the visibility map of Figure 10 the percentage of streets that falls within the visible set was calculated. This was done considering the fact that the urban landscape is visible by people walking in the streets, and that parameter can be of interest in order to determine how much this new landmark building is visible or not. From the analyses conducted on the shape files of streets, the total area of streets (which considers streets as well as yards) amounts at 2,575,802 m² (about 2% of the city surface). Using raster algebra on streets and visibility layers, it was calculated that 799,142 m² see at least one point of the skyscraper. In percentage terms, this means that – in good atmospheric visibility conditions – 31 % of the streets of the city of Turin are seeing this building.

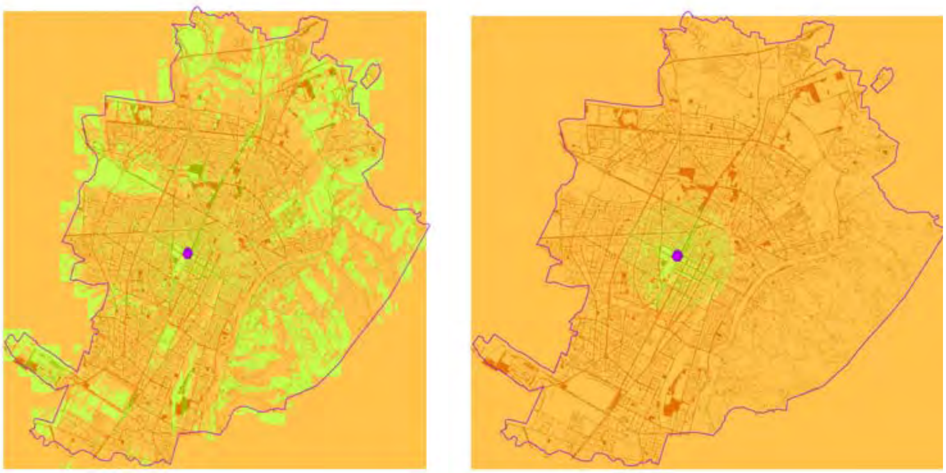


Fig. 10 and Fig. 11

6 THE SKYSCRAPER # 2

6.1 DESCRIPTION OF THE TARGET

This skyscraper has a square building shape of 45 m of side and is designed in the south of the city of Turin, near a railway station and a large tertiary district that was before the largest factory in Turin (Lingotto area). Once completed, this skyscraper will be the highest in Italy, including 42 floors, two of them underfloor: at the 43rd floor there will be a wooden roof open to the public. The project has been amended several times,

bringing the initial height of 220 m to the final value of 210 m. On the facades 1,000 m² of photovoltaic panels are going to be installed in order to ensure, as much as possible, the energy production of the building. The large windows construction is made to reduce the need for artificial lighting. The total land area on which the skyscraper is going to be built is approximately 70,000 m²; around 60,000 m² of retail space are expected in order to develop of this urban district. This project is also connected with another residential district for approx 5,000 inhabitants and a new railway station (Lingotto) with a bridge structure that will connect the current the station to the skyscraper.
The terrain height of the DTM is equal to the value of 234.50 m; the building height was set to 210 m, thus giving the four upper vertexes of the building at a value of 444.50 m. The skyscraper is indicated by four points (the four vertexes) placed at a height of 444.50 m.

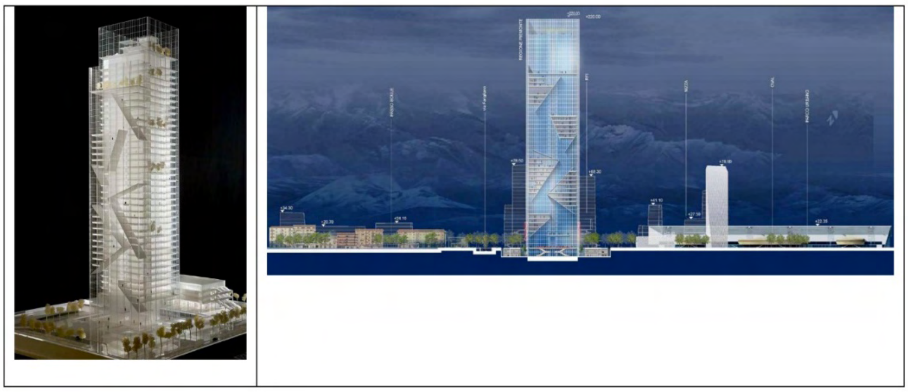


Fig.12.

6.2 CALCULATION OF THE VISIBILITY DISTANCES

For the calculations of the limit visibility distances, the following parameters were selected:

- object size *D* equal to 63.6 m;
- object size *H* equal to 190 m;
- visual acuity of 1;
- threshold visual size *S* of 100 square minutes (uninformed recognition with a contrast of 13%).

The object size *D* was taken as the diagonal of the square of 45 m, while the object size *H* is equal to the building height reduced of the height of the surrounding buildings equal to 20 m.
The previous assumptions give a limit visibility distance for the visual acuity $d_{l,v}$ of 218 km and a limit visibility distance for the psychological perception $d_{l,p}$ of 37.8 km. Since the lower of these distances is greater than most of the visibility distances for atmospheric extinction (see Figure 7), for such building it is merely always the atmospheric visibility, with its continuous variation of the visibility distance as a function of the meteorological conditions, that limits the visual detection.

6.3 VISIBILITY MAPS

In the following Figures 13 and 14 the visibility maps obtained with a visibility distance of 20 km and with a visibility distance of 1,6 km, as discussed in paragraph 4.4. Again, these visibility maps are cumulative viewsheds, determined using raster algebra and summing up the results of the visibility for each of the four points of visibility into which the skyscraper was discretized. In order to give a quantitative evaluation of the visibility of the skyscraper, from the visibility map of Figure 13 the percentage of streets that falls within the visible set was calculated. This was done considering the fact that the urban landscape is visible by people walking in the streets, and that parameter can be of interest in order to determine how much this new landmark building is visible or no. From the analyses conducted on the shape files of streets, the total area of streets (which considers streets as well as yards) amounts at 2,575,802 m² (about 2% of the city surface). Using raster algebra on streets and visibility layers, it was calculated that 819,316 m² see at least one point of the skyscraper. In percentage terms, this means that – in good atmospheric visibility conditions – 32 % of the streets of the city of Turin will see the new building. As can be seen from Figure 14 these areas may also be far from the skyscraper itself, which is located in the south sector of the city. An analysis on the other neighbouring municipalities should be done in order to ascertain to what degree the building is seen from the municipalities that are placed at the south of the city of Turin.

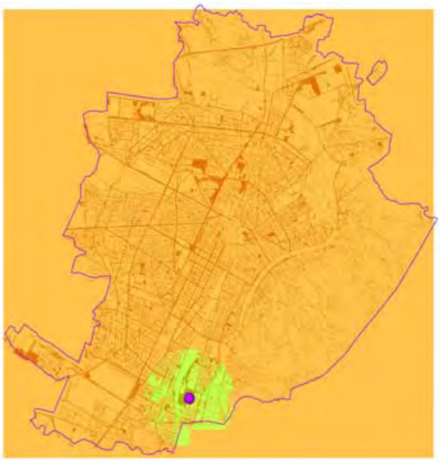


Fig. 13 and Fig. 14

7 CONCLUSIONS

The visibility analysis for urban environment was conducted on the study area of the city of Turin, one of the largest cities of the North-West of Italy. This procedure can become a shared methodology for landscape analyses, integrating both terrain and building models, that are now particularly considered in EIA procedures. A knowledge that is not qualitative but objective may be incorporated into the design process, in order to suggest improvements and corrections in the visual impact analysis and in the mitigation measures, in particular for a city like Turin where two new skyscrapers are under construction and many others are under design. A skyscraper, in fact, is an objects that, by its nature, cannot completely be mitigated from the point of view of the visual impact the tools and methodologies here described allow decision-makers and all the community to know how much and in what way the building changes will take effect on the perception of places.

a	apparent diameter	minutes
C	visual contrast	%
d	distance of observation	km
D	(horizontal) object size	m
$d_{l,a}$	limit visibility distance for the atmospheric extinction	km
$d_{l,p}$	limit visibility distance for the psychological perception	km
$d_{l,v}$	limit visibility distance for the visual acuity	km
H	vertical object size	m
S	visual size	square minutes
α	horizontal angle subtended by the target	minutes
β	vertical angle subtended by the target	minutes

Nomenclature

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SMART DIALOGUE FOR SMART CITIZENS

ASSERTIVE APPROACHES FOR STRATEGIC PLANNING

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ABSTRACT

It is very important to know how to communicate, but even more important is knowing how to listen. There is no dialogue without listening. Listening and speaking can generate a virtuous cycle that, enriching the field of information, allows the introduction of essential elements of innovation. It is relevant in this context the assertive ability of who manages and coordinates the decision-making processes. The potential of new approaches based on assertiveness are the new frontier of research discipline that is able to meet future challenges aiming to contribute to the construction of places and forms of living together in the growing interest of fairness and justice.

Assertive facilitator knows how to guide difficult people and handle very hard situations without adopting manipulative behaviors. He is able to detect the potential conflict and to bring to light the reasons for disagreement , softening the tone and avoiding any possible uncontrolled escalation. He encourages debates and open discussions; he has to build links too, fueling reports profits, collaborating with others toward common goals; speaking and discussing in groups and among groups; seeking solutions in which, both parties, come out winning. So the view expressed is argument of discussion in the development of the tools of urban structure, with the aim of implementing a participatory methodology in the development of planning tools. We propose an application in the series of meetings of initial preparatory participation to the formation of a Preliminary Plan for a medium size town.

KEYWORDS

Participatory processes, New governance, Assertiveness

1 CONFLICT, PARTICIPATION AND LISTENING IN NEW GOVERNANCE

The emergence of new economic and political conditions as well as of new explicit and implicit social needs, requires, as part of the territorial government, the adoption of innovative and experimental practices covering an inclusive attitude and a deep knowledge of the people, in order to reduce the distance between the decision maker/decisions and the citizens' needs. Consequently there is a complexity of choices to make.

The need to achieve higher and higher design quality requirements, requires a careful reconnaissance of the recipients and the quality of the interventions depends on the involvement of facilitators/mediators able to create a climate of mutual trust.

In this perspective it seems impossible to postpone a *holistic* approach to the planning, absolutely participative, as it is particularly suited to dealing with the "complexity", correlating different levels of treatment of problems: technical-scientific, political-administrative, social-cultural .

For planners, the method is to be identified in their participation; in a meaningful public participation by individuals and groups, to supporting processes to urban choices that affect them, to better know the local situation and to design in accordance with the knowledge the needs and the aspirations of the inhabitants themselves.

Moreover, the role of the planner is to be a *guarantor of listening* (Geddes 1915). Knowing the area, the city, the story is necessary but not sufficient: it is absolutely essential the *people's active listening*.

The involvement of the inhabitants and their participation strengthens social cohesion and relations with the public administration. Culturally, socially, politically and ethnically the parties involved are different from each other. This diversity is considered an asset that contributes to the creation of different scenarios.

For political and cultural movements social objectives to be pursued and participatory methods to achieve are not disjoint, on the contrary they are integrated in the same social and cultural development.

At the time of a real putting into practice the principles of an active citizenship and the protection of the excluded in the planning practices, several conceptual and operational difficulties occur: peculiarities of the context, issues and questions of the local community, the characteristics of their social status and their lifestyles, contradictions between values, ethics and local culture.

A structured process based on the use of methodologies, sometimes refined tools and unconventional attitudes of experts should be chosen to use efficiently the participation of the inhabitants.

Participatory processes undertaken in the institutional field require by the local authority, resources and considerable effort: costs and investments in terms of time, energy, mediation, authoritative dialogue, creative conflict management, acquisition of mutual respect and trust.

These actions, on the one hand have, as already said, the problematic aspects, on the other hand face resistance of no small importance: it is now an established aspect of the whole and critically addressed by disciplinary research (Musco 2006), that of *distrust* or indifference of the local communities in relation to opportunities in *official* or institutional participation; on the other hand, there is an intermittently interest, or only apparent, as part of the institutional actors, being, however, a considerable degree of discretion, which depends, ultimately, on the actual will of action of the individual local authority or responsible administration.

We need to consider the constraints due to the general limitation in the availability of resources of time and energy that allows the everyday life imposed by today's social organization (Ginsborg 2004), but also of skills and personal motivations: to participate is often considered a luxury, so activists, retirees, etc. prevail.

However, it emerges, the issue of institutional accountability that entails, at the same time, recruitment of individual personal responsibility, in practice as well as in research.

CONFLICTS	TYPE	CAUSE
a	relational	strong emotions misconceptions and stereotypes; wrong or incomplete communication; Repeated negative behaviors
b	Of value	fundamental; daily; of self-definition
c	Informative	missing or wrong information; different versions on the priorities; different procedures of evaluation or interpretation of the data
d	structural	definition of roles; time limits; physical-geographical relationships; unequal distribution of power and authority; unequal control on resources
e	Of interest	substantial; procedural; psychological

Tab. 1 Participation and conflicts – re-adapted from Carley, Christie, 1992

Methodological issues are of crucial importance. But it is not only the measurement with methods or techniques, but, more importantly, to compete with the harshness, even conflicting, issues and real problems, with all their political, ideological and interest implications.

Compared to the articulation of a plurality of practices and a multitude of languages , the assumption of a principle of responsibility is also declined from the principles of clarity and precision. Clarify roles, actors, interests, give clear and exact names to things, *to make oneself understood*, is the basis of the assumption of a principle of responsibility.

Planners must be at the service of the interests of each scene and sustain their motivation. In the name of social equity, they should be available to share their knowledge and to accept the argumentative size, which path to reach the decision.

Studies on *social mobilization*, arguing that "the planning is to a lesser extent in land resources and analysis and better relationships characterized by a process of mutual learning" (Friedmann 1973), conceived the plan as an *interactive* process. Planning, therefore, is conducted in *a face to face* contact with people interested in the decisions. The practice involves a process of *mutual learning* between the professional[1] and the dweller, in no predefined ways but formed and changed over the course of a planning process[2] consisting of field surveys and analysis of data, but also in an interpersonal dialogue.

The communication theory applied to planning proposes (Forester 1989), the idea of planning *for and with* the citizens, exploring what should be the ability of the planner help maximize the effectiveness of its role in relation to the powers in the game. The ultimate consequences of the critique of rational decision based on certainty, initiated by cognitive, condenses in the paradigm that goes by the name of the *garbage can model* (March and Olsen 1993), which describes, not an only uncertain situation, as in the cognitive model, but above all the *ambiguity*, almost impossible to manage[3].

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1 The *reflective* approach (Schön 1993) is characterized by a major disposal to listening and aiming to stimulate the client's participation in finding problems and building solutions.

2 John Friedmann (1973) described the growing gap between the so-called experts and their clients. A strong distance from the inaccessibility of the language with which professionals usually formulated problems. He believed that the two forms of knowledge should be integrated, developing personal relationships between customers and experts, through the adoption of what he called a *trans-active* planning style.

3 Actors enter and leave the scene of the political and participative arenas depending on how their own interests or problems, or tasks, or occasions change. Not necessarily their interest is merit of the

Moreover, in the perspective of communicative ethics, the values of the planning are dispatched fully only in the recognition of the axiom of *no-neutrality*[4] (Forester 1998), namely the "overcoming of the distinction of rational mold, hard to disappear, including the possibility to rationally discuss the facts and the inability to do the same about the values" (Borri 1998).
The search for ways in which the planning process can become more effective in suggesting and sharing some of the results and, subsequently, in implementing them, moves on the turn of argument (Habermas 1986)[5]. The plan also involves the ensuing debate and argument, that is the negotiation of a high pragmatic role into an ontological, as a structural component of the schedule.

2 THE SKILLED PLANNER AS ASSERTIVE FACILITATOR

The emergence of new economic and political conditions as well as of new explicit and implicit social needs, and the resulting complexity of the choices to be made, require the adoption of experimental and innovative practices, an inclusive attitude and a deep knowledge of the inhabitants in order to reduce the distances between the decision maker/decisions and the citizens' needs. The need to achieve increasingly high requirements of design quality, integrated and flexible, requires a careful reconnaissance of the recipients and the quality of the interventions depends on the involvement of facilitators/mediators able to create a climate of mutual trust.
Listening and speaking can generate a virtuous cycle that, enriching the field of information, allows the introduction of essential elements of innovation .
In this context, it is crucial the expert planner participatory whose capacity should be that of finding and recognizing forms of local wisdom valuating them as important resources in the process. These forms of knowledge and traditional skills, must be associated with unusual abilities and skills, related to communication, relationship and mediation.
The task is not only cognitive, but above all practical and ethical, able to awaken the citizens themselves, leaving the terms of perceived discomfort, turning opponents into allies, showing a reasonable confidence, producing encouragement and hope. Obviously they are unusual ability from the point of view of traditional skills training: scientific knowledge is accompanied by the knowledge of the emotions; the analytical skills alongside those of listening and empathy.
One of the features that should be a participatory process (Bobbio 2000) is the *informality*: the participatory processes, although structured, must be "organized in order to allow informal exchanges between participants and relationships face to face. Participants must have the ability to use non-technical language and change their orientations in the course of the interaction".
The facilitator has the task to assist the various stakeholders involved in the process, chairing the proper functioning in terms of procedure and interaction.

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decision: participating can be a value in itself, an obligation towards a third part, an expectation related to the own role or an answer to the simple desire to be there. The problem is particularly relevant to the arenas in which everyone can participate in any decision and where there is a large freedom of entry and exit (Bobbio 2003).

4 A moral assumption seems to be back the different political interpretations of urban planning: the planner can be a political actor *sui generis*, different from the other parties involved in the process, because he binds a some peculiar competence of *technical judgment* to a component of political judgment (common to the different actors).

5 Starting from critics of functionalist rationality that characterized the urban planning of the '70s, and basing on the theories of *communicative rationality* (Habermas 1981), the *communicative urban planning* was developed. It is able to influence almost all current urban planning theories and practices.

An important feature for the facilitator is *assertiveness*.[6] For this reason it essential the ability to listen to: while the aggressive agent judges and criticize while the passive one is overly compliant, the assertive one is open and gives due consideration to the other party. To do this, you need to *receive messages* of what is said, to paraphrase what is being communicated and synthesizing what you are discussing. Another essential element is empathy, which is able to capture the perspective of the interlocutor, assuming its point of view. Preconditions for assertive behavior are: good self-image in terms of self-esteem; adequate communication; freedom of expression; ability to respond to the questions and criticism; ability to give and receive praise; ability to dissolve conflicts.

The capacity is based on the perception of feelings and effort to understand the perspectives of others nourishing an active interest. This competence is necessarily based on the value of diversity and different points of view, as an opportunity and a contribution to the analysis of reality.

When you find yourself having to deal with conflicts, the potential of *assertiveness* emerges clearly.

The *assertive facilitator* know how to lead people and handle difficult situations with tension without adopting manipulative behaviors. It is able to detect the potential conflict and to bring to light the reasons for disagreement, softening the tone and avoiding a possible uncontrolled escalation. He encourages debate and open discussion; he has also to build links, fueling reports profits, collaborating with others toward common goals; converse and discuss in groups and among groups; seek solutions in which both parties come out victorious.

The reasons that may support an *unassertive* passive behavior, sometimes aggressive, can be recognized with the presence of certain factors that are often traceable form of communicative errors and cognitive distortions of perception and interpretation of context, beliefs not in line with the reality, but, most of the times, for political opposition.

Among the reasons that fuel a lack of assertiveness there is what you want/need to please others and avoid conflict at all costs. The assertive facilitator attempts to prevent conflicts, not to avoid them. Indeed, he is convinced that they may be useful if managed well.

Different *styles* can be taken over inclusive decision-making processes:

- Passive style. Conflicts exist and it is best to take note, so that avoiding them is a totally ineffective strategy. The best solution is to be able to govern them at best. It could be useful to face the problems and conflicts when they are in the initial stage, when the anxiety is less and more than adequate is our ability to make better use of cognitive resources available to us;
- Unassertive style. You are aggressive and insensitive to the reasons other proposals; that is, it gives no time to the other party to express their point of view; in this way, the unassertive takes himself off the possibility of improving the quality of his reports;
- Assertive style. Who recognizes the rights of their own and of the others is ready to listen to the views expressed by his interlocutor and to express his disagreement, maintaining total respect for him7; this leads him to accept negotiation as the primary tool to address and resolve the conflicts that inevitably arise.

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[6] *Assertiveness* (from Latin *asserere* which means to assert) or *assertion* (or self- statement) is a feature of the human behavior which is the ability to express clearly and effectively emotions and opinions. According to American psychologists Alberti and Emmons, it is defined as “a behavior that allows a person to act in his own interest, to defend his point of view without exaggerated anxiety, to express with sincerity and confidence his feelings, to defend his rights without ignoring those of the others”.

[7] For the assertive facilitator the self-value is more linked to the human dignity than performances and results.

- *Active listening*. Through the reformulation, the other party shall forward to the issuing his directions, which demonstrate that you understand the message, to have grasped the emotional dimension, and so on. This ensures a quality communication.

Among the basic assertive strategies there is knowing how *to say no*: to block initiatives deemed unacceptable, or only annoying, it is enough to say no and to maintain this attitude over the time. But there are several ways to say no, each of which has subtly different implications. The empathetic *No* does not raise another particularly negative responses. The dry and unappeasable *No*; *NO* not followed by explanations or messages of empathetic nature tends to incite hostility in the others, in what is perceived as an intolerable form of superiority or contempt, being able to stimulate the even more unpredictable reactions.

On the contrary, the proper criticisms tend to motivate the person to improve future performance and make positive relational climate.

The criticism should be focused on performance and not on the person, which should be fully respected. The criticism is useful if it helps to identify the points on which the party would do well to reflect and provide the necessary help to ensure that, in future, we do not fall into the same types of errors.

It manifests the continued willingness to provide help and suggestions for possible future difficulties. The assertive style of the planner does not aim to conflict, but to the democratic debate of ideas.

At times the capacity of an assertive person may be restricted from being worried not about the problem, but about himself in front of the problem.

TECHNIQUE	CHARACTERISTICS	ACTIONS
Assertive compliment	genuine appreciation of the performance or behavior of the interlocutor	precise and specific words; the compliment specifies what they enjoyed and why; it is not generic, it seems a flattery
Indication of discrepancy	It highlights the failure to comply with an agreement, but also his interest	Attitude aimed at discovering the causes and providing any assistance
negative investigation	it serves to defuse the charge of this destructive attacks with aimed only to defaming, without providing an adequate feedback	the caller is expected to leave the emotional tone with which he expresses attacks at the aim of indicating the elements on which there is disagreement
Broken record	form of effective defense against communicative situations in which the caller purports to change minds or wants to manipulate	repetition of the same response

Tab. 2 Assertive techniques

3 PARTICIPATIVE DIALOGUE AND LONG-TERM STRATEGIES

The table below shows an experimental application of what has been expressed, analyzing and evaluating the outputs related to the participatory process for the municipality of Castel San Giorgio[8], that started the preparation of the municipal development plan (Puc)[9], as well as the *focal points* (conflict) emerged during the meetings and techniques identified to overcome them.

8 Castel San Giorgio lies in the middle valley of the river Sarno, between the plain of Agro nocerino-sarnese to the west and the high valley of river Irno to the east. It extends on a 13 Km surface and has about 13.411 inhabitants (Istat 2011) with a density of 1056 inhabitants/kmq. It is characterized by a settled multi-centred structure, with 11 fractions, besides the town centre.

The Town Council has scheduled a number of meetings that are on view to the initial participation preparatory drawing of the Preliminary Plan, as required by current regional regulations.

A series of *participative conversations*, effective dialogues on the strengths and weaknesses of the territory, shared actions for future development, organized with the aim to take advantage of the power contribution of each, through ideas and suggestions, to arrive at an idea of a city that knows how to reflect the needs and expectations of all the groups involved.

There were weekly meetings for more than a month and with them a complex task of data collection started, aimed at acquiring all the information necessary for the preparation, evaluation of choices and preparation of the Preliminary Plan. The extension of settlements and the widespread fragmentation divided into 11 fractions [10], as well as the centre, linked seamlessly to the settlements of contiguous municipalities, suggested the idea to organize the above guide *participatory knowledge from below*, by combining settlements and parts territory of that share resources and critical recognizable and unique, so as to cope with problems and identify attitudes and appropriate and effective approaches on portions of quite extended territory.

MEETING	THEMES	OUTPUT
Initial conference	Presentation of the activities and of conferences	territorial resources/critical points
Territorial conferences	Approach to the territory by area: Ct1 – western context Ct2 – eastern context Ct3 – center context	territorial resources /critical points
Thematic conferences	Approach to the territory by categories: Ctm1 – city makers Ctm2 – city users	needs/critical points for themes and categories
Inter-institutional conference	Involvement of higher-level authorities: The Inter-institutional Conference of Urban Planning (I Cipu)	Contributions to the inter-communal structure and inter-institutional management

Tab. 3 Articulation of initial participation

The entire series of *conversations* was organized by identifying different variations of dialogue and, after an introductory lecture that explained the objectives of the participatory process best, it was articulated through three *territorial conferences*[11] or meetings in which they discussed issues related to the fractions that were analyzed from time to time, and two *thematic conferences*, where, in a dedicated manner, there was a dialogue between economic and entrepreneurial forces, stimulating observations relating to the socio-

9 The local Authority gave the project of the new urban plan to its own technical office with technical-scientific support by the Gruppo di Tecnica e Pianificazione Urbanistica of the University of Salerno.

10 Torello, Aiello, Campomanfoli, Santa Maria a Favore, Cortedomini, Santa Croce, Lanzara, Casalnuovo-Taverna, Fimiani, Castelluccio, Trivio-Codola.

11 Each meeting was organized into three phases:
- *Knowledge frame*: at first the presentation of the projects and founded materials so far, in general as well as regarding the specific sites;
- *Debate*: listening time totally dedicated to presents actors for collecting observations, ideas, expectations and everything useful to implement a preliminary strategic vision.
- *Synthetic summery of proposals*: final part with first evaluations in order to organize what emerged in the meeting.

economic and productive system, and with the components of associations, both political and scholastic, dealing with issues related to the collective life and the world of education and children.

The meetings concluded with an *Inter-institutional Conference of Urban Planning* (Cipu) involving higher-level institutions and political actors of neighboring municipalities with the intent of reaching the coordination of activities and initiatives that are inter-communal relevant for the detection and prosecution of objectives of urban renewal and economic development related to a territory historically integrated for functions and social composition.

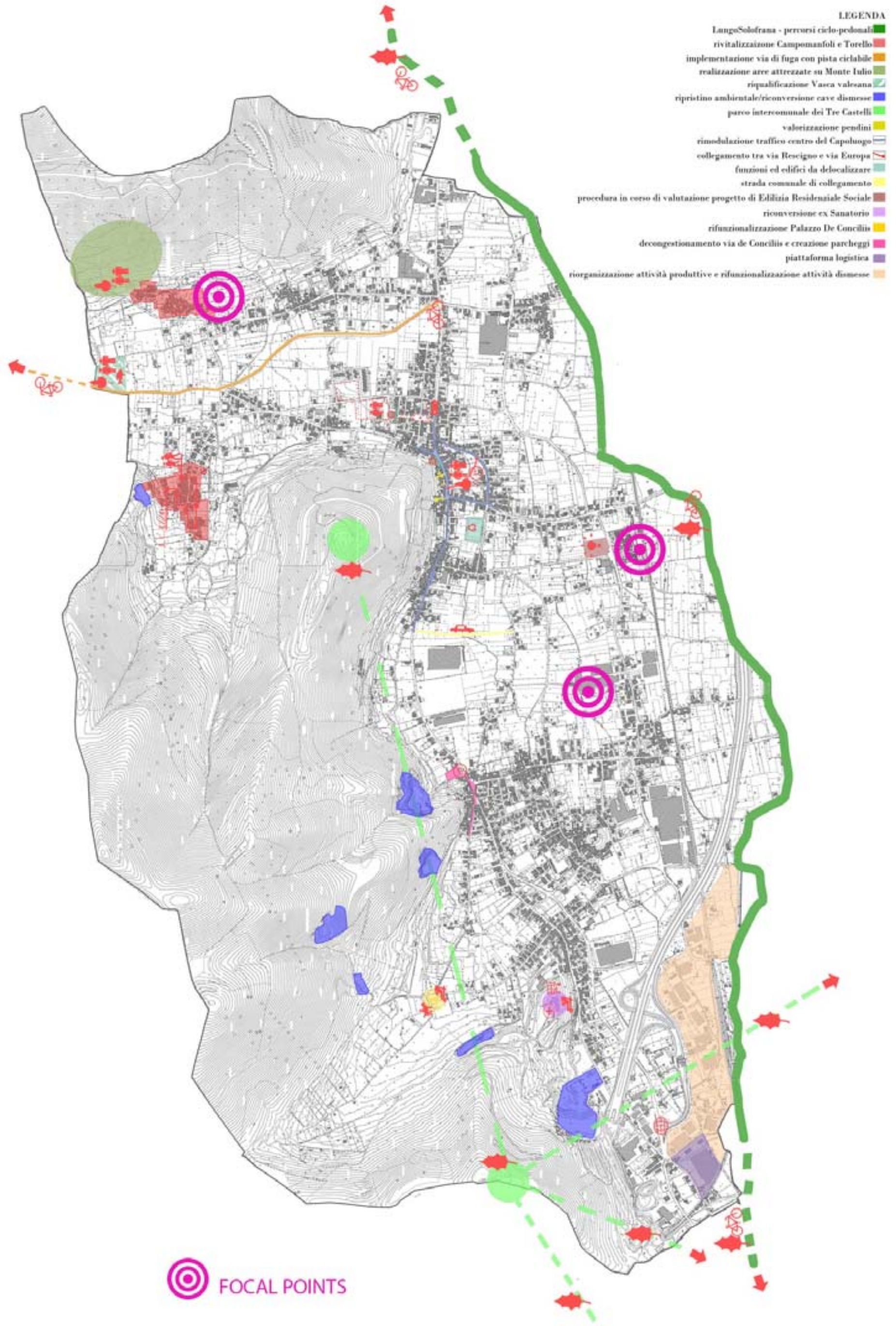

Fig. 1 .The system of knowledge – *territorialization* of emerged needs/proposals

The community has provided input and stimuli encountered with the full knowledge that the shortage of resources and critical issues can be overcome by the action of the citizens, individuals or associated, with the identification of priorities in the planning and subsequent monitoring action, demonstrating a widely collaborative and proactive attitude. The meetings were a place of intense discussion and active and collective processing and has emerged a broad line of accents widespread, despite the variety of contributions and of the parties involved and the inevitable different experiential education of each.
Nevertheless, notwithstanding the *collective priority* declared from the first meeting on the need to put in place a not calibrated planning on new expansions, rather than paid to services for a more livable, with the aim of reviving the municipal area in a dimension of wide area by implementing and promoting *quality and excellence*, there were three neuralgic situations each relating to specific themes and design proposals in place, as shown in the figure 1 above (*focal points territorialized*) and specified below.
It was immediately clear that the conflicts surfaced, with the exception of the proposed Social housing – causing a strong interest in specific subjects – were a result of bad information and incorrect dynamic of meetings.

FOCAL POINT	CONFLICTS	TECHNIQUE USED
Social Housing – private project	of Interest	Indication of discrepancy
repopulation of the historical centers of the fractions	Informative/Relational	Indication of discrepancy /negative investigation
Agricultural aeras - open land	Informative	negative investigation

Tab.4 emerged dynamics of conflict - synthesis

In particular, the lack of knowledge of the possible mode of action perceived such as mandatory, as for example restocking of historical centers and the protection and demarcation of the open territory, as well as new forms of public/private collaboration, led to misunderstandings and attitudes without adequate feedback.
In such a situation, it was decided primarily for the activation of attitudes aimed to clarify the elements of disagreement, suggesting to the various stakeholders to abandon emotional and contrasting tones, in order to defuse the deleterious charge in this demeaning and profitable critics at all. Instead, to bridge the information gap about the potential and possible actions on the ground, were treated, in special meetings, in-depth specific issues. For example, we focused on the deployment of private enterprise in the field of welfare and how it appears today necessary, taking shape as a mechanism for overall efficiency of the economic and social system and how is inevitable, however, undoubtedly a strong capacity for public programming, economic and urban planning, in which it must move. Arranging the leadership of private enterprise within public control through a system of programmatic rules regarding territorial and economic aspects: this is the main indication suggested with the ultimate goal of stimulating a specific and practical capacity of government of territory.
Another depth theme was the need to look at an actual plan of services, beyond the classical concept of urban standard with the prediction of an organization and networking of all the equipment and services that contribute to improve the quality of life of the community; in a moment of extreme awareness of a limited size of public spending, everything you can imagine , inter alia, with the intervention of private force and therefore a number of features for public use , made within an agreement with private investment and accessible to all through mechanisms of social control. The equalisation mechanism, building loans, compensatory transfers and other forms of intervention and innovative solutions in the area have been subject of a technically assisted meeting in which it was addressed the urgent theme of ' important

depopulation that has affected Campomanfoli, one of the most ancient areas between the fractions of Castel San Giorgio.

Therefore proposing topics of general interest to frame and understand the disagreement and the issues raised, the situation was substantially decompressed, redefining priorities and objectives for the whole community, all of them widely shared.

The entire output of the participatory process is merged into an organic Preliminary Plan, a strategic document, the result of the interaction between the careful listening and analysis carried out in advance and the technical knowledge need for a rational and efficient planning. (Figure 2)

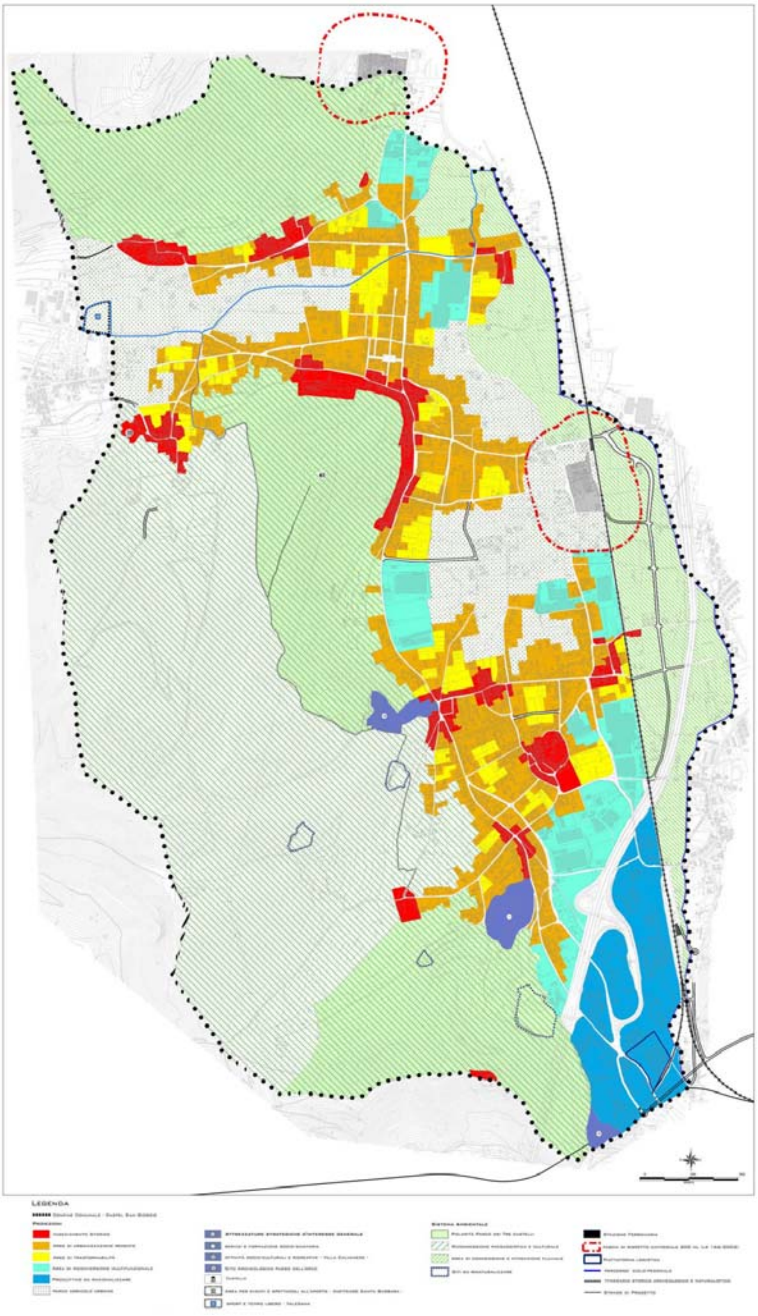

Fig. 2 The system of choices – Preliminary Plan

4 CONCLUSIONS

The potential of new approaches based on assertiveness represent a field of research and application that is the new frontier of research that disciplinary rediscovering their roots, is able to face the future challenges with the aim of contributing to the construction of places and forms of cohabitation with a view to the progressive fairness and justice. The assertive approach, applied to the case study presented here, has refined the outcomes of the entire process of participation. The structure and the choice of specific forms of dialogue for different critical points has contributed to the understanding of issues and particularly complex aspects related to urban management.

At the same time, it has allowed to improve the communication of most themes exposed to risk of conflicts. The role of the assertive facilitator is still unexplored and his know-how is an open matter.

Nevertheless, the "scientific literacy" of the set of stakeholders, on which the choices will weigh, is the most important theme in order to develop an effective and efficient planning.

Considering planning as a process, paying attention to both long-term impacts of the choices made, both to the degree of satisfaction of the different actors, it inevitably embodied the need for a new model of urban governance that takes into account the new demands of democracy, in its participatory dimension.

This means encouraging the transparency of the same decision processes in order to ensure the legitimacy and obtain the consent of all the parties, aimed, inter alia, to the selection of the alternative that offers the highest level of satisfaction for the greatest number of interests inevitably weighted according to the weight of each.

Based on the belief that it is just around the decisions, relationships and alliances between the different actors that are born and is structured all the productions of the territory, the participation stays the lietmotiv of all the processes aimed at identifying strategies for short and long term of government of the territory.

The ultimate aim of this approach is without any doubt the implementation of the quality of urban policies, pursued through the promotion of a better control of the inhabitants on their living environment, to construct a scenario in which we can recognize and confront, facilitating the implementation of new shares and overcoming paralyzing conflicts through the activation of forms of dialogue and mediation to reach shared and effective solutions.

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DIGITAL SOCIAL NETWORKS AND URBAN SPACES

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ABSTRACT

The goal of this paper is to explore how available data from digital social networks can be used to understand ongoing collective actions on urban micro spaces. For this we analyze two cases, one in Brazil and the other in Italy. We propose to conduct an exploratory exercise about group discussions in digital social networks interactions on issues that affect the use of residual public spaces as a way to understand how collective actions are trying to modify urban environment. Aiming to verify the possibilities of analysis of this kind of interaction we made a study of digital urban movements in two cities: Salvador (Brazil) and Potenza (Italy). Such study aims to perform social networks analysis from groups and interactions on digital communities. This permits to test specific research methods to understand how groups and individuals are articulated for qualify cities micro environments, by using digital social networks platforms as a way to improve public participation in a broad sense.

KEYWORDS

Social Networks Analysis; Public Participation; Urban Movements

1 INTRODUCTION

Social interactions of everyday life are permeated by technology. Social sharing and a dynamic information integration may enable the convergence of different points of view, by exchanging individual or group experiences. It also reveals various alternative ways to behave and act over urban space.

Gordon (2008) suggests the network technologies and corresponding practices significantly changes the nature of local situations, not only socially, because of the way we share information geographically located, as phenomenologically, the way we experience what's near. Ongoing research at laboratory LCAD at Federal University of Bahia – UFBa goes in that direction: the use of mobile digital technologies and its influence at the urban environment. This paper presents questions that have been discussed in two current research projects at UFBa: the project "Networked Citizen: from consumer to producer of information about the territory," developed in partnership with the PRODEB – Cia of Data Processing of Bahia – and the project "Digital Social Networks and their Impacts on Urban Space in Brazil". The objective of the paper it is to explore how data from digital social networks can be used to understand communication and re-composition of structures of social groups involved in actions to improve residual areas in urban space, using complex network theory. We observe the way people are using digital social networks to communicate and diffuse theirs interests, as well as the interactions are shaped around their more active members.

To verify the possibilities of analysis of this type of interaction, we made a study of digital urban movements in two cities: Salvador (Brazil) and Potenza (Italy). Our goal was to test alternatives as a way to expand a repertoire of research methods used to understand how groups and individuals are organized to deal with urban spaces, by using digital platforms social networking as a way to improve public participation in the broad sense.

2. PARTICIPATION, URBAN MOVEMENTS AND DIGITAL SOCIAL NETWORKS

Nowadays a widespread use of ubiquitous communication technologies are based in convergence and mobile networks. These technologies made possible new forms of sociability and allowed new social practices and actions. Social medias have given rise to new participation forms in issues related to urban life. On the path of this process we can notice that the mobilization around the theme of common goods in urban life could contribute to civic engagement, clearly embodying the cultural dimension to the concept of citizenship.

Several initiatives by citizens' groups, often associated with NGOs, seeking to occupy and redefine the use of urban spaces, are inserted in social movements that aspire to repopulate virtual and physical public space with elements of a public sphere. Public sphere is understood in this text as a mean of communication between people who want to govern their lives.

The term "participation" became popular as part of the political vocabulary of the social movements of the 60s of last century. Protests against the anti-democratic nature of urban interventions of the post-war cause, in those years, greater involvement of users and affected communities in the definition of projects, particularly in developed countries (Pereira 2009). Advocacy planning movements arise from then mostly aimed at improving the quality of urban life at the local level. They represent a first attempt to involve citizens in urban planning processes (Murgante 2013).

In the 70s of the twentieth century, authors denounce the excessive autonomy of the political sphere rather than the source of legitimation of power. "From there emerged new movements and theories about democratic mechanisms that sought to increase citizen participation in public affairs" (Silva 2009, 29).

The debate on public participation is renewed with the popularization of the Internet in the 90s and especially with web 2.0 in the mid first decade of the XXI century. According to Gomes (2005), the most enthusiastic phase with the possibilities of the Internet prevailed until the second half of the 90s. There was hope that the Internet should induce a renewal of the public sphere and participatory democracy. But, on the other hand, continues the author, studies have pointed to deficits of the Internet in terms of their contribution to modern democracies.

In the 80s, movements for social advocacy and nongovernmental organizations have already used the Internet in discussion groups and BBS (Bulletin Board System). In the 90s, diverse movements are integrated via web into collective actions, whether to engage in a common struggle, or to build a common activity (Antoun 2008).

Access and interaction are important for participatory processes – are in fact its conditions of possibility – but they are also very distinct from participation because of its less explicit emphasis on the dynamics of power and decision-making. Carpentier (2012) emphasizes that the defining element of participation is power. Poplin, Pereira and Rocha (2013) tested a Participatory Cube to analyze some Brazilian and European online participatory platforms as a framework for the analysis of participatory applications available online. It is composed by three axes that represent the most relevant dimensions: decision power, interactivity of communication, and the access to space of communication. They have found the more usual is wide access, but centralized communication (one to many) and narrow power of influence.

Van Dijk (2012) defines eParticipation as the use of digital media to mediate and transform the relations of citizens to governments and to public administrations in the direction of more participation by citizens. The author founds eParticipation is more used in the first phases of the policy process: agenda setting and policy preparation. Initiative of citizens frequently is related to policy evaluation and governments and public administrations rarely allow entries to the core decision making and policy executing phases, the author says.

Rustad and Sæbø (2013) focused on how, why and with whom local politicians engage on Facebook. They conducted a qualitative case study focusing on politicians in a local municipality in southern Norway by using their proposed framework. Their empirical results indicate that politicians *"still have some work to do to strategically harness their use, or non-use, of social media in political discourse"* (78).

Parviainen, Poutanen, Salla-Maaria and Rekola (2012) examined nearly 100.000 Facebook users and over their 27.000 interactions in the two Finnish presidential candidates' Facebook pages during a period of 14 days. They combined statistical and social network analysis to distinguish structural differences in the underlying friendship networks, such as in the interconnectedness of the page users.

From the network structure's point of view, they could see that underlying friendship networks of both pages differed in many aspects. The activity over time analysis revealed the evolution of both groups in terms of new page "likes" and the amount of posts. They also explored associations between the amount of friendship connections within the post and different "activity ratios". The authors conclude that activating the most connected users of a page will yield the page more activity.

It thus appears that the present studies have been devoted to understanding behaviors, seeking to associate them with interactions in digital social networks. They use Social Network Analysis (SNA) relying increasingly on large volume of data being produced and shared: the *Bigdata*. Applications based on social networks provide an operational context for interaction between the contact networks of each participant, expanding the social sphere. Within this type of application, social capital of each network node becomes available for privileged methods searching for ideas, content and people (Maistrello 2007). In the contemporary context, one of the goals of the study of social networks is analyzing relationships between social entities and the implications of these patterns and relationships to the social life (Wasserman and Faust 1994).

Such studies promote deeper analyses about social structures in these networks and a quantitative dimensioning of interactions. Thus, quali-quantitative evaluation of such social networks initiatives can happen following organized procedures and based on specific methodologies with concepts and applications of Social Network Analyses and Complex Networks Theory (Barabási and Bonabeau 2003), such as centrality, betweenness, density, clustering coefficient, degree distribution and so on (Wasserman and Faust 1994). This permits classifying complex networks for comprehending their internal structures using mathematical and statistical techniques.

Some studies on participation with the use of digital platforms mentioned here confirm the interest in adopting an expanded view of political participation to contemplate new social arrangements present in cultures that use communication networks as a medium to share views. Such social arrangements are considered here as a starting point to analyze two movements that try to change the use and meaning of certain urban spaces, they also propose to take care of these spaces collectively. This paper used data from online social networks and communities *fanpages* with an active presence on Facebook seeking to reclassify waste and degraded urban spaces in two cities, one in Brazil and one in Italy. Through quantifying more meaningful interactions conducted in 2012 and 2013 and structural analysis of relationships maintained in these groups, it is expected to characterize them and establish bases for comparison.

3. CASES DESCRIPTION

3.1 GARDEN IN MOTION (*IL GIARDINO IN MOVIMENTO*, ITALY)

The project Garden In Motion (*Il Giardino in Movimento* or GMO) rises from a prior facebook group named Parco del Basento devoted to discuss an idea to recover an degraded area near the Basento river, along the lower part of the city of Potenza (Southern Italy). This area became degraded since the process of *deindustrialization* starts from the mid 70s of last century, closing piggeries settled into and around.

A design of a great park – Parco del Basento – was conducted in 2010, by Studio WOP, and grew up with new supporters joining civil society associations and collecting signatures on a petition, calling for the construction of the park in 2012. Local newspapers reported the initiative, whereas professionals and professors were asked to give their opinion in public hearings with mayor and politicians. Social networking improved debate, reaching its peak between February and May 2012. The project was enriched by discussions with stakeholders and mobilized many citizens of Potenza that see the initiative as an opportunity to think about the city, to participate in the planning of urban space, to experience new forms of public participation.

As a result of this process, a group of dwellers continues to discuss the use of urban space through Facebook and meetings. These people are sharing visions on the present and the future of the city through fanpage and group forum called “Il Giardino in Movimento”, since the end of 2012. This way, they experienced, on their own, collaborative process trying to attend collective interests from local community - in short, the common good for citizens of Potenza nowadays.

3.2 COLLECTIVE YARDS (CANTEIROS COLETIVOS, BRAZIL)

Collective Yards (*Canteiros Coletivos* or CCS) is a group of dwellers that rises from discussions developed in digital social networks about urban problems in the city of Salvador (Northeast, Brazil), between January and February, 2012. Diverse manifestations, organized by unknown citizens or already constituted movements, happened in this period requesting deep changes in the municipality to restore the popular use of city public urban spaces. The creator of the movement explains how it was born in a TV interview, in September, 2012:

> *I have launched the idea of recovering an urban site near my house and wish that such actions would multiply by several city neighborhoods, rescuing our role of active citizen, who not only think, not only questions, but it does, search solutions, alternative search and get things done. From there we formed a group and began to define practical actions.*[1]

The first intervention was performed on a common and degraded area in a large avenue in Salvador. This experiment was replicated in other different and distant areas, afterward. The actions of *"planting, maintenance, painting and cultural occupation of spaces"* have succeeded in other parts of the city based on the invitation of organized social actors whose actions are directed to certain neighborhoods and areas of the city.

The interventions take place with anyone interested in collaborative efforts and/or voluntary participation. Online and offline actions aim to promote "an increasing number of residents with the possibility to transform the city". Collective Yards performs also a project in partnership with an NGO (Permaculture Institute of Bahia) which aims to make this type of intervention an educational practice, strengthening the educational aspect through direct practices. They develop and promote training workshops in the communities where interventions are performed.

4. DATA AND ANALYSES

Both projects host a discussion group and a *fanpage* in Facebook where actions are organized, debated and disseminated. In the group area of each project, the respective participants have autonomy to publish and interact with each other through posts, likes and comments, or even sharing the content for beyond the group. Public actions are organized and people are invited to participate in initiatives in a hyper-connected way using Facebook as main platform. For extraction of data we used the NetVizz application (Rieder 2013), which permits access to different kinds of data about the projects analyzed. In the first set of data extracted for analyzes, (I) we retrieved all the textual content of posts in each group and respective comments, just as statistics and aggregated values of the different measures, as comments and *likes*. On Facebook, the sum of these two measures is defined as Engagement and will be considered in this work.

The second set of data (II) retrieved from both projects two kind of networks: a) the friendship network of members belonging to each group; b) the network based on interactions between group members through the posts (likes or comments from user X on a post from user Y create an edge between X and Y). The last one set (III) retrieved a 2-mode network[2] of *fanpages* of each project between two kinds of nodes: posts and users. Two-mode networks are a particular case of social networks where two different kinds of elements (nodes) have relations (edges) exclusively between nodes of different types (Latapy, Magnien and Del Vecchio 2008). In the current cases, every time a user comments or likes a post in the *fanpage*, a link between the post and the user is created. For all networks analyzed we considered undirected edges between nodes[3].

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1 https://www.facebook.com/groups/coletivodecanteiro/.

2 It is possible creating 1-mode network (projection) of 2-mode networks formed by only one type of the nodes. If nodes A and B belong to type X and each one keeps a relation with node P1 (which belongs to type Y, in a 2-mode network), then, the 1-mode network projection for type X will create a relation between A and B.

3 Undirected edges represent a kind of relation which allows the existence of a link between a pair of nodes A and B, independent of direction. So, the relation does happen in ***A=>B*** as also in ***B=>A.***

4.1 STATISTICAL ANALYSIS

4.1.1 THE GARDEN IN MOTION PAGES

- The GMO group page

The GMO Facebook group page[4] was created in 2012 on the initiative of Studio WOP architect. It is an open group with 562 members (December 19, 2013).

This study made a first group recognition through its posts between October 1st, 2012 until September 2nd, 2013. During 337 days, there were 80 posts, sometimes only informative and/or calling for mobilization or participation in the events, sometimes sharing opinions and knowledge. We decided to analyze the content of 20% of the posts with the greatest commitment, computed here as the amount of comments and “likes” (Engagement) addressed directly to the post (not the comments on the post).

The post with highest number of comments (18) and *likes* (8) refer to photos of an event under the Musmeci Bridge. The comments are however a conversation between three friends whom combine a meeting on another date. The second one is a photographic record of an event held in the "garden" area, with 9 comments – many people are saying sorry for not having attended – and 10 *likes*. Third-placed one brings images of designs for redevelopment of the area under the bridge resulting from a workshop, whose election was through number of likes and comments.

- The GMO fanpage

The GMO Facebook *fanpage*[5] was created only on June 26, 2013. The page is defined geographically as *hyperlocal* in its description: *"In Potenza, between the Musmeci Bridge and the city, there is a garden that changes in a natural way. We think (and we live) in this space in a shared way"*. The area has a symbolic meaning for the group. The Musmeci Bridge is the main entrance to the city. It was built in 1976 and should be reverted into a riverside park, which was never built (Murgante 2013). With the desired realization of Parco di Basento project, the bridge and the whole area adjacent would become valued.

Until December, 2013 the *fanpage* reached 826 followers. Between July 15 and September 3, 2013 (50 days), there were 52 posts, on average 1.04 post/day. Engagement reflects the set of interactions observed for each kind of interaction mentioned. Unlike the data obtained for the group, here we also consider the amount of shares and liked obtained by the comments.

The top post in all aspects (22 likes, 7 reviews, 27 shares and 5 comments like) concerns to the disclosure schedule of the second phase of the workshop *"Il Giardino sotto il Ponte"*, held on 17th and July 18, 2013, under the Musmeci Bridge, when the chosen intervention among the designs made in the first workshop and put to a vote on the page has been performed. Except for the post with the schedule of the workshop, that has got a lot of likes (22) but also got record number of shares (27), the number of likes were responsible for posts get better positions in relation to engagement (28 *likes* on the photo of the intervention and 23 likes in group photo), in any other case there was more than one share.

Confronting group and *fanpage*, there is a tendency to use the second one to spread the idea of participatory design, conveying a large amount of media (videos, images) and information, especially those related to the first workshop. This channel was used for involving others dwellers in the movement, always reinforcing the idea of participatory design. It provides details related to intervention projects over the area of intervention, discloses the name of participants, as well as traditional media news about the movement.

[4] https://www.facebook.com/groups/389327887802076/.

[5] https://www.facebook.com/IlGiardinoInMovimento.

The *fanpage* has the role of an outside diffusion into the public set of followers, while the group page shares information deemed of group interest: calendars, events of other groups, links to publications, photos taken by its participants and photos of internal events performed by the group. On project´s *fanpage*, there are posts from several followers and participants, although with a predominance of some of them. The peaks of interaction (20% of posts evaluated for the periods of observation) occur primarily linked to events promotion. In case of *fanpage*, this occurs during the workshop held in July 2013. These peaks were more distributed on time in group forum.

4.1.2 THE COLECTIVE YARDS PAGES

- The CCS group page

The CCS forum on Facebook[6] is presented as an open group, which brings together people who believe in participatory management of public residual urban areas. Through actions of cleaning, planting and artwork, the group intended to lead the local people *"the idea that the strength of a collective can transform and reframe degraded and forgotten spaces of a city"*.

The group defines itself as a "collective" and states they seek to create a spirit of autonomy so that residents and retailers keep themselves locations recovered, promoting a new use of the area "for the community", rescuing *"the intense life on neighborhood streets"*. The group was born on December 19, 2013, and had 1,502 members in February, 2012.

The collected data from the group refer to the period between June 4 and July 29, 2013. In 56 days there were 107 messages posted in the group, most often calling to participate in events, sharing knowledge and opining on interest issues of the group, or reporting initiatives that reinforce its objective. 22 top posts considering engagement (*likes* and comments) represent 20% of posts in the group considering the period and received 246 *likes* and 61 comments.

The most liked (28 *likes*) was the post sharing news related to the collective from a traditional newspaper from Salvador: comments (4) congratulate the creator of movement. The second post with most *likes* (22 likes) was a post calling *to celebrate each day as the Environment Day*. The third post with highest engagement (18 *likes* and 5 comments) mention the Collective Yards project in a university class.

Considering the 22 posts analyzed, the one with more comments (11) ranks sixth place in terms of engagement. It is a message where the group sets up a meeting to discuss a new event. 3 posts that had higher engagement circulate pictures: newspaper timeline photos and posters pictures.

- The CCS fanpage

This Facebook *fanpage*[7] and the group forum were created in the same month, February 2012. *Fanpage* is presented with the same goal in group space. However, on page they reinforce the idea of education action group in the sense of *"proposing a new relationship, exchange, learning the day-to-day, collective work for the common good"*. The page had 2,704 followers until September 12, 2013 .

The data collected for this study refer to interactions between May 17, 2012 and September 26, 2013. In 497 days were posted on the status line 680 messages. On average 1.37 posts per day. 20% of the posts with top engagement (number of *likes*, comments, *likes* on comments, and sharing) totaled 136 entries in the status area.

The top post on engagement (161 mentions) got 58 *likes* and was shared 90 times: it concerns the release of a free workshop (gardening, ecology, art). Next is the post that got 149 entries and was shared 94 times,

6 https://www.facebook.com/groups/coletivodecanteiro/.
7 https://www.facebook.com/CanteirosColetivos?fref=ts.

referring to the mobilization for action intervention group in a square. Thirdly, the post with 128 entries in total and the largest number of shares (99), is requesting diffusion of a *flyer*.
The comparison of interactions amount (group and page), considering the 20 higher engagement, indicates that their dynamics do not coincide at all. There it is great focus on more engaged group interactions between June and July, 2013, period of protests in Brazil against indifference of public administration with relevant social issues as education, health and transport. Curiously, despite this, these posts do not refer to these manifestations.

4.2 SOCIAL NETWORK ANALYSIS

4.2.1 GROUPS: INTERACTION NETWORK AND FRIENDSHIP NETWORKS

The interaction and friendship networks of each group were firstly adjusted considering the biggest component of connected nodes for performing analyzes. In both cases these sub-networks represented, at least, more than 90% of original networks. This step is fundamental for computing metrics in social networks analyzes, respecting all the premises stated in Watts and Strogatz (1998), which ensure the possibility of studies and comparisons of considered projects. Random network (using the software Pajek[8] and allowing comparisons between relevant metrics such as clustering coefficient and length) and degree distribution were also generated for each network.

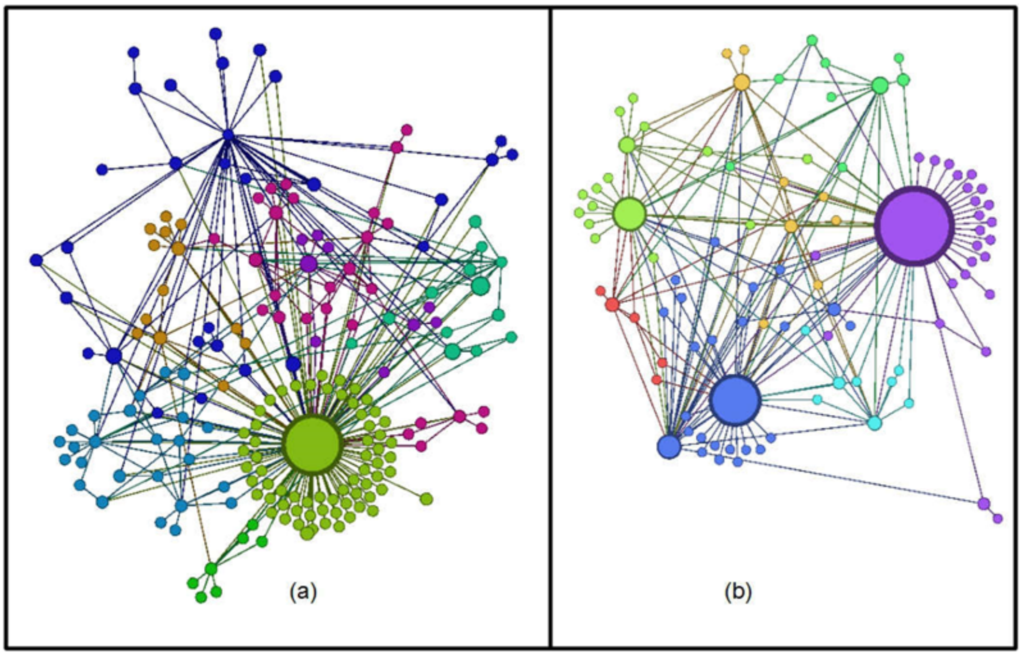

Fig. 1. Interactions networks for CCS (a) and GMO (b)

Networks generated from interactions among social actors can be named emerging networks and represent social interchanges performed by social interactions and conversations mediated by computing. Such complex networks generally show *Small World* characteristics (Recuero 2009). Figure 1 presents the networks of interactions on posts among participants of projects CCS and GMO, respectively.

8 Pajek is a very traditional software for SNA and generates randomic networks using Poisson distribution of degrees.

The colors in Figure 1 represent clusters of interaction. The figure shows a trend toward greater centralization in the case of CCS, where one of the actors has a very prominent role. In the case of the Italian group can also identify the most active actors but the leadership of the interactions is somewhat more distributed.

Figure 2 presents the friendship network of participants of each project, CCS and GMO respectively. Colors represent sex of users - blue nodes are Facebook users whom did not inform sex. For both interaction networks analyzed, comparing to the random correspondent networks, the clustering coefficients are high and average shortest path metrics are low. The degree distributions show no patterns in both cases. This allows us to classify the interaction networks as *Small World* networks, confirming Recuero. In fact, these networks function in a clustered way – very small subgroups or a place for inter-mediating meetings of already known users – another characteristic of emerging networks (Recuero 2009). Participants may not achieve the totality of users in the group as interactions remain inside little subgroups (of dialogues, of known people, of close talks), without a large socialization among the remaining users.

These examples of networks are efficient for interchange of information inside the clusters, but as they happen in a context of community, create digital trails for non-participants of such clusters, whom can also reach the posts and dialogues shared in the group, participating in debates and promoting information. This result confirms a characteristic of little complex social networks (Appel and Hruschka 2010), where subgroups have a tendency for high connectivity among their elements than with the hole group, tending to hierarchical organizations with communities inside communities. The friendship networks (Figure 2) metrics present the same behavior of the interaction networks, but the degree distributions present a tendency to Scale Free (Barabási and Bonabeau 2003) network. Figure 3 shows the degree distibution of connections and as the amount of elements in the CCS network is higher, its graphic presents different scale in frequency axes from the GMO network.

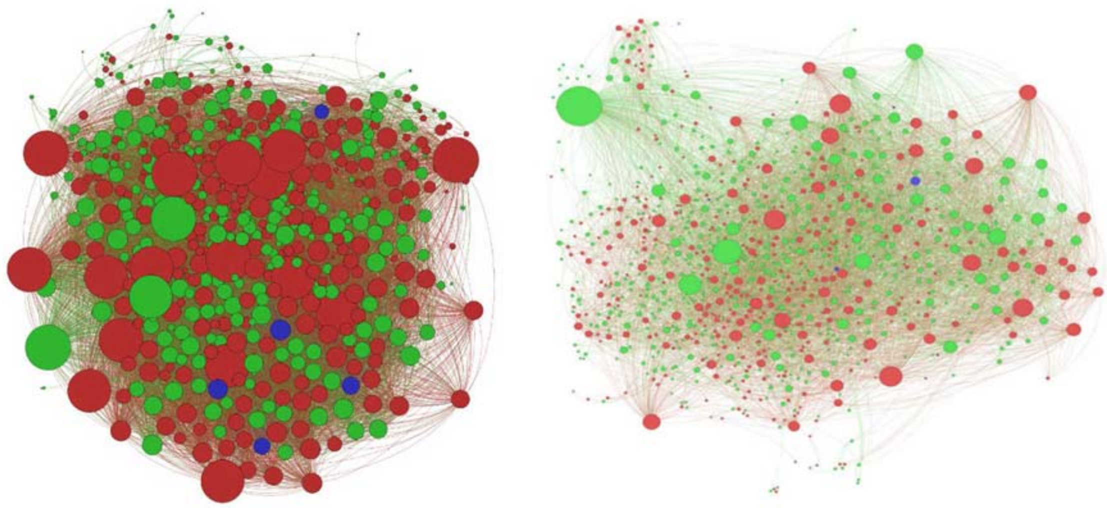

Fig. 2. Connections networks for GMO (left) and CCS (right)

In these cases, few people are linked to many others, while these are connected to very few people. So, most part of the connections belong to very few people in the observed groups. It was possible to realize that in these structures, some people have a higher attractiveness for new elements joining the groups, becoming fundamental for keeping dynamics in the projects, although, inside the group, the interactions show a clustered behavior.

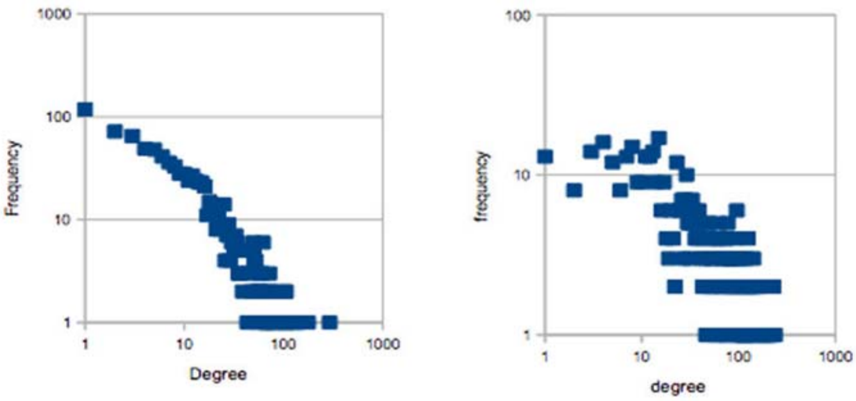

Fig. 3. Degree distributions of connection networks for each project: CCS (left), GMO (right)

We can conclude that these networks have their formation process highly influenced by elements with high attractiveness. In case of eliminating such nodes from their respective networks, these systems can crash originating incommunicable islands (the clusters). It is proper to make a parallel between goals of the groups and the scale free networks: both groups try to develop some kind of organization over specific urban environments that were in a neglected-chaos state. This kind of behavior is similar to those revealed in transition phases of unorganized systems for organized ones.

4.2.2 FACEBOOK *FANPAGES*

In relation to Facebook *fanpages* of both projects, we have extracted 2-mode networks (Latapy, Magnien and Del Vecchio 2008) formed by two types of elements: a) posts made by the *fanpage* administration and b) users that performed some kind of interaction, as *likes* or comments, on such posts. From both networks, we have generated four projections networks (Latapy, Magnien and Del Vecchio 2008) for each mode (two exclusive for users and two exclusive for posts) which gave us four 1-mode networks.

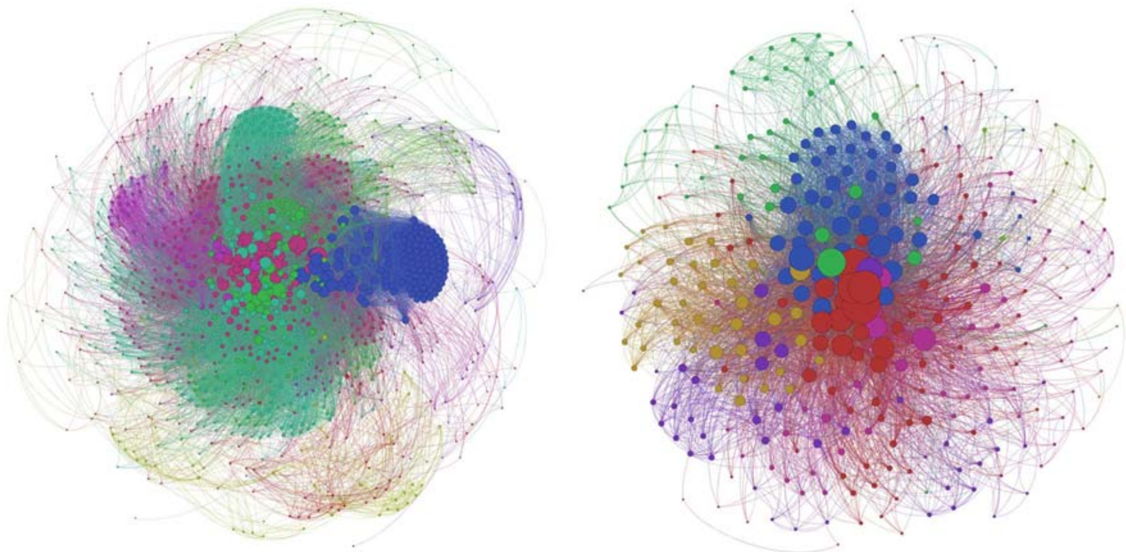

Fig. 4. Projection of users extracted from 2-mode fanpage network: CCS (left), GMO (right)

The projections exclusively for users (separated from the posts) for both projects can show how the followers “meet” in virtual spaces (the *fanpage* and its posts) trough interactions and content exchange,

establishing possibilities of contacts among strangers. Thus, we have analyzed such projections as well as their respective original 2-mode networks, generating and observing their metrics and structures.
Measures as average degree, density, average shortest path and diameter, evidence very similar results for 2-mode networks, even with very distinct values for amount of nodes and edges, which are the basic for most of metrics. Networks projections for users show similar behavior for clustering coefficient. A visual inspection on both 1-mode networks evidence clusters (represented by nodes colors) linked for few nodes, repeating a *Small World* tendency. This is confirmed by metrics in comparison with their respective random networks metrics in both projections: high clustering coefficient and low average shortest path. Such results permit us conclude that both projects have similar behavior and network structures, even in different countries and cities with very distinct population size and cultures.

5. CONCLUSIONS

According to Carpentier (2012), as the actual use of social media and correspondent practices often extend the theoretical reflections on politics, one can speculate how democratic values subsidize current visions of the common good, understood here as the right to the city.
Both cases work through the occupation of public space. In Brazil, the goal is on urban residual spaces. In Italian case, the focus is on a space whose quality has been degraded by previous usage given to it. We can say that these movements change the public space in a sense they try to improve its quality to become usable by citizens.
Similarities and differences in terms of goals, forms of speech and action can be observed. Il Giardino in Movimento comes to assure the area management for the city. This requires changes in urban legislation, they want to enhance the city, valuing Musmeci bridge, the entrance from the town, which it is an architectural heritage. The group also aims to develop different urban participatory projects by involving voluntary associations, university professors, designers and others professionals. Collective Yards wishes changes social behaviors and local communities with a more educational approach. Implicitly, it also wants to promote environmental awareness. There is involvement of distinct neighborhood associations and a university project.
The main stage for debate and develop such actions were digital platforms, specifically digital social networks, as Facebook. This permits people from distinct neighborhoods can discuss and organize meetings, interventions, debates in physical places, creating new social interaction and exchange of ideas, motivating others to keep acting on urban spaces or joining the group actions. The way Facebook is used to communicate and spread interests and collective actions shows similar dynamics in usage of posts published by both groups. GMO uses fanpage to spread actions for a broader audience, while the group forum diffuses information for group interest. In CCS case, posts with more response from participants are related to recognition from the press or students groups, while most liked posts in fanpage are related to publicizing of movement activities (workshop, gardening), as in GMO. We may conclude that, in both cases, forums reinforce relations among elements of the groups, while fan pages work for publicizing and engaging people in groups actions. Fanpages are used to get visibility outside, while the group pages are used to a kind of inside conversation.
Social data analysis reveals great similarity in the interactions and network structures, considering examples from different countries, with different cities not only in culture but also in size and dimensions. The use of these tools and data proved to be useful. The classification of networks from each case reveals a short path between nodes in almost all networks structures. Although structure of interactions had shown great

polarization in CCS case and wider distribution around some poles in GMO case, it could be expected that interactions and connections emerged from such digital trails pass could perform interferences on urban experience through contemporary and diffuse processes.

Castells (2000) says that the trend for networks formation is central in our society and institutions. Above all both, social networks and social movements became on-line. As data about social networks can be found today in digital format, computational approach seems adequate for data acquisition. Once gathered, data must be analyzed and this can be done in a quantitative way or by a qualitative approach. As we are dealing with a great amount of data, manual treatment could be highly time consuming. DNA is a way of extract information about agents, opinions, interactions by use of computational tools, however we find that to go further in the knowledge there is a need of mixed methodologies – not only statistical and computational but socio spatial analysis – different professional backgrounds are essential to a better data interpretation. DNA it is useful tool that can highlight the points that must be analyzed in a qualitative and, in some cases, manual approach. Following insights brought by social data analysis, as a future work we believe that content analysis of discourses and meanings contained in the posts will bring new findings. We will explore Semantics Networking Analysis as a first approximation to discover meaning shared by those groups about participatory actions on urban public spaces.

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IMAGES SOURCES

Fig. 1, 2, 3, 4 created by authors.

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SOCIAL MEDIA GEOGRAPHIC INFORMATION IN TOURISM PLANNING

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ABSTRACT

Social media are playing an increasingly important role as information resource in tourism both for customers (i.e. the tourists), who gather trustworthy information supporting the choice of destinations and services from peers, and for businesses, which can use the same information for improving their marketing strategies. The use of social media data can also offer new opportunities for decision-support in tourism planning. With improved understanding of the motivations of tourists and tailoring tourism service supply, decision making can be facilitated by emphasizing the strengths of tourist destinations for past and potential visitors. However, this kind of information about tourists perceptions and opinions is not always properly analysed by planners. Understanding the user satisfaction, which depends on factors related to both the location and the services that the local industry proposes, may offer valuable information in tourism planning at regional and local level.

In the light of the above premises, the goal of the study presented in this paper is to propose an integrated approach to investigate the relationships between tourists satisfaction, destination resources and tourism industry for supporting design and decision-making in regional tourism planning. The methodology developed in the study includes data collection from popular tourism social media platforms (i.e. Booking.com and TripAdvisor.com.com), and their integration with territorial and tourism data. Spatial and statistical analysis techniques are then applied to elicit insights from tourists perceptions on success factors which may be used in decision-making and planning support. The case study demonstrates the value of social media data and computational social science techniques in tourism planning. The paper concludes with a critical discussion on the potential of using such an approach in more general urban and regional planning setting.

KEYWORDS

Social media geographic information, Spatial analysis, Tourism planning, Spatial planning.

1 INTRODUCTION

This study focuses on tourism phenomenon, analysing relationship between demand, industry and location identified as fundamental variables. The research aims to study tourist preferences on destination and tourism industry services as represented by review judgments collected by two major tourism social networks, namely Tripadvisor.com and Booking.com. The investigations are carried on exploring the potential of publically volunteered comments, for providing useful knowledge about people preferences in space and time. For research purposes, a traditional method for collecting information about such preferences, performed via ad-hoc surveys can be expensive and time consuming. For this reason this work presents an alternative approach, by which tourist preferences for location and services are discovered by processing and analysing publically available social media data.

The paper explores three questions related to tourists preferences :

1. Which are the most popular destinations?
2. Why people chose those destinations?
3. What attracts tourists attention and what do they appreciate/disregard?

and eventually,

4. How this knowledge can be use as tourism planning support.

The underlying assumption is that this kind of study and its provided methods and tools can be used successfully in urban and regional planning as much as in tourist planning, for in both cases they contribute to take into account a pluralist customer- (or citizens) –oriented view on strategic development issues.

From the methodological perspective, the central challenge in answering the questions above is how to manage the big amount of available data to discover useful knowledge.

The method builds on a set of spatial analysis and statistics techniques, useful in describing and visualizing the spatial distribution and detecting patterns and hot-spots. In addition, textual analytics techniques (Campagna et Al, 2013; Campagna, forthcoming) have been applied in order to discover the knowledge enclosed in the huge amount of qualitative social media comments. The findings provide insights into the Sardinia tourism industry which could aid in the development of new planning approaches. They also offer a benchmark for future comparative trend analysis and directions for tourism policy design. After examining the past studies on the travel consumers online social networks and the most popular web sites (Section 2), the paper focuses on the destination choices and judgments represented in numerical and linguistic terms (Section 3). In Section 4 the research methodology and the early results of the case study are summarized and briefly discussed. The paper concludes (Section 5) with the summary of findings and future steps for extending the presented work.

2 DEVELOPMENTS IN TOURISM SOCIAL MEDIA

In the last decade, the fast evolution of Information and Communication Technology (ICT) enabled consumers to have ubiquitous access to a broad range of information services. The degree of interactivity established by the Web 2.0 paradigm enhanced the role of Internet as information source, with a secondary role as opinion source (Grabner et Al, 2012). Combining the commercial, technical, social and psychological aspects of groups of people, the interacting individuals behave as an online community. Wenger et Al (2002) defined a community as a group of individuals who want to interact to develop knowledge, share experience and build up their own identity. The development of a common knowledge base is the driving force of a community. Social, economic and technological aspects are incorporated into the community. In addiction with developments in social media every piece of information, can be commented or rated in some way.

Tourism is one of the sectors which exploited the advantage of the advances in ICT and in the development of online communities. On the supply side the tourism marketing (i.e. the way to promote tourism industry, the different destinations, or the holiday packages) have been totally transformed (Dippelreiter, 2010). It is no surprising to observe that travel and tourism related topics are among the most popular in on-line social networks. (Baggio et Al, 2008). Likewise, on the demand side, the travellers use the Internet to obtain tourist information, to share their experiences, to establish relationships with people from various destinations or to purchase travel related products. According to Chung and Buhalis (2008) Internet supports i) the pre-travel phase, where all the search and bookings can take place online; ii) the in-travel phase, through interactive forums and/or blogging while on the road; and iii) the post-travel phase where people can share experiences, review hotels and destinations, and post photographs and videos from their trips. Travel plans, destinations, hotels reviews and discussions within the tourists on line community denoted the ever growing trend within the so-called world of Travel 2.0 world (Conrady, 2007).

TripAdvisor.com and Booking.com are among the most popular platforms of the latter kind. They play a significant role in the online tourism market. They can be considered as market-driven social media. While on the one hand, these platforms represent an important marketing channel through which destinations and tourism enterprises can reach and persuade potential visitors (Biassoulis, 2002), on the other hand they assist consumers in posting and sharing their travel-related comments. Travellers opinions and personal experiences based on reconstruction of their trips in turn serve as information to others. TripAdvisor.com with its web and mobile applications is based on the idea that travellers rely on the reviews of other travellers to plan their trips, or at least they may be satisfactory helped in their decisions by them. Currently TripAdvisor.com contains 10 millions of travel reviews and opinions written by 5 million of registered members, and it counts 25 million visitors per month (Miguens et Al, 2008). The Booking.com website, established in 1996, attracts visitors from both the leisure and business sectors worldwide. Booking.com is available in more than 40 languages, and offers over 367.033 properties in 190 countries. From a quick look at TripAdvisor.com and Booking.com the following general ideas are evident: in both cases, information posted with regard to destinations, tourist operators, restaurants and tourists services and facilities is autonomously generated by its users. They also feature reviews, comments and ratings on destinations, hotels, attractions, or other tourism related services. Furthermore different kinds of multimedia posts are supported as well as discussion forums on specific topics.

When location also is available, all these type of information, as all information derived from forums, discussion blogs or social network, could be considered as Volunteer Geographic Information (VGI). In recent years the term VGI became popular to indicate the avalanche of information which every second is shared on the web by users acting as sensors (Goodchild, 2007). According to Sui and Goodchild (2011), more recently the convergence of GIS and social media granted by interoperability of geo-web tools is further enriching the possibility of sharing the knowledge not only about the Earth surface but also about all the biological, social and cultural phenomena there happening. In facts, as Campagna et Al argue (2013), VGI may include both geographic information collected by groups of people within crowdsourcing initiatives and geo-tagged multimedia collected for personal purposes by the Internet users and publicly shared through archives in the cloud. Social media information may be geocoded in different ways, using either the position of the author (if public), or the location of the post (i.e. recorded trough a gps sensor of a mobile device if available), or through toponyms parsing in the text. VGI has been proven useful in many application contexts such as emergency response, environmental monitoring and spatial planning (Poser and Dransch, 2010).

3 DESTINATION CHOICES AND TOURISTS PREFERENCES

Most studies of tourists preferences address tourists destination choices as the key element in the travel decision-making process. According to Dellaert et Al (1998) this element is combined with accommodation or activity choices. The investigations of decision-making processes, mostly conceptual in nature, have focused on the types of decision rules and the decision-making stages that are likely to be adopted by tourists. On the other hand, research in choice factors has been primarily addressed with empirical examinations of critical attributes used by tourists as criteria for determining their travel alternatives (Crompton, 1979). This section provides a brief explanation of tourists travel destination choices and their travel motivation. In addition a brief explanation, based on literature review, of the main factors that influence costumer preferences is provided.

3.1 TRAVEL MOTIVATION AND DESTINATION CHOICE

Knowledge of consumer psychology is extremely important in determining the success of a destination (Rodriguez del Bosque and San Martin, 2008). In this sense, an exploration of psychological concepts such as attitudes, decision-making processes, emotions, experience and satisfaction is necessary for understanding costumers choices and preferences in tourist destination. Destinations consist of a well-defined geographical area, such as a country, a region or a city and they can be referred to a product or a brand. Many studies on tourist travel choice distinguish between various approaches to the definition of tourist destination. Van Raaij (1986) defined the travel destination as a product, which is partly given and partly man-made. The given part refers to natural features of the destinations such as climate, landscapes, beaches, mountains and historic-culture buildings. The man-made part refers to features such as hotels, package tours, transportation, sports and recreation facilities, which can all be adapted to customer preferences and budget. Ferreira (2011) claims that tourist destinations should be conceived as brands and they should be managed from a strategic point of view. Buhalis (2000) regarded destination as a defined geographical region with a political and legislative framework for tourism marketing and planning, and it is understood by the visitors as a unique entity. Destinations thus offer a mix of tourism products and services, which are integrated under a brand name.

Determining the factors that influence tourists choice for a destination is essential in developing appropriate marketing strategies. Age, income, gender, personality, education, cost, distance and nationality are factors that affect choices destination (Van Raaij, 1986). According to Kuang Hsu et Al (2009) travel motivation is a dynamic concept; it changes from one person to another and from one destination to another. Cooper (2009) pointed out that one popular typology for understanding travel motivation is the push and pull model by Crompton (1979). The push motivations are useful for explaining the desire for travel while the pull motivations explain the actual choice of destination. The Crompton model identifies seven socio-psychological (push) motivations (escape, self-exploration, relaxation, prestige, regression, kinship-enhancement, and social interaction) and two cultural (pull) motivations (novelty and education). Uysal and Jurowski (1994) further developed Crompton model: they summarized internal (push) and external (pull) motivators to travel. Internal motivators include desire for escape, rest, relaxation, prestige, health and fitness, adventure, and social interaction. External motivators were based on attractiveness of the destination, including tangible resources (i.e. beaches, cultural attractions and recreational activities), and travellers perceptions and expectations (novelty, benefit expectations, and marketing image). In more recent studies, researchers have added shopping as a motivational characteristic of the destination (Uysal and Jurowski 1994; Cooper, 2008).

3.2 COSTUMERS PREFERENCES

According to Crouch et Al (2004), consumers judgments depend basically on the strength of their beliefs or expectations about the quality of various features or attributes associated with services. Personal preferences, like motivations, may be both intrinsic, reflecting individual likes and dislikes, and extrinsic, or socially conditioned. The weight of an attributes is usually related with the relative importance that consumers confer to each attribute. This means that each opinion strictly depends on tourists direct past experiences with other services of analogous nature. Kuang Hsu et Al (2009) argued that tourists decisions are complex multi-faceted decisions in which the choices for different elements are interrelated and evolve in a decision process over time. Most studies of tourists travel choice address tourist destination choice as the key element in travel decision-making. These process is influenced by a number of psychological (internal) and no-psychological (external) variables, and consists of a number of different stages that are marked by specific actions.

In order to meet the target of tourists expectations, hotels should provide an ample range of quality services, including reception, meals, room service, tennis courts, beach nearby location, swimming pools and gardens, among others. But how can we define service quality? Service quality can be considered as a composite measure of various attributes. According to Dubè and Renaghan (1999) it not only consists of tangible attributes but also of intangible or subjective attributes such as safety or quietness, which are difficult to measure accurately and which are usually studied by linguistic information (Benitez et Al, 2007). Lewis and Booms (1983) define service quality as a measure of how well the service delivered matches customers' expectations. Benitez et Al (2007, after Berry, 1985) argue that the "quality that consumers perceive in a service is a function of the magnitude and direction of the gap between expected service and perceived service". Judgments expressed by numbers are easy to interpret, but linguistic information is more difficult to measure through a mathematical function. Linguistic information characterizes subjective knowledge and is usually ignored by analysts when forming mathematical models that represent real world phenomena. However, attributes measuring service quality are characterized by uncertainty, subjectivity, imprecision and ambiguity (Benitez et Al, 2007). When consumers make decisions, they usually employ this subjective knowledge and linguistic information. Beside tourism marketing and planning, tourists are an important target audience for urban planning: in order to take into account tourists preferences, planners must deeply study the phenomenon of tourism and attempt to understand and internalize tourists needs and perceptions (Dickey, 2005). An accurate identification of customer perception is a first step to maintaining the status of a city image as a popular travel destination.

In the light of the above premises the next section reports on the analysis from the spatial perspective of visitors perceptions of tourism destination and services in Sardinia.

4 MULTIDIMENSIONAL ANALYSES OF TOURISM SOCIAL MEDIA INFORMATION

In order to understand the tourist preference dynamics in Sardinia, as expressed by Social Media Geographic Information (SMGI), a two scales approach was adopted. Firstly analyses at the regional scale were carried on to describe tourists preferences spatial patterns and to identify location of interest; the latter may include clusters of positive or negative preferences, or individual spots of interest. Then, at the local level (i.e. within the single cluster or spot of interest) further analysis were carried on aiming at understanding the possible reasons beneath the patterns and singularities, with the assumption that they may help in explaining success or failure factors with regards to destination and services features. Both at the regional and the local levels, an investigation method was adopted including descriptive spatial analysis and spatial statistics coupled with explanatory SMGI analyses, including Spatial-Temporal Textual analysis, which can be defined as the textual analysis constrained by space and time boundaries (STTx; Campagna, forthcoming).

In synthesis, operationally the study was carried on according to the following workflow:

1. Data collection and geocoding: data were extracted by Booking.com and TripAdvisor.com.com, geocoded and integrated in a geodatabase for analyses;
2. Regional preferences dynamics analysis: data were analysed for all the region at the municipal unit of analysis with spatial analysis, spatial statistics, and STTx in order to detect clusters and hot/cold-spot;
3. Local preferences dynamics analysis: data were integrated with authoritative data from the regional Spatial Data Infrastructure and other official open data sources in order to find explanatory hints on the preference dynamics and to get deeper insights on the relationships among tourist preferences, local territorial features and quality of industry services in selected destinations.

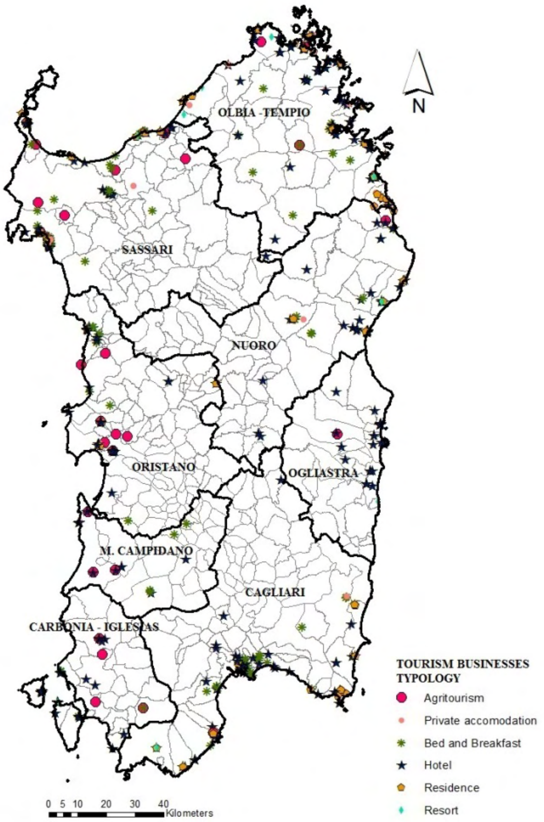
The last two steps were carried on iteratively on the relevant clusters and spots as in the examples reported in the remainder of this section.

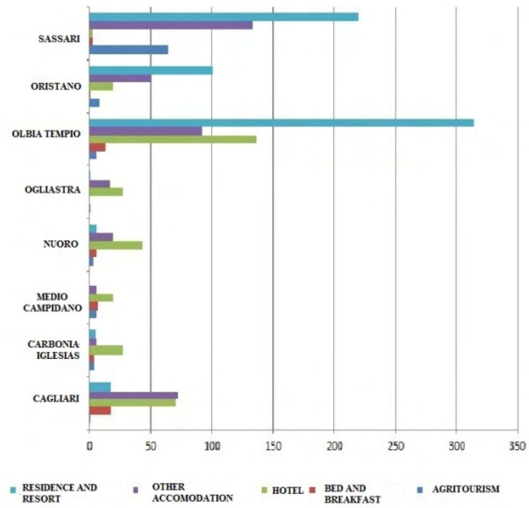
4.1 DATA COLLECTION AND GEOCODING

In the first step, of the study a database was created extracting data from TripAdvisor.com.com and Booking.com in the period between May 2012 and May 2013. Through these applications customers can book, rank and review hotels, flights and restaurants (*or Tourism Services, TS)*. The focus of the portals is to filter content based on rankings that are derived from other users ratings. Thus, rankings are split into several categories, such as value/price, rooms, location, cleanliness and sleep quality. Available rating categories however are determined by the type of reviewed item. The reviews are enriched by the possibility to add multimedia elements or travel maps of previous trips or to take part in discussion forums. Thanks to the availability of the location of the services they can thus be considered Social Media Geographic Information (SMGI; Campagna, forthcoming). Thus, the study required the adoption of a mixed methods approach, in which quantitative and qualitative information were collected in a database for analyses. The quantitative information concerns the score of tourist evaluation criteria, while qualitative information includes customers textual descriptive review.

Concerning the quantitative analysis it should be noted that in TripAdvisor.com a rating scale consists of five ordinal values (or stars), ranging from 'terrible' to 'excellent'. A separate mandatory overall rating summarizes the total customer satisfaction. In Booking.com a rating scale consist of numerical integer ordinal values, ranging from 1 to 10 (i.e. the higher the better). Beside quantitative assessment, in both platforms, a text box records qualitative natural language reviews. The title is a concise short text formulation of the assessment, while the comment is a long text field. After the data collection, a geodatabase was created including 2100 Tourism Lodging Service (TLS) records extracted from TripAdvisor.com and 1900 TLS records extracted from Booking.com. As working set an unified database of 992 records was used. The records provide lodging services name, category, location, and related quantitative score. It should be noted that the lodging services category includes not only hotels, but also other types of accommodation such as resort, bed&breakfast or agritourism. The 992 record dataset shown in Figure 1, includes all and only the lodging services featuring in both sources for which all data were available, and can be considered a representative sample.

In order to analyse spatially the location of the tourism business patterns in Sardinia, geocoding was performed on the extracted addresses, providing the exact location of the tourism operators. Point locations were found automatically for around the 80% of the items. Due to a variety of reasons, approximately 20% of the geocoding required manual editing.





PROVINCES	N Businesses (from SMD)	N Businesses (from Statistical Regional	VARIANCE
CAGLIARI	204	678	0.30
CARBONIA-IGLESIAS	40	240	0.17
MEDIO CAMPIDANO	30	96	0.31
NUORO	85	380	0.22
OGLIASTRA	49	210	0.23
OLBIA-TEMPIO	275	785	0.35
ORISTANO	71	371	0.19
SASSARI	238	135	1.76

Fig. 1 Distribution of tourism businesses typology by provinces

Figure 1 shows the spatial distribution of the customers review on the TLS in Sardinia, divided into 5 main categories: agritourisms (6%), bed and breakfast (15.7%), hotels (42%), private accommodations (29%), residences and resorts (7.3% of total numbers of operators). The results of the analysis by provinces revealed that three provinces have emerged as important tourist destinations in the tourists perception: Olbia-Tempio (27,8%) Sassari (24%) and Cagliari (20,6%). Other four provinces (Nuoro 8,6%, Oristano 7,3%, Ogliastra 5%; Carbonia-Iglesias 4%) are well represented by tourism businesses; whilst the province of Medio Campidano is only represented by the 3% tourism businesses. In addition, analysis of the significance of tourist appreciation in the coast and in inner areas in Sardinia revealed that 92% of tourism reviews sample concerns LTS (917) in the coastal areas, while only less than 8% of popular tourism businesses is found inland. Nevertheless, Nuoro and Medio Campidano Provinces together provide notable inland popular TLS with almost the 13% of the total number of reviewed tourism businesses. This may mean that tourists visit these areas to discover a less popular side of the island, which is characterized by its nature, cultural heritage and traditions. However, in terms of number of visitors this kind of tourism still does not compete with massive preferences for tourism along the coast. The chart in Figure 1 shows the result explained above together with provinces distribution of the different types of tourism facilities.

Analysing the spatial patterns of TLS typology together with the semantic of their reviews may offer interesting hints to characterize different destinations for tourism planning purposes. As an example, it can be noted from the analysis that Cagliari TLS supply is characterized by a strong dominance of B&B, while for Alghero and Olbia, which are also major coastal city tourism centres, hotels and residences are more popular among tourists. This determines different overall TLS models for the destinations. The analysis of the content of the reviews for the different models may help to get better insights on the success factors of the different models, and give useful hint for the choice of the more sustainable tourism development model for other underdeveloped destinations.

4.2 SPATIAL ANALYSES OF TOURISM PREFERENCES

After the preliminary descriptive analyses of the preferences dataset, the second step of the methodology is the application of spatial analyses of tourism preferences to explore spatial patterns of positive visitors judgments at the regional level. The application of spatial analytical techniques allows the exploration of the spatial dynamics of visitors perception and their relationships with different variables. For each TLS the database includes a score record, which is the average of six main attributes:

- 1. Location, which is related to the geographic position of the structure;
- 2. Services, referring to all transport facilities, shopping areas, bars and restaurants;
- 3. Price/quality ratio, referring to structure clearness, staff kindness and all type of comforts offered by the operators;
- 4. Staff (kindness);
- 5. Room cleanness(Cleaning);
- 6. Comfort, referring to all facilities and services that hotels provide to their customers.

It should be noted that the attributes *Location* and *Services* explain the territorial features of the destination while the others express the perceived quality of the TLS supply.

Thus the data model allows the investigation of the spatial patterns of both preferences on territorial and tourism industry features at the local level across the whole region. The following analysis show some examples to explain which are the favourite destinations globally and by the two perspectives. The analysis starts by mapping the Tourist Positive Preferences Incidence (TPPI, i.e. the ratio between the positive scores and the TLS by municipality) in Sardinia. Figure 3 shows the distribution of the TPPI (left). The TPPI shows an overall high spatial concentration in the North-East of Sardinia. The Costa Smeralda district appears as the only area where the global tourism preferences fulfil overall visitors expectations. Looking at individual municipalities, the analysis shows that Alghero exposes the highest TPPI rate. The other two municipalities with a high TPPI are Cagliari and Olbia. Also in Figure 3, two maps show the pattern of TPPI by destination territorial features (centre) and by tourist industry services quality (right).

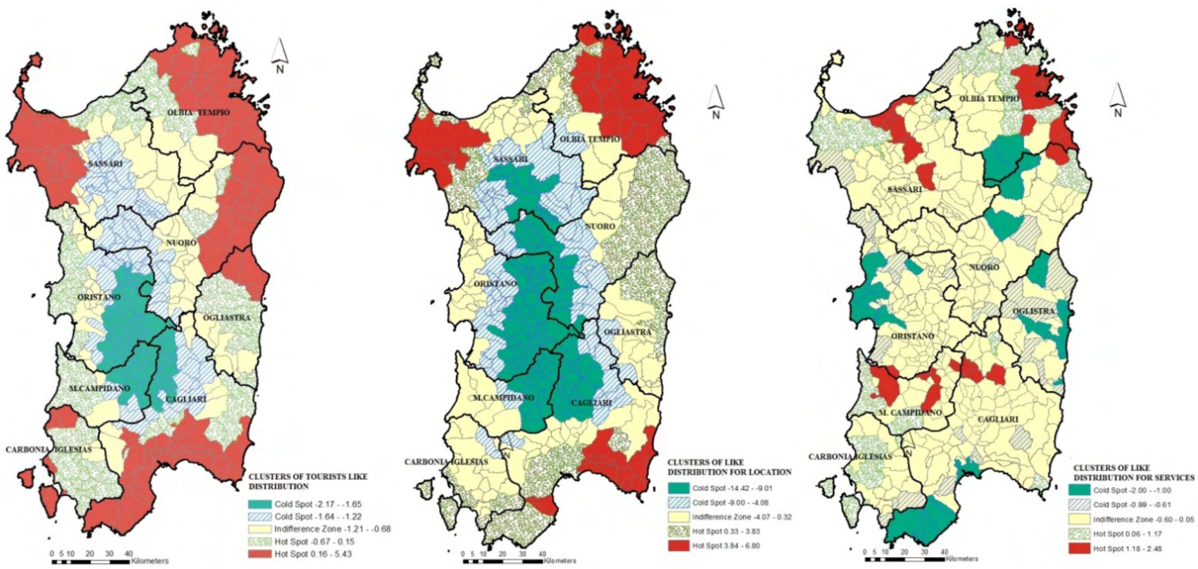


Fig. 3 Areas characterized by positive preferences (TPPI): global (left), location (center) , and services (right).

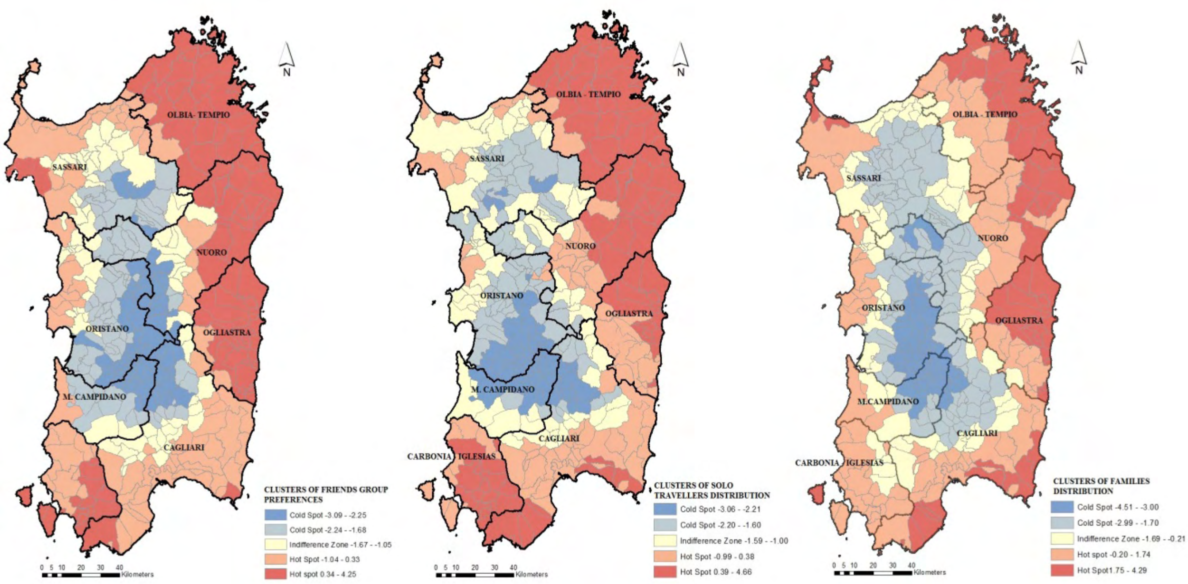


Fig. 4 Different tourist typologies affected surfaces

The analysis of the preferences allows also detecting the areas by typology of users. The maps in Figure 4 shows the results for three tourists categories, namely “Group of friends”, “Solo Travellers”, and “Families with children”. This information may be very helpful in shaping marketing strategies and in tourism planning.

4.2 SMGI ANALYTICS AT THE LOCAL LEVEL

After the analysis of tourism dynamics at the regional level, identifying clusters and spots of successful destinations through the preference patterns, the methodology adopted for this study has shifted to the local scale for further analyses aiming at finding explanatory answers for the phenomena under observation. The shift from the regional to the local scale is also conducted relying on spatial analysis and spatial statistics techniques on an integrated SMGI / A-GI (Authoritative- Geographic Information) data database. As an example case study for the sake of illustrating the methodology steps, the tourist destination of Alghero have been chosen as the regional analyses demonstrated its highly successful performance. The analyses at the local scale are intended to investigate the success factors within the single destination in order to extract useful hints to be used for further planning in the same or other destinations.

Alghero has been recognized as a best-selling destination from different tourists typologies. Thus, the following questions one should answer were “*Why tourists interest concentrates in Alghero?”* and “*What exactly in the destination does attract the tourists attention?* In order to answer these questions, summarising the review by neighbourhoods, the map in Figure 5 shows the spatial clusters of preferences: the historic city centre of Alghero attracted the main attention of the visitors, while the modern residential districts in the outskirts, in this case, represents a cold spot. However the most interesting question arising from this analysis may be why certain coastal areas are not considered by the visitors and the answer may give useful suggestions to planners and decision-makers for further analysis. This kind of research can be supported by the integration of SMGI data with other A-GI on demographic, land use, transport facilities or socio-economic data coming from the regional SDI. In this sense, one interesting research question is whether spatial statistic methods such as regression analysis can be used to understand whether the spatial interest of the participant is influenced by environmental or socio-cultural variables. This represents the next future step in the extension of the study.

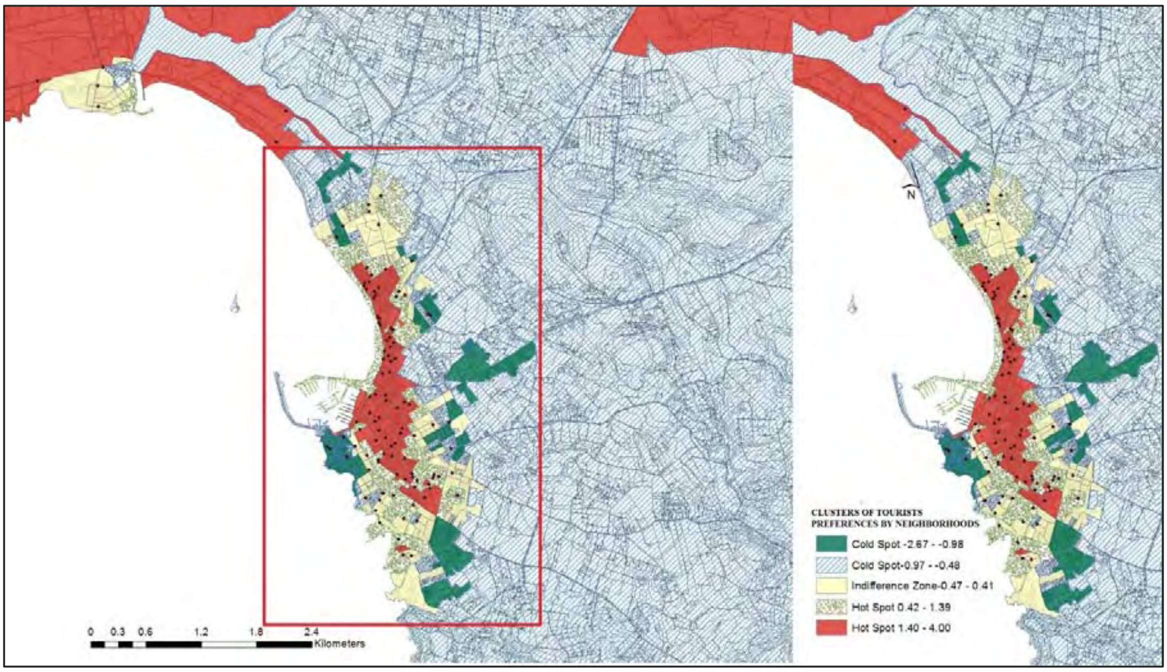


Fig. 5 Significant patterns in Alghero municipality

Another effective way to investigate the why tourists demonstrate to prefer certain areas or destinations rather than other may be given by the STTx analysis on their reviews. We want understand not only where but also what people think, analysing the reviews content. The analysis was carried out using the tourist comment database, which collected data regarding tourist user origin, language used, time comment and the textual judgment (positive and negative). For the overall Sardinia more than 880.000 reviews were extracted in five different languages (Italian, Spanish, English, French and Portuguese), of which 1050 in English relate to Alghero. The chart in Figure 6 shows the tag cloud of the latter comments dataset spatially constrained by the preference hot-spots in Alghero.

Fig. 6 Tag Cloud for hot spot affected areas of Alghero

The textual analysis using Tag Cloud led to discover knowledge enclosed into this huge amount of text comments. The Tag cloud is essentially a visual representation of labels (tag) or keywords contained in different word strings. Generally, this representation is presented with a weighted word list in alphabetical order, where the larger font is attributed to the most repeated words (Kaser, 2007). Text analytics techniques allow visualising on the map relevant posts (Berry and Kogan, 2010) not only by keyword but also by time, for knowledge discovery exporting data, especially when the amount of information rapidly grows. In the present example, the most popular 20 words were extracted. The figure shows how the majority of the words in the posts refer to spatial or physical aspects of Alghero, such as *location, beach, town, old city* and *city centre*. Other frequent words are related to tourism structures, such as *hotel, stuff, room* and *pool.* Outcomes of the textual analysis also indicate higher levels of satisfaction with location, facilities and services. According to the results, the main reason for tourists to visit Alghero seems to be related to both its natural attractions, which include natural sites, such as beaches, and the presence of a unique cultural heritage. These facts generate a positive tourism location image, which is the most influential psychological factor at play when tourists decide where to travel. People with doubts regarding of travel destination, will probably choose a destination with a good image. Textual analysis results also indicate a high level of satisfaction with the destination leisure sites, such as typical *restaurants* and typical *food.* In addition, results expressed a high level of satisfaction with the supply of accommodation, the cleanliness of structures and the kindness of the employed stuff.

5 DISCUSSION AND CONCLUSIONS

The results presented in this paper rely on the first outcome of an exploratory study to get insight on what kind of analysis may be carried on in order to extract from Social Media and Geographic Information meaningful knowledge relevant for planning and decision-making. The case study falls in the domain of tourist planning which is closely related to urban and regional planning. In fact, as the results of this study demonstrate, the success of tourist destination is closely dependent not only by the quality of the tourist industry offer but also by the territorial setting of the destinations, including the natural, cultural and the physical character of the places, as well as infrastructure and services. Further analyses are currently ongoing to extend this early framework and to earn deeper insights on the one hand on the functioning of tourism preference dynamics, and on the other hand, from the methodology perspective, on the formalization of a novel and robust integrated A-GI/SMGI analytics.

Still, this study gives empirical contributions to the evaluation of social media data using spatial analysis tools in tourism literature. The first one is related to the use of exploratory spatial analysis as a method to visualize and interpret visitors perception based scores. The literature on tourism services distribution highlights several issues and debates, but often the spatial dimensions of visitors subjective perception was omitted so far. In addition, the measure of this spatial dimension and its representation may open new opportunities for planners as well as new research challenges, in order to use authoritative and social media GI for a pluralist and customer-oriented policy-making in tourism planning. Many of the assumptions and findings can be anyway applied to the more general field of urban and regional analysis, design and planning.

Additional analyses are currently under development aiming at understating the possible integrations of SMGI with a more complex territorial model relying on further official spatial data resources on demographic, land use, transport facilities or socio-economic data coming from regional SDI. In this sense, one interesting research question which will be tested is whether spatial statistic methods such as spatial regression analysis can be used to investigate quantitatively how the spatial interest of the participant is influenced by environmental or socio-cultural variables.

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IMAGES SOURCES

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RE-USE/RE-CYCLE TERRITORIES

A RETROACTIVE CONCEPTUALISATION FOR EAST NAPLES

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ABSTRACT

In the vast majority of cities all over the world, urban growth takes place in peri-urban spaces.
City models are in deep crisis facing the disappearance of differences between city and countryside. The urban sprawl of settlements in Italy, and also in Europe, is quite different from sprawl phenomenon and suburbs basically referring to American cities. Urban sprawl is characterized by one-family houses, dispersed in the countryside and by large industrial enclaves close to infrastructures networks. Italian situation can be interpreted as a peri-urban model instead of sprawl condition. The rural-urban fringe derives from the erosion of the countryside due to the abandoned residential settlements and the industrial patterns.
In the contemporary Italian urbanized landscape, urban and rural realms merge, creating complex “hybrid” types of space, consisting of residential areas, commercial zones, agricultural land, recreational and nature areas. The rural-urban fringe, an area between the city and the countryside, is characterised by spatial and functional heterogeneity and by a large amount of drosscapes, “in between spaces”, abandoned industrial buildings and sites and underused spaces without development programs.
This article addressed three main questions: Are there alternatives to closure and abandonment? Is it possible to consider the recycling of *drosscapes* as a new paradigm in opposition to the crisis of international finances and city models? Can the networking of residual rural-scape represent the new strategy to regenerate urbanized landscape?

KEYWORDS

Recycling, drosscape, hybrid space, rural-urban fringe

1 INTRODUCTION

1.1 CONTEMPORARY FORMS OF METROPOLITAN SPACE

The paper topic are landscape recycling tools related to land consumption, using *open spaces* as a starting tool for regeneration. This approach can lead to relevant results: on one hand, to give again centrality to brownfields and disused areas, the "remains" and "wastes" of territorial system, legitimized for the first time by Lynch's Wasting Away (1990); on the other hand, as in the Third Landscape by Gilles Clément (2003), to assign a systemic role to disused space, pointing out the "awaiting" condition as an opportunity not related to future transformations, but to practical "takeovers" and ecological "reconnections".

Openess relates to the ecological function of communities within their everyday territory, identifying their characters as a base for the *commons* of the city, building a sense of identity and belonging within the *urban metabolism*, as firstly Jane Jacobs assumed (1961).

As Tim Jackson (2010) points out, the economic crisis gives us an unrepeatable opportunity to invest in the change: open networks (land, energy, transports, water, waste and food), and the built heritage, are the raw materials capable of transforming urban spaces, through the overcoming of sectional interests and the restoration of physical and social connections in the urban areas. In this perspective, *urban ecology* is interpreted as a contextual relation between community and inhabited *open space*: the new paradigm of recycle, confirming the centrality of common goods, gives the chance to use strategies based on what already exists, enhancing the solidarity and the common values, starting from wastes and remains of a parasitic vortex, which has transformed our territories.

On the other hand, it's undeniable that, after a century of uncontrolled and unquestioned growth, of blind faith into prosperity and economic wellness, the contemporary city is oscillating nowadays between the fear of *indefinite expansion and dispersion/disintegration* (Secchi 2005). Today cities are *shrinking* (Oswalt 2006) -while urban-planning debates focus on the growth of the megalopolis, many of the world's existing population centers are watching their citizens (and functions) walk away. Between globalization, deindustrialization, suburbanization, the transition to post-Socialism, high unemployment and, in some cases, wider national population losses, the phenomenon is growing.

The exterior areas of cities have seen in the past the concentration of docks, industries, manufacturing activities, etc. This has been due to a lot of factors, such as their proximity to accessible routes, the abundance of empty lands, a consolidated absence of institutional policies, etc. Such a trend led also to the positioning of all the activities shut out from the classy city centre, such as pumping stations and dumping grounds, thus affecting for decades the resident population, causing social exclusion and economical gap in comparison with higher standards of the inner parts of the city. This phenomenon increased in recent times with the closure of many factories, the re-location of docks and the consequent loss of jobs and land values, in addition to the economic and social crisis. Since the Sixties the big cities, with the coming of the post-industrial era and the loss of meaning and use of old industrial developments, show up rows of empty spaces, brownfield areas and neglected sites. The city once in expansion, starts *shrinking* to its *limits*, filling them with new functions and meanings.

In whole Europe, after the de-industrialization the urban growth came to a standstill: the city shrinks to its *limits*, uncovering its *wastelands* and *drosscapes*. The *in-between* landscapes stood at the margins, *awaiting a societal desire to inscribe them with value and status* (Berger 2006, 29)

This way, limits of the city are no more perceived or conceived as simple and plain *lines*: they are among different conditions and situations, belonging to various regions in the same time, shaped by local meanings from different sources. *Liminal space, but also 'liminal' as a space* (Zanini 2000). Liminality is a psychological concept by the anthropologist Victor Turner: it refers to the mental state of initiates during a transition ritual. *Liminal spaces* are *thresholds*, surrounded by dissolving boundaries. Limits are *thresholds* too: they are no part of the inner city, but neither of its outskirts. They're *spaces of transition* between the interior and the exterior of the contemporary city, places where *liminality depicts a "no man's-land" open to everyone* (Zukin 1991, 269)

The sprawl city usually creates abandoned and empty spaces as well, that derive from unplanned, poorly designed and unmaintained open spaces and vegetation. The drosscapes in the sprawl city are the composite of many landscape fragments, such as empty properties, strips, lots and a large amount of different in between spaces. Sometimes these lands are left intentionally empty until it is possible to develop them. Since many of these drosscapes are on the margins of these new sprawl cities and are waiting for a new valuation, they are often described as liminal too.

In the last few years the financial and economic crisis changed the perception of economic and social values and called for a transformation of the territory. Reclaiming brownfields has thus become crucial for a future socio-economic development.

These vacated and deprived lands stand as a claim for the contemporary city. For ages sectional urban policies forgot to address liminal spaces; contemporary age need to re-think the remains of industrial era, its physical and social decay, combined with a global process of critical analysis of *shrinkage* effects above vast areas.

Drosscapes by definition evocate the idea of a recycling area, and they represent a new paradigm that emphasizes the productive integration and re-use of "waste landscapes". Drosscapes are places with disappearing rules, even laws: forgot by the city, and by its administration and urban policies, abandoned to a development of their own; in a way, independent from the common process of life and growth of contemporary city, which is fast and competitive, while limits are slow and almost self-sufficient, almost self-governed. The silences of authorities, the lacks of urban planning and policies, are transforming fast environment, remains of the *production city*, into *suspended landscapes*, waiting for a different shape and meaning.

The biggest issue about the re-cycle of urban drosscapes is that the concept of waste sometimes is highly subjective and it is not based on homogeneous value system. However, the situation is quite clear in presence of the combination between contaminated sites and industrialized areas. For instance, in the area East of Naples, sites that were previously used for chemical and petroleum plants have been closed for a future re-use, due to their high toxicity.

1.2 IN-BETWEEN SPACES / RE-CYCLING STRATEGIES

The paradigm of recycle is a good way to start reducing land consumption, especially relating to the landscape we built in the past. This reduction is not a contraction of urban growth, but an afterthought of urban culture and lifestyles, thus implying the necessity to re-consider even parts of the city which gradually lost their meaning and shape. The reference is a model of *smart* city, capable of material recovery of existing values and built environment, especially in presence of brownfield areas. These areas have a great potential, through the improvement of the existing resources: soil, water, land uses, nature and ecological relations, culture and local urban values, not last the material remembrance of industrial architecture. These resources entail specific actions: ecological rules redefinition, ecosystemic preservation, planned compatibility with new functions, etc. The fewer changes that are made and the less energy that is required to make them, the more effective a recycle strategy will be. You can change something without necessarily requiring a major intervention.

Therefore re-cycle refers to new life cycles of materials, products, spaces and buildings that completed their planned life cycles. It is strongly connected to the concept of reducing and re-using. But in addition to reducing and re-using tools, re-cycle implies different dimensions and multiscalarity. It is dynamic and strategically adaptive, aimed to environmental sustainability (e.g., reduction of land consumption, carbon dioxide emission, in site materials reuse, etc.). In addition, while recycling creates new economic opportunities, it also enhances social inclusion, due to its bigger attention to the production process and its indirect consequences. The purpose of a good re-cycling project is to harmonize the life cycle of varied landscape sets, which are decaying at different speeds, following the 3R system, Reduce/Reuse/Recycle. Germany adopted this perspective during the 2006 Venice Architecture Biennale, in the exhibition called the “Convertible City. Modes of Densification and dissolving Boundaries”, underlining regulations to limit the uncontrolled growth, and again during the 2012 Venice Architecture Biennale, with the exhibition called "Reduce. Reuse. Recycle", with practical and operational tools of recycle and re-use. In parallel, in 2012 Italy hosted at the MAXXI Museum (Rome) the exhibition, called “RE-CYCLE. Strategies for architecture, the city, the planet”, which presented recycle in transversal and interdisciplinary approaches, through interventions on buildings, cities, landscapes, together with works of media, in Italy and all over the world.

2 CASE STUDY: URBAN REGENERATION IN THE EAST NAPLES AREA

2.1 EAST NAPLES: FROM PIANA CAMPANA TO CAMPANIA FELIX

The metropolitan territories of Naples, called “Piana Campana”, are composed by a high-density conurbation between the cities of Naples, Caserta and Salerno. This sprawling urban area is located at the margins of the compact cities and has a chaotic structure derived also from illegal processes. Density and dispersion of settlements are mixed in this territory. Historical centres are connected with each other through a continuous urban pattern, where hybridization exits between urban and rural scape. Naples metropolitan region is a multipolar structure, but not an actual network, based on efficient mobility systems.

Campania Region has not an acclaimed tradition of spatial planning on regional and municipal levels. It is made of a combination of results born from several sectional policies (infrastructures, production settlements, shopping malls, etc.), not integrated in the landscape planning. Residential settlements are separated from urban public spaces, as for example parks, public facilities, open public spaces, etc.

This phenomenon generated a territorial fragmentation with spontaneous and low quality urban patterns.

In the Piana Campana region there are a lot of spaces “*in transition*”, like the eastern part of Naples itself. East Naples is a combination of “waiting-spaces”, because they are still waiting for a project; they could be considered also as drosscapes (Berger 2006), born in different periods, spaces that ended their lifecycle: “dead spaces” with a strong power for urban regeneration. This urban fringe could represent a strategic element to re-discover the tradition of agriculture in Campania “Felix” (designation of the ancient rural landscape due to the large amount of harvesting obtained each year).

This work focuses on the re-use of under-used or no-longer-in-use spaces and on the possible alternatives to closure and abandonment. The recycling of drosscapes represent a new paradigm to escape the international crisis, re-imagining the future in a cyclical way.

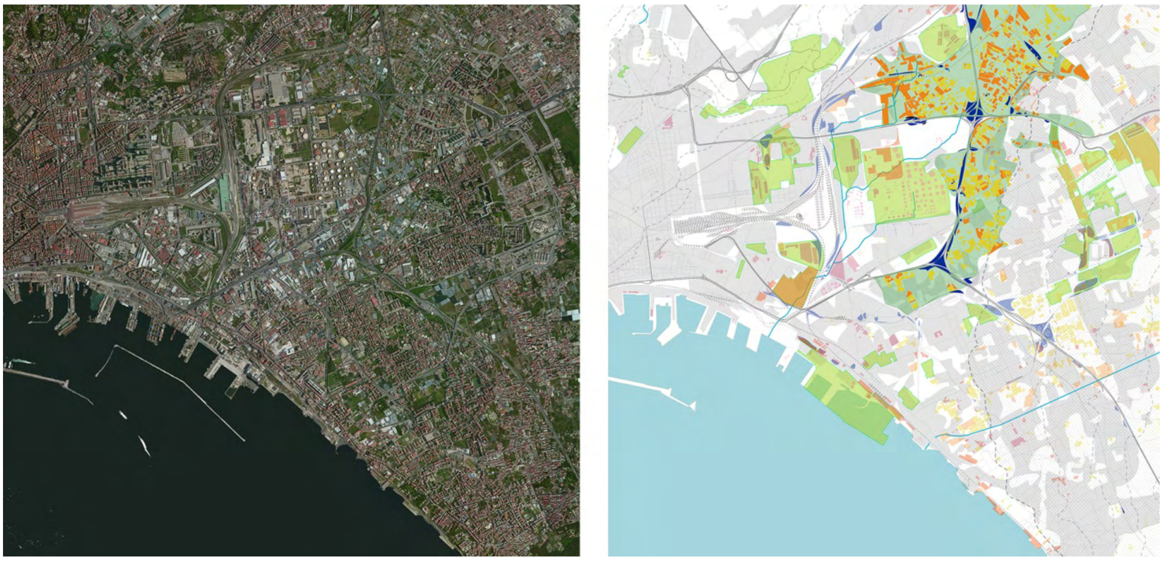

Fig. 1 Esat Naples: aerophotogrammetry and land use

The Piana Campana region is crossed by Regi Lagni, eighteenth-century canals, designed by engineer Domenico Fontana. The general aim of the project was the reclamation of marshes near Acerra city. These territories were taken away from water: for this reason, water can be considered as a primary landscape element here. Therefore, water represent a key landscape element for the East area of Naples as well, but today drosscapes occupy the 40% of all the territory. The area is almost totally urbanized, and territory is nearly completely consumed. There are industrial abandoned enclaves, urban abandoned settlements in the peri-urban spaces and technological machines. The rural-scape is fragmented and eroded by urban low density dispersion, by greenhouses and by other kinds of hybrid spaces as parking lots, logistic platforms, are underutilized or not utilized areas.

East Naples has an advanced process of abandonment in comparison with other regional territories in Italy. The lifecycle of the urban and environmental system (industry, "blue network", marsh) are largely consumed or in a crucial point of crisis. The planning at the municipal level (P.R.G. 2004) does not focus on the strategies to stimulate new lifecycle for the drosscapes and does not take in consideration the residual rural-scape and the others "in between spaces".

2.2 THE CYCLICAL MARSHES IN THE AREA EAST OF NAPLES

In the Augustus time, the Romans restored the Campania Region creating a large centurial grid. In this territory, at the end of the Empire, the marsh re-appeared. In the 1610 there was the Regi Lagni reclamation by Domenico Fontana. It reduced the importance of the Sebeto river for this region and reduced its character of marsh. The integral reclamation in the second half of the nineteenth century prepared the soils for the industrial settlements that included the reclamation machine inside its structure.

Today the closure of factories caused a new appearance of water on the surface of the ground, like in the time of the marsh. That's why water is a primary key element for a landscape themed design project in the East area of Naples.

The green core of the rural-scape in this part of the region is the object of this research. Waterscape, even if largely underground, is a main project theme, capable of overlap itself on the sectional previsions of the local plan. The project strategy is to re-discover and re-propose the specific moment prior to the crisis of

East Naples historic model: the marsh (1400), the reclamation of the countryside (1890), the industrial city (1966), the “waiting city” (2014).

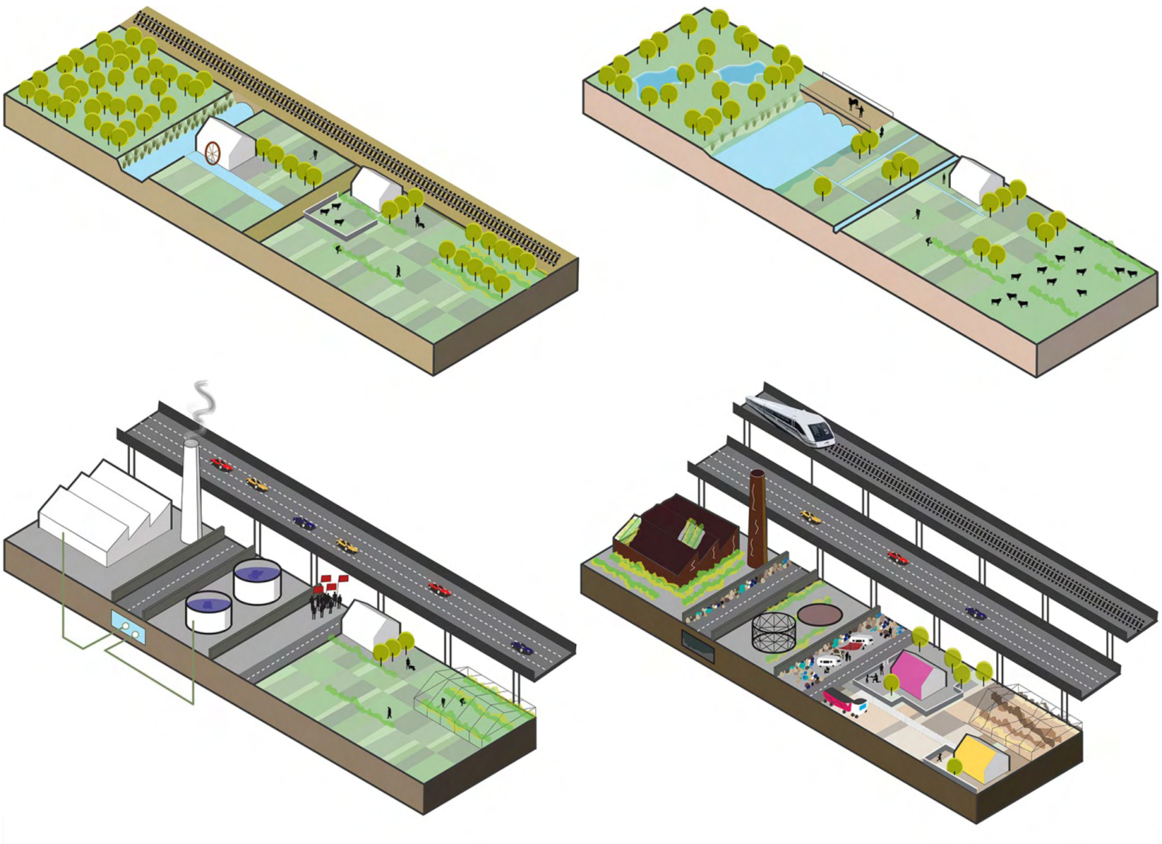

Fig. 2 Retro-active conceptualisation

This is a retro-active conceptualisation and a construction of an *inverse* palimpsest. Instead of *writing*, the idea is to *erode* signs and *erase* the “ground noise” of hybrid landscapes (dispersed settlements, “in between spaces”, rural-urban fringe, etc.), to re-interpret the residual tracks and invisible testimonies, to look for hidden project images.

Time is another main element of the project. Different temporal cycles exist in this region and they are the object of the project: time as a shape and time as a cycle.

Recycle paradigm in East Naples relate to its past lifecycle, following an archaeological perspective, discovering ancient worlds. All these worlds are important for the project and they live together in the same time: the industrial past co-exists with marshes; the residential future is connected to urban agriculture.

The residual rural-scapes, object of the project, are marginal areas ignored by real estate investors. Therefore these kind of spaces are extremely interesting and represent an important economic and ecological resources. These residual spaces, wastes, micro-areas abandoned could be immediately re-used to create a network to connect the urban fabric through temporary uses, re-green canals and creates green way. The project aims to support the re-creation of a “Third Landscape” (Clement 2003) as a biological necessity.

Fig. 3 the rural scape in East Naples

3 CONCLUSION

When both built environment and infrastructures had ceased to be at the core of the urban development, landscape and open spaces values appear to be the only way to give urban and social order to cities. Therefore, landscape is not only a reference, but an actual design key element, showing relevant characters:

- first of all, the liminality, i.e. a uniqueness, a peculiar attitude to transition; no use and no development has to be considered as definitive and immutable, in order to save its dynamism, urban metabolism and social mix;
- secondly, the historical and environmental characteristic, in need to be correctly evaluated: it doesn't mean to slide into indiscriminate preservation, but just to preserve its individuality, through the 3R system;
- finally, the accessibility, its closeness to the city core, whose relationships encompasses various scales, interweaving the local planning with the spatial strategies.

The aim of the research was to identify new strategies to inhabit peri-urban areas regenerating wastes following a resilient strategy, as an opportunity to create new high quality open spaces, green and mineral spaces through recycle techniques. In such a perspective, urban farm land, parks and infrastructures are regarded as potential factors to produce waste recycling to improve open spaces.

In the Italian context, the case of East Naples within the wider case of the Piana Campana could be an interesting laboratory to experiment new challenges, using re-cycle networks as new planning strategies.

NOTES

§ 1 by L. Amenta, A. Attademo and S. Castiello. § 2. by L. Amenta and E. Formato. § 3 by L. Amenta and A. Attademo.

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IMAGES SOURCES

Figg.1, 2, 3, 4: by L. Amenta, S. Castiello, C. Di Marco.

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URBAN LAND USES AND SMART MOBILITY

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ABSTRACT

The object of this work consists of the will to define a renewed relationship between spatial planning and transport systems, which focuses attention on road safety, whereas to date the studies on this relationship have mainly examined the transport impacts on land use. Therefore, in addition to the analysis of the physical characteristics of road infrastructure, there is a need to examine which urban land uses can generate points of risk, both in terms of attraction of vehicles and pedestrian flows as well as in terms of concentration of vulnerable road users, in order to organize a complete information and telecommunication system for road safety.

In short, considering a specific testing ground, some urban land uses have been located, with relative dimensional analysis and characterization of access conditions in typological-functional terms: services (schools, healthcare structures, sports facilities); tertiary/production industry (wholesale, shopping centres, industrial sites); tourism sector (hotels, resorts, historical and cultural heritage).

The collection of information, corresponding to mapping of prospective risk factors, represented the basis for the entry of specific data within a wider reference database.

KEYWORDS

Smart City, Spatial planning, Transport systems

1 NEW TRANSPORT-SPATIAL INTERACTION PARAMETERS

The present research was conducted within the National Operational Programme for research and competitiveness for the convergence regions PON M2M[1] – "Mobile to Mobility Information systems and telecommunications for road safety".

The research programme, highlighting the lack of an analysis and intervention methodology which takes into account all the aspects that influence, or are influenced by accident rates (infrastructure, flow, landscape-environment, anthropy, etc.), aims to provide services based on access to a geo-referenced database, which is interoperable and predisposed to evolve towards new development scenarios, containing cartographic information associated with information on info-mobility and road-safety. The object of the research consists of the desire to define a renewed relationship between spatial planning and transports, which focuses on road-safety in the face of studies, which have mainly regarded the impact of transport in terms of land use and vice-versa.

Specifically, studies on transport-spatial interaction have been produced in North-American countries and were prevalently conducted in urban contexts or on a metropolitan scale. The possibility of extending the aforementioned research to a regional scale with empirical approaches and by means of models which are capable of reproducing the interaction between levels of accessibility and the location of residential and economic activities (Coppola & Nuzzolo, 2006), has been investigated.

Besides this experience, numerous models of microsimulation of spatial and transport use are applied (Wegener & Spiekermann, 1996; Landis & Zhang, 1998; Salomon et al., 2002), as well as complex models which, based on the theory of cellular dynamics (CA), consent the reproduction of the interactions which arise between spatial and transport systems (Batty, 1997; Ferrand, 2000).

Starting from these assumptions, the work develops concentrating on the study of the literature pertaining two cardinal concepts, namely road-safety and quality, in order to better understand the extent to which factors of an urban or architectural type can influence not only the articulation of mobility within specific contexts, but also safety, paying particular attention to the influence of the morphological-urban conformation of the reference context on determined components regarding mobility (traffic, public movement, public safety, movements of residents), as well as the importance of connected factors, for example, the lack of services and hygienic-sanitary conditions of buildings, public streets and spaces, the citizens' quality of life and the orientation of choices.

The starting objective consists of the need to select global urban, environmental and landscape indicators, or rather factors which are believed to be relevant for the evaluation of and the successive planning of choices within the analysis contexts. This is conducted through the acquisition of specific data that is useful for the discovery of their critical and strong points, also with the support of interviews/specific surveys. An objective which is essential in order to create a database of values and indices capable of providing guidelines which useful for: highlighting the parameters which mainly influence road safety and the articulation of mobility, even in proximity to the analysed urban contexts and, therefore the analysis of the selected data in order to generate reflections and possible solutions, highlighting the parameters which mainly influence the citizens' quality of life and their choices, and the analysis of data in order to generate technically sustainable solutions.

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[1] The NOP is part of Action Line I "Support for structural changes" and of Operational objective 4.1.1.1." Scientific technological field generators of industry transformation processes and creators of new sectors" – Action Line II: "Support for innovation". Working group SSD ICAR 20: Research activity supervisor - prof. arch. Mauro Francini; Research grant holder - dott. ing. Annunziata Palermo, dott. ing. Maria Colucci and dott. ing. Myriam Ferrari; Research activity collaborator - dott. ing. Maria Francesca Viapiana.

Some pertinent national and international normatives were analysed to support the aforementioned reflections, in order to compare the Italian dynamics with other European countries.

The main objective indicated within the White Paper (2001) was to "reduce road victims by 50% by 2010". The only countries which met such an objective are Latvia (-55%), Spain (-51%), Portugal - Estonia (-50%). Italy lowered its accident rate by 33%, but still struggles to meet the set parameter.

Directive 2008/96/CE, which regards road safety management, marks new objectives in line with community expectations, highlighting a series of priority aspects to be addressed: improve the impact procedures on road safety; evaluate the possibility of extending the measures to road infrastructures of a different rank; carefully define orientations and guidelines.

From the study of European experiences conducted, the case of the Swedish government resulted as being particularly interesting. In 1997, by means of the *Vision Zero* Project, issued new guidelines in the field of road safety: the meeting of *zero* deaths in a decade; a new ethical approach, which views an accident as an unusual event and views safety as a moral value for society. A new approach which regards the study of the road environment, conceived not only as an infrastructure, but above all as a place of safety.

The spread of these guidelines influenced the research activities of many universities (including the University of Adelaide, the University of York and the University of Lulea), leading to the definition of suitable corrective factors – connected to the properties of the specific reference morphological contexts - in order to obtain a higher level of road safety.

In the specific case of Italy, from a normative viewpoint, it is necessary to highlight some steps, which were defined within the Road Safety National Plan guidelines, defined as a: "an articulated system of directions, of measures for the promotion and inducement of plans and instruments to improve safety levels by the owning and managing bodies, of infrastructural interventions, of measures for prevention and control, of normative and organisational tools, with the aim of improving safety according to community objectives".

The previously mentioned instrument highlights how the factors of *environmental conditions* of a territory – and therefore the type of infrastructure, the morphology, the relationship between a settlement structure and the road network, the properties of collective transport –"determine the number and seriousness of road accidents in a clearly prevalent manner compared to individual behaviours". Such data allows risk factors to be identified and therefore isolated, specifically, those that are called *environmental risk conditions*, stating that they do not regard driver behaviour nor the dynamics of the accident, but the *entire environment within which the accidents occur.*

The parameters which are highlighted in current regulations regard the mobility and evaluation of damage correlated to road accidents (road accident rate, average daily traffic; total entity of social damage), as well as the role of the functional furnishing of the road in the definition of its safety, encompassing a series of variables (from the choice of safety tools to the definition of lighting parameters).

Each of these aspects directly influences the management and maintenance of the road in its entirety, as well as influencing both the accident rate and the risk factor.

However, more specifically, concerning the relationship between road safety and the urban component, only within the regulations of some Northern European countries does the hierarchical classification of roads occur in two phases. The first phase considers the functional category of the road (as in Italy), based on the geometrical properties of the infrastructure, on the type of traffic components and on the relative role played in the spatial context. The second phase takes into account the allowed speed assigned in relation to the presence of particular urban elements (schools, shopping centres, residences, etc.)

Through such settings, it is possible to correlate the functional classification of the road to the urban context in which it is found, thus defining the allowed relative speed.

European Union guidance correlates more frequently the urban component of transport policy, in line with the concept of sustainable urban transport.

On the basis of results obtained through different initiatives and experiments, some fundamental principles were established within the Sustainable Urban Transport Plan, which constitutes the main instrument for the management and control of sustainable actions on mobility; these include: guaranteeing accessibility for different types of users (residents, commuters, pensioners, disabled people); guaranteeing the safety of citizens both in terms of mobility and of health; containing air pollution and increasing the use of clean energy sources, and contributing to the increase of urban quality.

Following a study of the abovementioned literature, the parameters useful in order to widen the transport-spatial interaction were defined. They generally coincide with the different physical properties of the road infrastructure and functional of the accessibility of an area of interest, or rather the presence of urban elements which "incentivise" life quality, which also belong to a "periurban" field. These, in turn, contribute to a variation of the princes of lend and, therefore, the definition of policies and of spatial design. However, most importantly they can play an important role in order to guarantee appropriate road safety standards, in that they are generators of dangerousness points if associated with, for example, a greater attraction of vehicular and pedestrian flow or a particular concentration of weak road users.

To summarise, after having identified the urban uses involved, considering a specific experimentation field, some of them were located, with relative dimensional analysis and characterisation of the access modes (compared to the main viability) in typological and functional terms (services –schools, healthcare structures, sports centres; tertiary/productive sector – wholesale, shopping centres, manufacturing establishments; touristic sector – hotels, resorts, historical-cultural heritage), with the aim of creating a preliminary mapping of the potential risk factors useful for the insertion of specific data within a more extensive reference database (DB).

The studies conducted come under the following operative objectives (OR) and the relative activities of the national operative plan: OR 2 *Study of factors and creation of risk chain* - Activity 2.2 "Contextualisation of risk factors and scenarios in real road settings"; OR 4 *Construction of multi-profile database* - Activity 4.1 "User profiles and associate functional requisites" and Activity 4.2 "Structure of the system and the DB"; OR 9 *Construction of the test site* - Activity 9.1 "Acquisition of the reference test site" and Activity 9.4 "Construction of GIS model and data input"; OR 10 *Experimentation and testing of prototype* - Activity 10.1 "Validation of the Mobile prototype" and Activity 10.2 "Verification of efficiency/usability of the web platform for professional users" (Palermo & Francini, 2013).

2 IDENTIFICATION OF SOME FACTORS OF THE RISK CHAIN

In terms of *contextualisation of risk factors and scenarios in real road settings*, attention was focused on the study of the interactions between urban use and road safety. This was in order to better understand how to use cartographic data in terms of road accident prevention and, consequently, define the relative risk factors and indicators and identify the interest variables to be inserted in the DB.

Many studies of the literature were analysed in order to define the factors and risk indicators, including that from the national Observatory on Italian autonomies for the coordination of communication and making the road network safe – born from an initiative of ANCI (*Associazione Nazionale Comuni italiani*) and UPI (*Unione delle Province d'Italia*) with the support of the Ministry of Infrastructures and Transport.

From the study, it emerges that road accidents seem to depend neither on the demographic dimension, nor on territorial density. Nor do they depend on the rate of motorisation of the cities. Instead, the correlation between the "resident population", "territorial density" and "rate of motorisation" from the study emerges to be approximately zero, even with worthy clarifications.

While the rate of motorisation appears as an independent variable, it is correlated with neither territorial density nor the number of accidents. The geographical dimension resulted as being closely connected to the interpretation of data on the rate of accidents with particular attention to the urban sector.

Moreover, notwithstanding the difficulty of collecting particular links between the characterising elements the city attitude and the number of accidents, it is possible to discover other aspects, such as "urban morphology" and "commuting", which have both positive and negative effects on the urban accident rate, connecting the aforementioned elements.

Concerning urban morphology, starting from the classification of cities based on spatial density levels from Istat, which examines two types of cities; those that are "spread" and those that are "compact", characterised by different spatial structuring which affect mobility and the use of private modes in different ways. It emerges that: at the moment in which public transport cannot cover large territories, identifiable in the definition of "spread cities", the road network is extensive which can favour increased speed of vehicles with a greater risk of accidents. Instead, in "compact cities" extended public transport can cover the various areas of the city with increased efficiency, while the road network is less extensive, discouraging, in theory, vehicle speed with positive effects on the accident rate.

In spread cities, therefore, the number of vehicles is greater than that of compact cities, like the number of accidents, for this data it leads to the hypothesis of a correlation between urban morphology, rate of motorisation and accident rate.

Commuting is a phenomena undergoing rapid growth as people increasingly decide to live outside urban centres but continue to use them as their place of work. This has consequences for mobility and urban congestion, affecting cities with a high rate of attractiveness, since the infrastructures for viability and transport must be able to stand a greater flow of citizens, residents and commuters.

In order to integrated the aforementioned considerations and to complete them in each aspect, attention was concentrated on that indicated within Attachment II – "Road safety controls for infrastructural projects" from the previously mentioned Directive 2008/96/CE, which defines: the criteria to be applied in the preliminary project design phase; the applicable criteria in the detailed project design phase; the applicable criteria in the closing phase; criteria to be applied in the first functioning phase (evaluation of road safety in light of the effective behaviour of users).

Such criteria resulted as being useful in order to articulate, in overall terms, the elements to be considered as a priority for the definition of suitable levels of security.

The specific urban references originate from such general elements which allowed the identification of the potential risk factors representing the information to be inserted as a priority in the reference DB, as well as creating a hierarchy of viability, an analysis of the characteristics pertaining to dimensions and the conservative-functional state and the typological classification of road intersections (roundabouts, crossroads, intersections with traffic lights, etc.), with a dimensional and functional analysis of them (presence and properties of horizontal and vertical road signs, presence of critical structural elements, presence of elements of disturbance, etc.), or rather: the location of urban uses, with relative dimensional analysis of the access modes (compared to main viability) in typological and functional terms: *residence, services* (green public spaces, equipped green public spaces, schools, hospitals, private clinics, car parks, sports centres, etc.), *tertiary* (retail, wholesale, banks, post offices, chemist's, public offices, etc.); *productive sector* (Agricultural, artisanal and industrial activities); *tourist sector* (receiving and tourist

structures); *historical-cultural heritage* (important and/or protected buildings, castles, historical buildings, archaeological areas, etc.); *urban fittings.*
The collection of this information, coinciding with the mapping of potential risk factors, further synthesised in a data collection table, represented the starting base for the structuring of a Spatial Information System suitable for the needs of the M2M project and characterised by a high level of flexibility and openness towards the possible access and integration with existing databases, both geo-referenced and non geo-referenced, with main reference to the competences of the involved territorial bodies (public administrations).

3 GENERAL PARAMETERS OF THE MULTI-PROFILE DATABASE

In order to define appropriate *user profiles and associated functional requisites*, and therefore to render the system one which can be integrated and interoperated. The conducted studies highlight the need to refer to what are known today as new instruments of participation; these instruments, or rather social networks, result as being particularly useful in an active participation logic of the users as they are essentially based on *gaming* logic. More specifically, reference is made to a particular type of social network: *geo-social networks* or *location-based social networks*, which arose from the use of services offered by GIS systems within the social networks. The user, due to these systems, can provide and share information regarding their own geographical position with other network users. In the current case, it results as being useful for the definition of factors, indicators and standards of quality, as well as the control of performance requisites of specific urban functions. Furthermore, it is necessary to highlight how all this is possible, in *real time*, thanks to the use of mobile devices such as smartphones or tablets, equipped with GPS.
Particular attention was paid to the definition of some of the system functional requisites, connected to the delineation of a specific "user profile" potentially characterised by eventual categories of sub-users, for whom dedicated access with suitable privilege levels to specific DB areas must be made available.
All this is essential in order to ensure the supply and management of the service, whilst meeting a high level of personalisation of the system, as well as notable levels of loyalty and maximum satisfaction in its use.
The M2M project operated a first distinction between *professional users, non professional users* and *commercial users.*
Professional users are users who use the M2M platform for work reasons (e.g. road infrastructure management such as EELL, ANAS, Motorways, etc.; Police Forces and those who perform security control or emergency management, Accident and Emergency service management, general management of Insurance companies, etc.).
Non professional users are those who use the M2M platform exclusively for mobility purposes, or rather all those who have smartphone devices with M2M software, who collaborate in the production of data acquired by the platform and extract from it information relative to their mobility choices and with detailed information on road safety strategies.
Commercial users are users whoseM2M platform use is with the aim of offering paid services to share information relative to the selling of services linked to mobility (for example: hotels, restaurants; insurance services; other commercial activities; etc.)
With reference to this classification, attention was focused, within the "professional user" type, identifying a specific sub-category, that relative to local authority technicians (primarily public administrations), that fine themselves managing spatial information directly or indirectly connected to road safety on a daily basis.

For this user-profile, by means of face-to-face investigations, supported by semi-structured questionnaires, it resulted necessary to make dedicated access with suitable levels of privilege available to DB areas for processing sensitive data and that with direct impact on the info-mobility platform management system, in order to determine, codify (both quantitatively and qualitatively) and represent the interconnections between road accidents and the location of particular urban functions.

Concerning the work conducted in relation to *the DB system and structure*, an analysis was conducted that was pertinent to the identification of possible database architectures for the creation of the prototype, examining the hardware and software aspects and evaluating the advantages and limits in terms of cost, complexity and performance of the possible solutions identified.

In this regard, we highlight that from the bibliographic study conducted of the possible DB architectures, *two-tier client-server* and *multi-level client-server* emerged. The *client-server* architectures are organised in tiers, each tier corresponds to a node or group of calculation nodes on which the system is distributed. Each of these functions as the server for the preceding level and as the client for the successive level.

Starting from such suppositions, the specific Activities conducted regarded the design of a system for the archiving of data and for their successive extraction in order to be visualised.

In order to acquire the aforementioned information referring to the context chosen as the location of the test site, two specific data survey forms were structures, which present elements which were successively reflected on in terms both of vertical and horizontal integration as well as the streamlining of redundant information pertaining to the acquisition of data.

The survey forms created refer to two different types: *general form,* relating to the entire reference spatial area for the test site which in turn can be divided into investigation sub-areas, to facilitate data acquisition; *detailed form*, pertaining to each property subject of interest, in which it is possible to better specify valuable information.

4 TEST SITE REFERENCE AREA AND DATA LOADING

The test site reference area is situated in the province of Crotone and refers to a section of the SS 106 highway.

In order to analyse sufficiently, the municipal parameter was used as the preliminary parameter of spatial reading and of the relative urban uses, with specific reference to the Towns of Crotone, Cutro and Isola Capo Rizzuto, which are crossed by the road section being examined.

In the specific case of the Town of Crotone, in which the successive verification of theoretical assumptions was concentrated, situated on the east coast of Calabria, with a surface area of 179.83 km², at 8 m.a.s.l., bordering with: Cutro, Isola Capo Rizzuto, Rocca di Neto, Scandale, and Strongoli. These towns are linked to Crotone by an intense road network based on two main road axis, highway number "Ionica" and highway n. 107 "silana-crotonese". All the other arteries branch off from these two axis.

Cutro, in particular, is connected to the municiapl territory of Crotone by highway n. 106 and municipal road n. 44. The following are present in the borough: a provincial road, n. 43, and a highway, n. 109. Instead, Isola Capo Rizzuto is linked to Crotone by provincial road n. 50. Two other provincial roads are present in the borough (n. 48 and n. 45, which is connected to highway n. 106), as well as numerous municipal roads, the most important of which is n. 60.

Hereafter follows a summary of some captured data for the town of Crotone, which were also preliminarily synthesised by means of cartographic processing and in the aforementioned survey form.

For reasons of simplicity, the data analysis and restitution of the relative results, the municipal territory was divided into two parts: Crotone 1 (to the north); Crotone 2 (to the south).
Before describing the analysis, in order to better understand the typological and functional relation of urban uses with the spatial context, a brief analysis of the entire borough was conducted pertaining to the dimensional characterisation of the most interested viability and the access modes compared to the main viability. From the analysis, it emerges that the Town of Crotone, which is situated on the Ionian sea in at the mouth of the Esaro river and is part of the Authority of the inter-regional basin of the same river, whose southern part is entirely located in the "Capo Rizzuto" marine reserve. The aforementioned two main road arteries, which cover it entirely, and cross it are: from north to south, highway 106 "Ionica", from east to west, highway 107 "silana crotonese".
The two arteries, which play an important role in the viability of the municipal territory, are in fact the fundamental component of the viability of Crotone and permit the Town to communicate with the rest of the region and the nation.
SS106, followed in a southern direction, connects Crotone to Catanzaro (70 Km) and to Reggio Calabria (250 Km). Instead, following the same road in a northern direction, it is possible to arrive in Taranto (240 Km). Highway 106 also consents access to the A3 Salerno -Reggio Calabria motorway, by means of the aid of spur routes situated throughout Calabria. The road, therefore, forms one of the most important accesses to the town, however it does not result as being quite efficient. The dimensions of the road site and the radius of curvature create numerous problems for its users. Moreover, it has a very high accident rate as the road crosses the town and is the site of numerous pedestrian crossings and grade level crossings. Many improvement works have taken place over the years, which regarded a large part of the road, improving journey times. The aforementioned highway 106 is characterised by some extensions, which branch off in the Town of Crotone, acquiring the suffix "Bis".
Instead, highway SS107, if followed in a western direction connects Crotone to Cosenza (100 Km) and Paola (142 Km). This road also provides access to the A3 motorway, representing one of the most important means of crossing of the region. Furthermore, it allows for a rapid crossing of the Sila altiplane and connects the Ionian territory with the Tyrrhenian one, thus favouring the economic development of Crotone, and forms, the same as highway 106, one of the most important access routes to the town, notwithstanding that the user often experiences difficulties due to the lack of maintenance. The accident rate is very high due to the users' lack of care who, when using it, underestimates risks: the road crosses man built up centres, with the presence of grade level crossings (above all foothills).
Two provincial roads are present, SP52 and SP22, which cross the town from west to east and are respectively positioned to the south and north of the town. SS22 provides a connection between SS106 and SS107. The two provincial roads connect the various detached settlements of the town with the urban nucleus. However, even in this case conservation is not optimal due to a rather scarce level of maintenance.
The rest of the viability comprises of local roads of different dimensions. These roads branch off throughout the entire town territory, transforming into travelable mule tracks where it becomes more impervious, or rather in the west where it is in the vicinity of the Sila altiplane. Instead, the roads near the sea or the urban nucleus in the majority of cases connect to SS106.
With regards to urban uses, from the conducted analysis it emerges that the area identified as Crotone 1 is affected by limited elements representing services, the tertiary sector, the productive sector, the tourism sector and historical-cultural heritage. The *services* are characterised by the presence of a middle school (VII circle of Crotone), positioned in the area of Papanice; two parking areas (the first near Crotone train station, whose users are mainly commuters, the second situated along SS106 in correspondence with its intersection

with SS107, now decaying and practically totally unused); reduced space reserved for public parks, mainly concentrated to the north of the urban nucleus, near the coast, which is not entirely equipped; two sports centres which are situated quite close together, on the right bank of the Neto river and characterised by a discrete level of maintenance. Among the most interesting *public offices* present in the zone are: the Public Prosecutor of Crotone's Office; the Province of Crotone, INPDAP and the Tax Office (Agenzia delle entrate). A *Poste Italiane* sorting office is also present, which serves as a depot for vehicles and as a switchboard. Referring to the *tertiary sector*, there is a chemist's, a bank, and three limited companies, two of which are situated within the industrial area. In the industrial area, there has been a disappearance of the activities connected to it which occurred during the crisis which seriously affected this territory (taking "Pertusola Sud" as an example). Today, each *productive sector* (primary, secondary and tertiary) is characterised by different Activities mainly regarding the production of wine, the harvesting and pressing of olives, the production, even international, of hydrogen and oxygen, the rubbish disposal, with the presence of a zone for the collection of solid urban waste in the area of Papanice. Near the station, there is also a port terminal. The *receptive structures* consist of the presence of two Bed & Breakfasts, while the *places of worship,* which in part characterise the historical-cultural heritage, we recall the Parish of S.S. Isidoro contadino and the Parish of S.S. Salvatore.

From the analysis conducted in the area identified as Crotone 2, it emerges that, in reference to urban uses within the *services* category, numerous schools are present, the San Giovanni Dio hospital with more 300 beds, as well as four private clinics and several sports centres, all located and catalogued in detail. Instead, the *tertiary sector*, is represented by the presence of multiple credit institutes and numerous post offices, of which there are seven branches. There are also many pharmacies and the activities dedicated to retail in various reference sectors, with more than one hundred retail shops and restaurants. Finally, the *tourist sector*, is characterised by the presence of various hotels and seaside structures, which are also located and catalogued in detail.

In reference to the *Construction of the GIS model and relative dataloading,* with a view to integrating the collected information and above all in order to use the arranged cartographic data in terms of road accident prevention, as well as acquiring data, two preeminent directions were followed: control of correct data transfer, without losing information, but means of the arranging of an adequate implementation methodology useful for developing the programme properties, as well as its specific functions; explication of the interest variables to be inserted within the DB, in correlation with the defined risk factors and indicators.

Precisely in reference to the construction of the GIS model and the relative loading of data, work was conducted in order to insert data found for the town of Crotone in the reference GIS model, following studies conducted in terms of comparison of the alignment method and the manual method, from which it emerged that the alignment method [2] resulted as being more appropriate as it also permitted the

[2] The method of alignment is characterised by the following phases: loading of aerial photographs (this step occurs exploiting georeferenced aerial photographs in ecw format pertaining to a flight made in 2000, with Gauss – Boaga, Monte Mario Italy 2reference geographical coordinates); assigning of a system of Gauss-Boaga, Monte Mario Italy 2 geographical coordinates, to the dwg tables, setting the coordinates for some known points (such a step resulted as being necessary prior to data processing, since at the basis of loading data on a GIS system it is necessary to set a system of uniform geographical coordinates); overlapping of aerial photos with the dwg files; transformation of the product in shape file; product verification. The manual method initially thought of and described as an exclusive solution for the use of Quantum GIS 1.8.0 open source software. From a comparison with the analytical method, it resulted as being inappropriate, above all in terms of time necessary to reproduce the tables, which had already been processed and presented in dwg format, substantially conducting a new structuring of the same.

improvement of a series of information compared to that obtained using the graphic method (e.g. known point coordinates).
The procedure used a series of steps that are structured inserting a mixed procedure, which uses two methods: a graphic method and an analysis method.
In conclusion, with a view to integrating the collected information and above all in order to use the prepared cartographic data, also in terms of road accident prevention, work was therefore conducted in terms of verifying the correct transfer of data, without risking the possible loss of information, by means of the predisposal of an appropriate implementation methodology, useful in developing the programme properties, as well as some of its specific functions, in terms of explication of interest variables to be inserted in the DB in correlation with the defined risk indicators and factors.

5 INTEGRATION OF SPECIFIC DATE IN ORDER TO EXPERIMENT AND TEST THE GENERAL PROTOTYPE

In order to pursue the research objective, at this point, as already stated, since the studies on this subject belong to the theme of urban and spatial planning associated to that of road safety, starting from the formulation of the initial hypothesis according to which urban uses can generate points of dangerousness, in that they are connected, for example, to a greater attraction of vehicular and pedestrian flow and/or a particular concentration of weak road users (children, pensioners, disabled people), the following categories of urban uses were defined which were useful for the general aims of the programme: services; tertiary/manufacturing sector; tourism sector.
The initial subdivision presented other analysis categories, in terms of location of uses, as previously indicated, with relative dimensional analysis and characterisation of access modes (compared to the main viability) in incorporated typological and functional terms; subdivision which was synthesised in a last analysis of the three aforementioned reference categories.
Successive to data loading, the interrogation criteria, which are summarised in the following table, were defined through location controls.
The interrogation criteria refer to: *relative distance* (variable on variation of urban use in connection to its level of dangerousness in terms of proximity to the investigated section and to the possible exploitation of the same use by weak users); *distance from the notable point* (which sums the previously chosen interrogation buffer value, 250 m, to the relative distance); *concentration level* (variable, in terms of range, for each use category, based on a first control interrogation on the effective presence of a maximum value of concentration of the urban use category in the reference buffer).
In relation to the definition of the starting ranges, the minimum assigned value is equal to 1 in that it is intrinsic to the definition of dangerousness, therefore a starting value of 0 would have no significance.
Following the normalisation of values and the definition of the reference range of the Urban Dangerousness Index (UDI) (as indicated above in the analytical representation), the values in percentages of γ coherent with the general formulation of the M2M project were identified.
In terms of validation of the Mobile prototype, as well as the successive verification of the efficiency and usability of the web platform for professional users, it therefore arises that each urban use characterises, in terms of relevance of dangerousness, a similar weight as the differentiation criteria are connected, both to the relative distances and the effective concentration level of some categories compared to others that, according to the definition in literature of each single urban use, will result as generally having an almost constant proportional relationship, even referring to a different analysis site.

To this purpose, it should be remembered that the destination field can be deduced from multilevel OSM, applications, which are adaptable on a global level (Crotone is only a reference adopted for the test site).
The location and interrogation verifications of the GIS M2M model are summarised hereafter by means of explicative screenshots pertaining to the properties of the aforementioned urban use categories (selection elements, which are interconnected).

URBAN LAND USES	RELATIVE DISTANCE (m)			DISTANCE FROM THE NOTABLE POINT (m)			CONCENTRATION LEVEL		
	d1	d2	d3	D1	D2	D3	Basso	Medio	Alto
Services	125	250	500	375	500	750	1-2	3-4	>=5
Tertiary/manufacturing sector	250	500	1000	500	750	1250	1-9	10-19	>=20
Tourism sector	200	400	800	450	650	1050	1-5	6-10	>=10
yi							0,25	0,5	1
βi				1	0,5	0,25			

IPU=Σyi * βi	IPU		γ	IPT= IP + γ*IP
	0<IPU<0,3	Basso	10	
	0,3<IPU<0,6	Medio	20	
	0,6<IPU<1	Alto	30	

Tab.1 characterisation factors of the urban dangerousness index

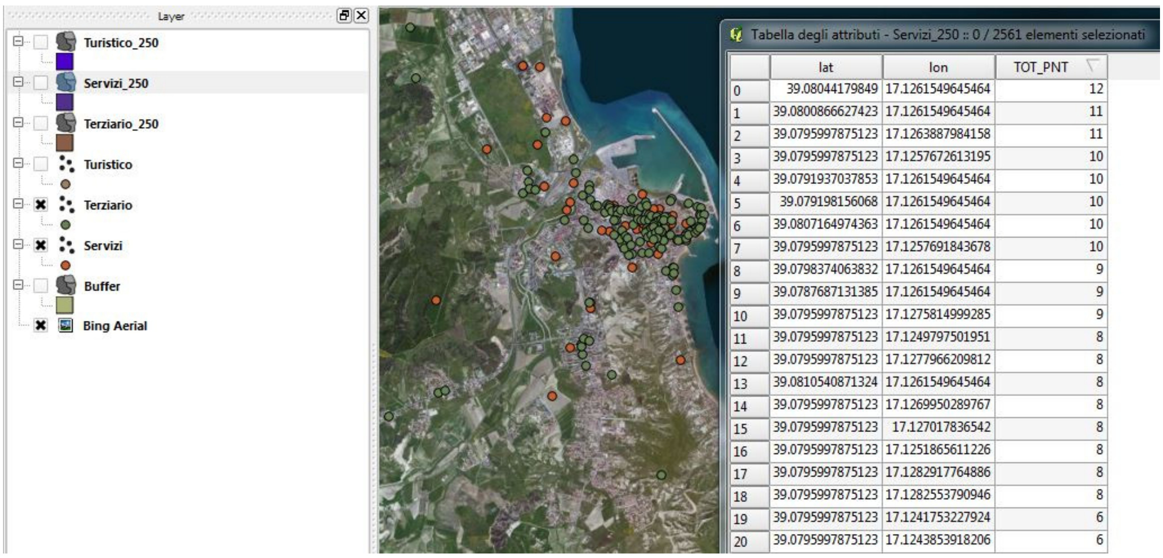

Fig. 1 location and interrogation verifications

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IMAGES SOURCES

Fig. 1: National Operational Programme for research and competitiveness for the convergence regions PON M2M.

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THE DESIGN OF SIGNALISED INTERSECTIONS AT AREA LEVEL

MODELS AND METHODS

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ABSTRACT

In this paper the results of the PRIN research project named "Guidelines for the urban transportation network analysis and design: methods and models for designing at area level the signalised intersections" are summarised. In the research project, several problems of signal settings optimisation at area level were studied and some methods and model for optimising the signal setting parameters were proposed. All proposed methods were tested on a real-scale case: the road network of Benevento. The results of the research showed that the proposed methods are able to solve the problem in acceptable computing times also on real-scale networks.

KEYWORDS

Network optimisation, Arterial coordination, Traffic-lights, Road traffic

1 INTRODUCTION

A city can be defined a Smart City if ICT and transport infrastructures are conceived and designed so to ensure a sustainable development and a high level of quality of life. The smart mobility is an important dimension of the Smart City, since in urban areas the economics and environmental impacts of the mobility (of people and goods) are very significant. In this context, the design of traffic-lights at area level is an "action" very useful in order to contribute to the smart mobility. Indeed, in congested urban networks a major part of total travel time is spent at intersections and a correct design of them can reduce significantly the total travel time and the (GHG and pollutants) emissions.

The signal settings are usually optimised for an intersection independently of others (isolated intersection) but better results can be obtained optimising signal setting parameters at area level.

In the literature, several techniques and models have been developed for optimising signal settings, and three main problems have emerged: (a) single junction optimisation; (b) arterial optimisation/coordination; (c) multiple junction optimisation (signal network control). Problem (a) regards the isolated junction while problems (b) and (c) regard the optimisation at the area level.

In this paper, we summarise the results obtained during the development of a PRIN (National Relevance Research Project) research project funded by the MIUR (Italian Ministry of Schools and Universities) where the design of signalised intersections at area level have been studied.

In the literature, the arterial optimisation/coordination problem was widely studied. Some important books (ITE, 2009; Roess et al., 2010) report the main solution methods and approaches. Of the many papers, books, handbooks and software programs that have been proposed, some tackle the problem using simulation-based models, while others propose to use analytical models. Examples of simulation-based models are TRANSYT-7F (Robertson, 1968; Wallace et al., 1988) and SIGOP III (Liebermann et al., 1983) while analytical models have been proposed by Gartner et al. (1975) and Liu and Chang (2011). Other papers tackle the bandwidth maximisation problem (Morgan and Little, 1964; Little, 1966; Inose and Amada, 1975) that arises when the coordination regards both directions of the arterial. This problem was studied amongst others by Little et al. (1981), Gartner et al. (1991), Stamadiatis and Gartner (1996), and Papola and Fusco (1998).

The multiple junction optimisation problem can be seen as a particular case of the more general *Equilibrium Network Design Problem* (ENDP), where signal settings assume the role of decision variables; this problem is also known as the *Signal Setting Design Problem* (SSDP) and for solving it two different approaches can be identified (Cascetta et al., 2006): a global approach and a local approach. In the first case, the problem is actually an ENDP, formulated with a (non-linear constrained) optimisation model, and is also known as *Global Optimisation of Signal Settings* (GOSS). In the second case, instead, it is assumed that the signal settings of each junction are designed so as to minimise only the total delay at the same junction according to a specific local control policy. This problem is known also as *Local Optimisation of Signal Settings* (LOSS) and is the focus of this paper. The general problem was studied by Marcotte (1983), Fisk (1984), Cantarella et al. (1991), Cantarella and Sforza (1995), and Cascetta et al. (1999, 2006).

The LOSS problem can be formulated as a fixed/point problem and was studied, amongst others, by Allsop (1977), Smith (1979), Dafermos (1980), Fisk and Nguyen (1982), Florian and Spiess (1982), Gartner (1983), Meneguzzer (1995), Cantarella and Improta (1991), Smith and Van Vuren (1993), Al-Malik and Gartner (1995), Cascetta et al. (1999, 2006), and D'Acierno et al. (2012).

The GOSS problem can be formulated, instead, as a (non-linear) constrained optimisation problem where signal settings assume the role of decision variables and was studied, amongst others, by Sheffi and Powell

(1983), Yang and Yagar (1995), Heydecker (1996), Chiou (1999), Wey (2000), Ziyou and Yifan (2002) and Cascetta et al. (2006).

In this paper, summarising the results obtained during the PRIN research project, we focus on three problems:

1. optimisation of signal settings of two-way coordinated arterials;
2. local optimisation of signal settings problem, known also as "combined assignment-control problem";
3. global optimisation of signal settings.

For all problems, mathematical models will be formulated and solution algorithms will be proposed and tested on a real-scale network.

2 TWO-WAY COORDINATED ARTERIALS

Coordinating the signal settings of an arterial is a control strategy to minimise travel delays on a main road with multiple consecutive intersections. The solution of the single arterial coordination problem is simple if the arterial is one-way: in this case optimal green offsets can be calculated according to distance between intersections and average flow speed, always obtaining the ideal coordination corresponding to the maximum bandwidth (defined as the time interval during which the vehicles are able to travel on the road without any stops at intersections). The same problem is more complex for two-way arterials where the problem is usually approached as one of bandwidth maximisation. However, the latter does not ensure minimum total delay (or total travel time) on the network.

In this section we study the problem of coordinating two-way signalised arterials with a view to minimising total delay, using a microsimulation approach to explore the solution set. In the following we summarise the results reported in D'Acierno et al. (2013), paper produced during the development of the PRIN research project.

2.1 MODEL FORMULATION AND SOLUTION ALGORITHM

We consider a two-way arterial where all intersections are signalised; we assume that the cycle time, C, and the effective green times, g_c and g_{nc}, are calculated as a function of known traffic flows (subscripts c and nc refer respectively to the coordinated and non-coordinated phase), for instance with the well-known Webster (1958) method. The objective is to optimise the total delay on the arterial, td, that is the sum of the delays at all approaches to the arterial's junctions. Obviously, the total delay depends on the offsets of the junction, $\boldsymbol{q}$. The total delay is calculated by a microsimulation model.

The optimisation model can be formulated as follows:

$$\boldsymbol{q}^* = \text{Arg}_{\boldsymbol{q}} \min \ td(\boldsymbol{q})$$
$$\text{s.t.:}$$
$$\mathbf{0} \leq \boldsymbol{q} < \boldsymbol{C}$$
$$td\,(\boldsymbol{q}) = MS\,(\boldsymbol{q})$$

where $\boldsymbol{q}$ is the vector of the offsets; $\boldsymbol{q}^*$ is the optimal value for q; $\mathbf{0}$ is the zero vector (a vector with the same dimension of the q vector with all components equal to 0); $\boldsymbol{C}$ is the cycle vector (a vector with the same dimension of the q vector with all components equal to C); $MS(\boldsymbol{q})$ indicates the microsimulation model that is able to estimate the total delay as a function of the offsets.

This is a constrained non-linear optimisation model requiring a microsimulation model to be set up to estimate the value of the objective function; in order to solve it, D'Acierno et al. (2013) proposed and tested two versions of a multi-start Neighbourhood Search (NS) algorithm. The two versions were different according to two different approaches for generating the next solution in the NS algorithm: the *Steepest Descent Method* (SDM) and the *Random Descent Method* (RDM). The necessity of a multi-start procedure is due to the non-convexity of the objective function. For the details about algorithms, refer to the previously quoted paper.

2.2 NUMERICAL RESULTS

The proposed model and algorithm were tested on a real case, namely an arterial in the urban network of Benevento (Italy); Figure 1 reports the arterial and the traffic flows. In this case, we have only two decision variables that are the offsets q_1 and q_2, assuming that the offset of the first intersection is equal to 0. We considered three starting solutions: Solution 0, where the offsets are all equal to 0; Solution A, where the offsets are designed so to be optimal in one of the direction; Solution B, where the offsets are designed so to be optimal in the other direction. Moreover, we performed an exhaustive search, in order to verify the goodness of the results, assuming a discrete step equal to 5 s. In Figure 2(a), the shape of the objective function is reported and in Figure 2(b) the steps of the multi-start neighbourhood serach.

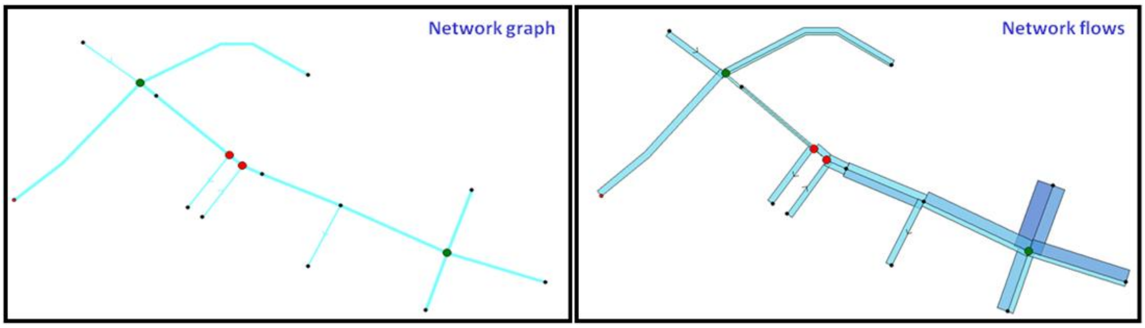

Fig. 1 Two-way coordinated arterial test case

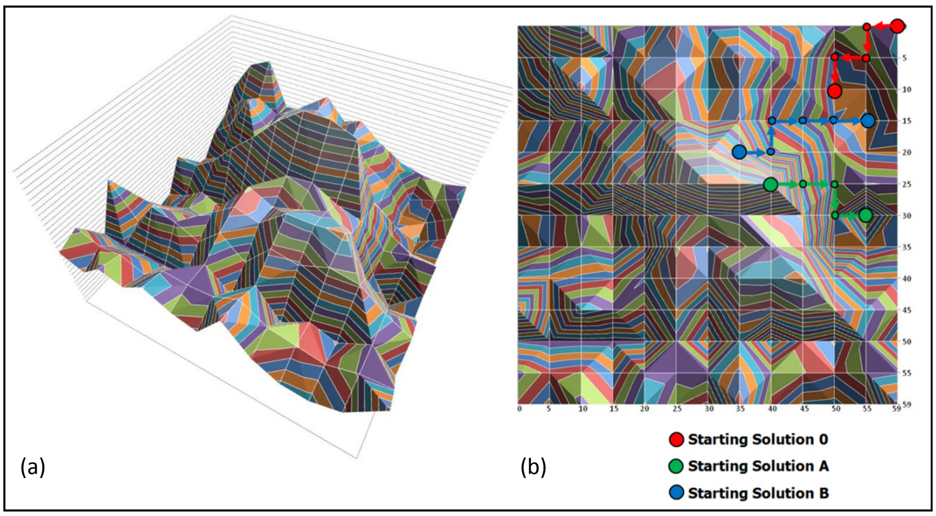

Fig. 2 The shape of the objective function (a) and the steps of the algorithm (b)

On examining the exhaustive search it can be noted that the best solution obtained by the multi-start neighbourhood search method is also the global optimum (Starting solution A). Moreover, the three local optimal solutions have similar values of q_1 (in two cases the value is the same).

An exhaustive search is possible in this particular test case since we have only two offsets to design. In longer arterials where there may be up to 8-10 offsets to design, an exhaustive search is not possible with acceptable computing times. However, the proposed multi-start neighbourhood search is able to produce some local optima with acceptable computing times.

3 LOCAL OPTIMISATION OF SIGNAL SETTINGS

The *Local Optimisation of Signal Settings* (LOSS) problem arises when signal control parameters of an urban road network are locally optimised and have to be consistent with equilibrium traffic flows. This problem can be formulated with an (asymmetric) equilibrium assignment model.

In the following, we summarise the results reported in Gallo et al. (2013), paper produced during the development of the PRIN research project. In particular, we study the LOSS problem, examining the model formulation, proposing some solution algorithms and testing them on a real-scale case.

3.1 MODEL FORMULATION AND SOLUTION ALGORITHMS

For solving the LOSS problem, the following fixed-point mathematical model can be formulated (see also Cascetta et al., 2006):

$$\boldsymbol{f}^* = \boldsymbol{f}(\boldsymbol{c}(\boldsymbol{f}^*, \boldsymbol{g}(\boldsymbol{f}^*)))$$

where $\boldsymbol{f}$ is the link flow vector; $\boldsymbol{f}^*$ is the equilibrium link flow vector; $\boldsymbol{c}$ is the link cost vector and $\boldsymbol{c}(.)$ the vector of link cost functions; $\boldsymbol{g}$ is the vector of signal settings; $\boldsymbol{g}(\boldsymbol{f}^*)$ is the local control policy (for instance, Webster, 1958).

In terms of theoretical properties, the link cost functions are non-separable, since at each intersection the cost of a link depends on the flows of all concurring links (the control policy recalculates signal settings as a function of all flows at the intersection). Therefore, the Jacobian is not positive definite and the uniqueness of the fixed-point solution cannot be stated (Charlesworth, 1977, showed that more than one equilibrium solution can be found). Instead, the existence of a solution is ensured by the continuity of the functions (a condition that is satisfied for stochastic route choice models, continuous cost-flow functions and continuous local control policy functions).

In order to solve the problem, we propose three algorithms based on an MSA framework (Powell and Sheffi, 1982; Sheffi and Powell, 1982). The MSA (Method of Successive Averages) is widely used for solving traffic assignment problems. For solving the traffic assignment problem three MSA algorithms are available: the MSA-FA (Flow Averaging), which is the original version proposed by Sheffi and Powell (1982); the MSA-CA (Cost Averaging), which was proposed by Cantarella (1997); and, the MSA-ACO (Ant Colony Optimisation), which was proposed by D'Acierno et al. (2006). For the details about algorithms, refer to Gallo et al. (2013).

3.2 NUMERICAL RESULTS

The model and algorithms were tested on the urban network of Benevento, a town in the south of Italy with about 61,000 inhabitants. The transportation model (demand and supply) was built during the design of the Urban Traffic Plan of the town. The network graph has 1,577 oriented links, which represents about 216 kms of roads, and 678 nodes. The zoning of the study area is very dense, with 66 internal zones; the cordon sections are 14, so the total centroids are 80 (66 internal and 14 external). Figure 3 shows the graph of the network: different colours for links and nodes indicate different kinds of roads and intersections.

In order to test and compare the algorithms, we generate 35 different scenarios, considering seven different demand levels (ODXX) and five different supply models (SIGXX), increasing the number of signalised intersections.

The three algorithms, MSA-FA, MSA-CA and MSA-ACO, were implemented in Visual Basic code and all tests were conducted using a PC Intel Core i7-2600 (3.40 GHz).

The three algorithms were tested for all 35 scenarios; Table 1 reports the number of iterations and the corresponding computing times. The comparison shows that MSA-ACO and MSA-CA algorithms perform better than MSA-FA for almost all scenarios. Between MSA-ACO and MSA-CA the differences are less substantial, although MSA-ACO seems to work slightly better. The differences between algorithms are very significant when the demand is high (OD18 and, above all, OD20) and when the signalised intersections are numerous. In three scenarios, MSA-FA algorithm does not converge in acceptable computing times: the algorithm is stopped after 100,000 iterations but the convergence test always tends to decrease.

Figure 4 shows the convergence of the algorithms in the scenario SIG48-OD20; in the diagrams only the first 200 iterations are represented.

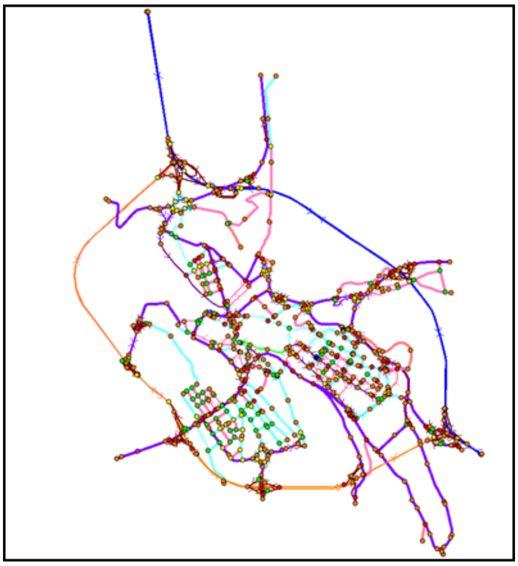

Fig. 3 The graph of the road network of Benevento

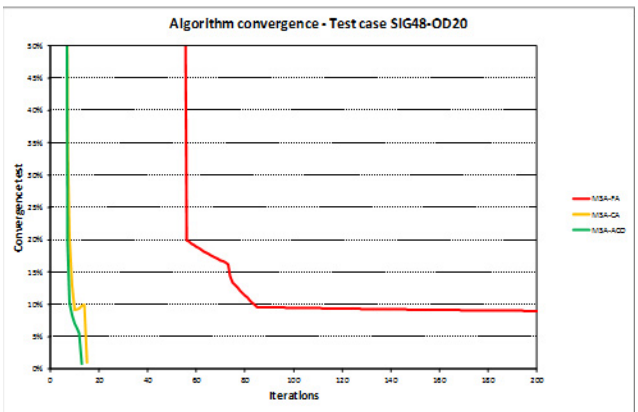

Fig. 4 Convergence of algorithms for the scenario SIG48-OD20

Assuming total travel time as a performance index of the network, we compare, for all 35 scenarios, the solutions obtained by solving the combined assignment-control problem with the solution that can be obtained by applying the local control policy without updating flows and signal settings until convergence. In Table 2 the total travel times on the network are compared; we report only the results obtained with MSA-CA algorithms, since the results obtained with the other MSA algorithms are similar (a slight difference in total travel times is produced by the approximation due to the stop threshold but the final solutions are in practice the same). The results (see Table 2) show that great advantages of applying the methodology are obtained when the network is very congested and the signalised intersections are numerous; in this case, travel time reduction may be as much as 17 %.

					Iterations			
		OD08	OD10	OD12	OD14	OD16	OD18	OD20
MSA-FA	SIG08	7	16	31	49	51	110	62
	SIG18	7	16	32	49	51	131	59
	SIG28	7	12	28	46	49	137	>100,000
	SIG38	6	9	28	46	50	137	>100,000
	SIG48	6	9	28	45	50	83	>100,000
MSA-CA	SIG08	7	8	7	9	11	14	15
	SIG18	7	8	8	9	11	14	15
	SIG28	7	8	8	9	9	10	13
	SIG38	7	7	7	9	11	10	13
	SIG48	7	7	7	9	11	10	15
MSA-ACO	SIG08	4	7	12	11	8	14	13
	SIG18	4	7	12	16	7	15	12
	SIG28	5	7	12	16	11	10	10
	SIG38	5	7	8	9	8	9	10
	SIG48	5	7	8	14	8	14	13
					Computing times (s)			
		OD08	OD10	OD12	OD14	OD16	OD18	OD20
MSA-FA	SIG08	12	25	47	72	94	160	87
	SIG18	11	25	48	73	95	191	84
	SIG28	13	19	42	68	91	209	>150,000
	SIG38	14	15	42	68	92	199	>150,000
	SIG48	13	15	42	67	91	121	>150,000
MSA-CA	SIG08	11	13	12	14	23	23	23
	SIG18	12	13	13	15	22	22	23
	SIG28	12	14	14	15	19	16	20
	SIG38	16	12	12	15	25	17	21
	SIG48	15	12	12	15	22	17	23
MSA-ACO	SIG08	8	13	19	18	13	22	20
	SIG18	8	14	19	25	11	24	19
	SIG28	9	12	19	24	17	16	16
	SIG38	9	12	13	15	13	14	6
	SIG48	9	13	14	21	13	21	21

Tab.1 Comparison among MSA-FA, MSA-CA and MSA-ACO in terms of iterations and computing times

					Total travel time of starting solution (minutes)			
		OD08	OD10	OD12	OD14	OD16	OD18	OD20
MSA-CA	SIG08	110,456	158,614	248,457	410,218	662,313	1,023,507	1,521,819
	SIG18	109,412	156,502	242,116	395,744	638,237	984,243	1,468,881
	SIG28	109,412	148,394	226,692	366,471	591,821	919,602	1,385,807
	SIG38	105,518	148,959	228,788	369,840	593,438	915,727	1,377,422
	SIG48	104,681	147,794	226,061	363,210	585,764	907,879	1,362,882
					Total travel time of final solution (minutes)			
		OD08	OD10	OD12	OD14	OD16	OD18	OD20
MSA-CA	SIG08	109,968	152,151	224,507	354,985	567,568	876,225	1,301,436
	SIG18	108,943	150,127	219,523	342,824	545,542	838,175	1,247,938
	SIG28	108,943	144,309	206,360	320,056	510,916	790,713	1,189,227
	SIG38	105,517	144,180	206,678	318,313	502,405	770,677	1,159,057
	SIG48	104,707	143,153	204,220	312,260	492,506	755,738	1,134,521
					Percentage variation			
		OD08	OD10	OD12	OD14	OD16	OD18	OD20
MSA-CA	SIG08	-0.4%	-4.1%	-9.6%	-13.5%	-14.3%	-14.4%	-14.5%
	SIG18	-0.4%	-4.1%	-9.3%	-13.4%	-14.5%	-14.8%	-15.0%
	SIG28	-0.4%	-2.8%	-9.0%	-12.7%	-13.7%	-14.0%	-14.2%
	SIG38	0.0%	-3.2%	-9.7%	-13.9%	-15.3%	-15.8%	-15.9%
	SIG48	0.0%	-3.1%	-9.7%	-14.0%	-15.9%	-16.8%	-16.8%

Tab.2 Comparison among starting and final solution in terms of total travel times

4 GLOBAL OPTIMISATION OF SIGNAL SETTINGS

The GOSS problem arises when the parameters of all (or some) signalised intersections of a network are jointly optimised so as to minimise the value of an objective function (such as total travel time). This problem can be formulated with a non-linear constrained optimisation model.

In the following, we summarise the results reported in Gallo et al. (2014), paper produced during the development of the PRIN research project. In particular, we study the GOSS problem, examining the model formulation, proposing some solution algorithms and testing them on a real-scale case.

4.1 MODEL FORMULATION AND SOLUTION ALGORITHMS

For solving the GOSS problem we formulate the following optimisation mathematical model:

$$\boldsymbol{g}^{\wedge} = \text{Arg}_{\boldsymbol{g}} \min \, [\boldsymbol{c}(\boldsymbol{g}, \boldsymbol{f^*})]^{\mathrm{T}} \, \boldsymbol{f^*}$$

with:

$$\boldsymbol{g}^{\mathrm{T}} = [g_1^A, g_2^A, \ldots, g_i^A, \ldots, g_n^A]$$

subject to:

$$\boldsymbol{f^*} = \Delta \, \boldsymbol{P}(\Delta^{\mathrm{T}} \boldsymbol{c}(\boldsymbol{g}, \boldsymbol{f^*})) \, \boldsymbol{d}$$

$$g_{min} \leq g_i^A \leq C_i - g_{min} \qquad \forall \, i$$

$$g_i^B = C_i - g_i^A \qquad \forall \, i$$

where $\boldsymbol{g}$ is the signal settings vector; $\boldsymbol{f}$ is the link flow vector; $\boldsymbol{g}^{\wedge}$ is the optimal solution; $\boldsymbol{f}^*$ represents the equilibrium link flow vector (obtained by solving an equilibrium assignment problem on the network); $\boldsymbol{c}(.)$ is the link cost vector; $\boldsymbol{P}(.)$ is the route choice probability matrix; Δ is the link-route incidence matrix; $\boldsymbol{d}$ is the demand vector; g_{min} is the minimum value of effective greens (for instance 15 seconds).

In this formulation of the problem we assume that the cycle lengths are not considered decision variables and all signalised intersections have only two phases; these assumptions allow the number of decision variables to be reduced to one for each signalised intersection.

For solving the optimisation problem we propose to use a multi-start method based on a *Feasible Descent Direction Algorithm* (*FDDA*), as well the *Neighbourhood Search* (NS) cited in Section 2.1; also in this case both approaches based on steepest descent (SDM) and random descent (RDM) methods were adopted. The multi-start approach is necessary since the objective function is not convex, except for simple cases, and looking for more local optimal solutions can improve the final results, even if it requires higher computing times. In particular, in the proposed algorithm we will assume that decision variables (i.e. $\boldsymbol{g}$) are discrete and express the duration in seconds of the effective green times. For the details about algorithms, refer to Gallo et al. (2014).

4.2 NUMERICAL RESULTS

The proposed algorithms were tested on the urban network of Benevento (for details see Section 3.2). We tested the considering the following starting points: (a) all variables g_i^A equal to 50% of the cycle; (b) all variables g_i^A equal to g_{min}; (c) all variables g_i^A equal to $C_i - g_{min}$; (d) all variables g_i^A equal to g_i^A*, where g_i^A* represents the solution of the LOSS problem; (e) random values for all variables g_i^A.

Initial tests were implemented to compare the SDM approach with that of the RDM, by applying all assignment algorithms in the case of the starting point (a). The results summarised in Table 3 show that the RDM almost always requires less computational effort both in terms of calculation times and algorithmic steps. In Table 4 are reported the results obtained adopting the multi-start approach with the RDM approach. The results show the applicability of the proposed methods also on real-scale networks with acceptable computing times.

FDDA approach	Assignment algorithm	Decision variables g_1	g_2	g_3	g_4	g_5	g_6	g_7	g_8	g_9	Optimal objective function value	Algorithm Iterations (AIs)	UNLs	UNLs/AIs	Calculation times [min.]
Initial values: starting point (a)		45	45	45	45	45	45	45	45	45					
SDM	MSA-FA-F0	55	47	55	65	52	58	53	43	45	2863.078	297	10870	36.599	145.62
	MSA-FA-UE	55	45	55	65	50	58	53	43	45	2862.182	299	638	2.134	8.85
	MSA-CA-F0	55	47	55	65	52	58	53	43	45	2864.588	297	2079	7.000	26.30
	MSA-CA-UE	55	49	55	66	50	58	55	42	45	2862.212	282	574	2.035	7.96
	MSA-ACO-F0	55	47	55	65	52	58	53	43	45	2859.963	297	2079	7.000	27.90
	MSA-ACO-UE	45	45	45	45	45	45	45	45	45	2868.986	19	43	2.263	0.61
RDM	MSA-FA-F0	55	47	55	65	51	58	53	43	45	2863.071	290	10668	36.786	133.29
	MSA-FA-UE	55	47	55	65	51	58	53	42	45	2862.165	428	919	2.147	12.31
	MSA-CA-F0	55	47	55	65	51	58	53	43	45	2864.581	232	1624	7.000	21.50
	MSA-CA-UE	51	45	56	65	49	58	49	45	45	2862.216	232	483	2.082	6.53
	MSA-ACO-F0	55	47	55	65	51	58	53	43	45	2859.956	354	2478	7.000	31.29
	MSA-ACO-UE	55	47	55	65	51	58	53	43	45	2862.164	417	854	2.048	10.93

Tab.3 Comparison between SDM and RDM approaches

	Decisional variables g_1	g_2	g_3	g_4	g_5	g_6	g_7	g_8	g_9	Optimal objective function value	Algorithm Iterations (AIs)	UNLs	UNLs/AIs	Calculation times [min.]
Initial values: starting p. (b)	15	15	15	15	15	15	15	15	15					
Algorithm implementation	54	48	55	65	51	58	53	42	45	2862.163	446	1344	3.013	17.58
Initial values: starting p. (c)	75	75	75	75	75	75	75	75	75					
Algorithm implementation	55	47	55	65	51	58	53	42	45	2862.164	578	1211	2.095	15.02
Initial values: starting p. (d)	59	51	50	69	53	59	58	40	59					
Algorithm implementation	56	49	51	66	49	60	56	41	55	2862.165	287	942	3.282	11.57
Initial values #1: starting p. (e)	56	65	54	34	62	44	55	39	73					
Algorithm implementation	56	45	55	65	52	58	53	44	45	2862.180	287	600	2.091	7.87
Initial values #2: starting p. (e)	48	37	36	65	27	16	57	68	35					
Algorithm implementation	54	47	56	65	51	58	53	44	45	2862.157	270	567	2.100	7.44
Initial values #3: starting p. (e)	21	18	46	25	55	38	73	51	24					
Algorithm implementation	56	46	55	65	51	58	53	43	45	2862.158	566	1234	2.180	16.19
Initial values #4: starting p. (e)	28	49	73	61	65	65	50	40	19					
Algorithm implementation	56	47	55	65	50	58	55	43	46	2862.175	309	680	2.201	8.93
Initial values #5: starting p. (e)	44	34	27	49	52	40	44	37	52					
Algorithm implementation	56	47	55	65	51	58	53	43	47	2862.168	559	1154	2.064	15.16

Tab.4 Implementation of the multi-start approach in the case of FDDA-RDM

5 CONCLUSIONS

The Smart Mobility is an important aspect of the Smart City and the optimisation of traffic-lights at area level is an effective action that can be implemented in order to reduce travel time, congestion and environmental impacts of urban traffic. In this paper we proposed models and methods for designing the signal settings at area level. We studied three different problems and proposed for each one some models and methods for solving them. The results showed the applicability of proposed procedures on real-scale cases and the reduction of travel time on the network.

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PROPOSAL FOR CONTENTS AND GUIDELINES

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ABSTRACT

As an endless melting pot of experimentation and innovation, cities must reorganize and retrain compared to the growing new needs. In the light of the actual urban debate, it can be useful to do an in-depth study. In fact, the quality of urban life and collective well-being cannot be separated from the identification of a network of public services and facilities, that organizes and structures the city. That network is not resolved in the themes of pre-school and compulsory education, public interest, green spaces, car parks and public interest, but rather has a wider variety of types.

Noting the failure of attempts to define, a priori, a quantity of universally valid services, it is necessary to rethink the ways and criteria of most of the infrastructural facilities.

The "Piano dei Servizi" is the tool for the implementation of a concrete policy of services for public interest, and it means the transition between a planning standard, in terms of quantity, in a standard that meets quality requirements. It represents a specific section of the urban development plan, which has to consider problems and shortcomings, and try to solve them by finding opportunities which physical locations offer. In this way a planning standard is not configured as an abstract quantity, but as the material composition of the urban plan, which results in a land use and land development proposal.

KEYWORDS

Facilities plan, Services plan, Performance standards, Urban quality

1 INTRODUCTION

In recent times and sometimes, in some contexts, planning standards have undergone a process of profound revision, both in planning practice and in the legislative codification. There is a need to move from a administrative and trivialized use of the instrument, which completely dried up it and transformed it in a mere accounting mechanism, towards a perspective of programming services, directed to the location and the actual performance. This turnaround has been caused by a number of changes, which can be ascribed mainly to the phenomena of both endogenous and exogenous type.
The endogenous phenomenon concerns the transformation processes of urban settlements. The problem of the expansion of the city gives way to the redevelopment and enhancement of the existing urban settlement, and the balance and the sustainable use of resources are new objectives of town planning, with particular attention to environmental and social aspects.
In parallel with the urban context, the exogenous phenomenon, instead, concerns the profound changes in society, economy and culture. A new articulation of social classes corresponds to a change in the way of living in the city, so it can be observed a strongly articulated framework of the demand for services. The services of public use and public interest, in the broadest sense, related to "facilities for habitability" of a settlement, are not resolved in the range of public services, identified by the planning standard, but it is necessary to add the private services for public use, the commercial services, the networks, and a demand for innovative services of different types: social housing, slow mobility, ecological and environmental green spaces, prevention and emergency services, a-spatial services (that don’t consume land surface and are related to the social needs).
In such changed context, the inadequacy and ineffectiveness of the standards as defined by the national current legislation, take on greater importance. On the one hand, the planning standards have the merit of having allowed the establishment of a substantial reserve of surfaces, in a particular historical period, on the other hand, their limits are rigidity and abstraction in relation to local diversities and social and demographic evolution, to the forms of urban development and to the type and mode of management.
In fact, the efficiency of the standard endowment doesn’t appear disconnected from:

- "spatial distribution": it means that the supply of services is possible only with reference to their concrete articulation in shaping an urban settlement;
- "evaluation of the services actually provided," that is the real efficiency of the endowments to services;
- "accessibility", which is a prerequisite that is structured on several levels: physical, temporal and economic. Physical accessibility means the ability to reach the service, considering the mobility devices that allow accessibility. Temporal accessibility considers the schedules, times and multi-functionality of infrastructures. Economic accessibility or affordability indicates the possibility of economic access to the service.

This picture, briefly outlined, sketches out that there is a transition in planning standard, and generally in town planning. There is a shift from a quantitative approach to an approach directed to performance and quality, depending on other detailed aspects of the specific urban context. Quality is a goal to be pursued when planning; while being an inseparable link between quantity and quality, quantity must be a prerequisite or give aid to quality.

2 EXPERIENCES OF PLANNING SERVICES

In legislative matters, the reforms undertaken since the mid-70s are further strengthened in 2001 with the amendment of art. 117 of the Constitution, so that the government of the territory becomes a matter of "concurrent legislation", since the State is responsible for the determination of the fundamental principles, while Regions have to legislate about the discipline of detail.

Looking at the different regional urban planning laws, it is possible to identify two different approaches to the standard:

- quantitative: the endowment of areas to the standard per capita is different and variable, and depends on the total number of inhabitants of the municipalities, their capacity of settlement, the average rate of population growth over the last decade;
- qualitative: some regional urban planning laws ("Lur") encourage the formation of the plan of municipal services, and dealing with urban and environmental quality standards.

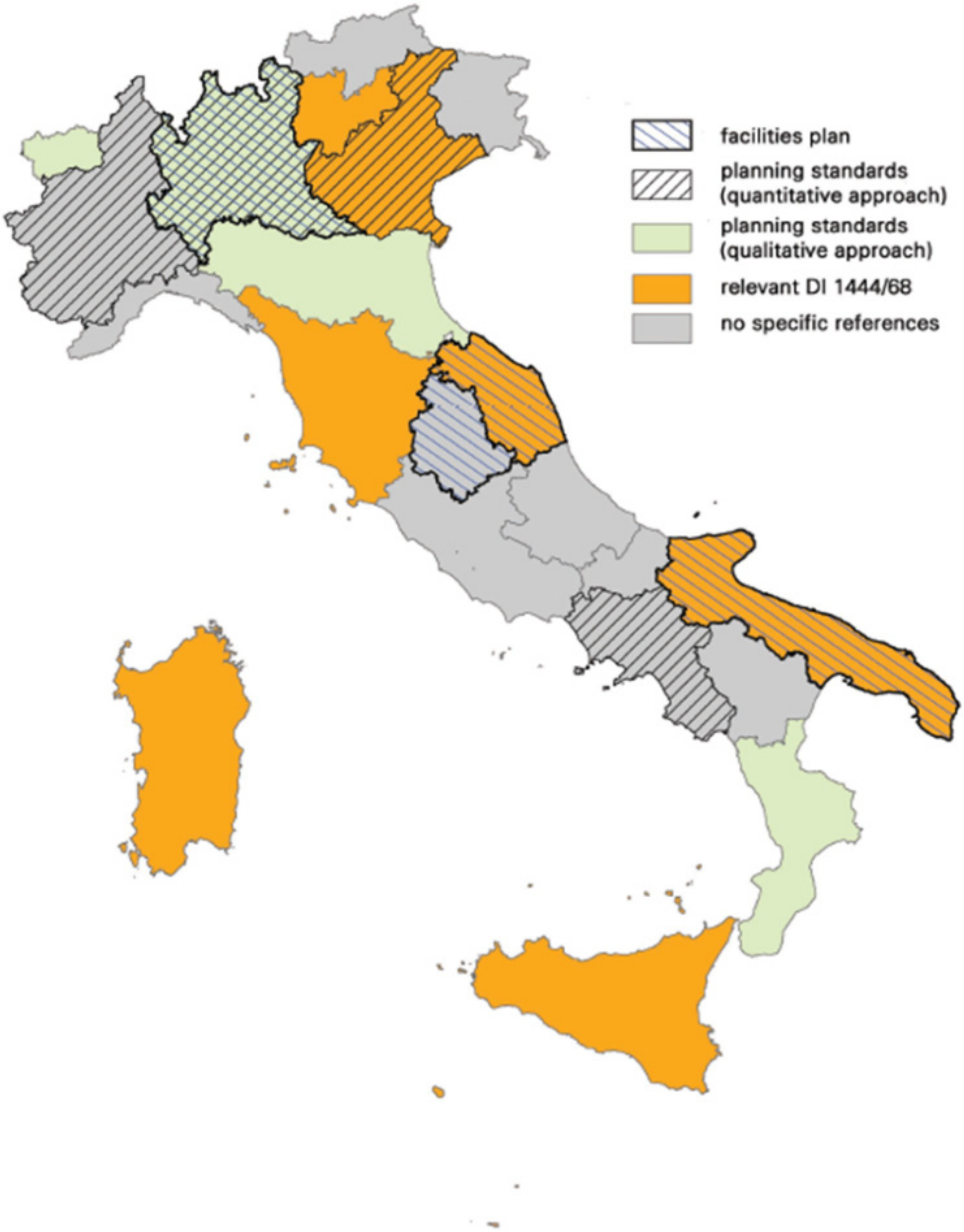

Fig. 1 "Lur" analysis about planning standards

It is necessary to distinguish regions in which planning laws explicitly refer to Inter-ministerial Decree (DI) no. 1444/1968 (Veneto, Tuscany, Marche, Puglia, Sicily, Sardinia, Prov. Aut. of Trento) from those that give their quantitative requirements (Piedmont, Lombardy, Veneto, Campania).
Quality standards or planning standards suitable to meet new needs and social demands, which at one time were not taken into account in the DI 1444, are readable, here and there, in the regional laws as claims for benefits that areas and services should give. The regions have not exercised a great "fantasy" about the project, so we can say that the regional legislation, even the most recent legislation, is "old", which in one way or another follows the trail laid down in 1968 by the national legislation.
The only autonomous region of Valle d'Aosta has explicitly declared its lack of interest in the definition of quantitative standards, stating clearly that its goal is to define quality. The concept of quality and the definition of how quality should be considered and evaluated, also appears in the law of Calabria, as well as in the law of Emilia, and in the last two zoning laws of the Lombardy Region. Moreover, in Lombardy, Umbria, Marche and Puglia, regional laws invite to the preparation of services plans, with a view to efficiency of the same.
The Lombardy Region is an administrative context which has been always characterized by a strong tendency towards experimentation and legislative innovation .
The concept of performance standards appears for the first time in Lombard legislation with the regional law no. 9/1999 on Integrated Planning Intervention (PII).
The Lombard Piano dei Servizi has undergone an evolution over time and a transformation of its role in the planning instruments: from a "residual role" in the general plan set up by the Planning Law no. 1150/1942, in the DI no. 1444/1968, in the regional laws no. 51/1975 and subsequent no. 01/2001, to a "central role" in the recent regional law no. 12/2005.
In 2005, Lombardy introduced the Piano dei Servizi (PS), i.e. a thematic planning instrument which legislates in matters of local services to the municipal scale, it defines the operational criteria and implementing policies, as well as the quality objectives of settlements and welfare .
An important development is the new concept of the Plan of Services, that within the scope of municipal reference, obtains full autonomy, and plays a fundamental role for public facilities and public-general interest, both in terms of quantity and quality. In conjunction with the Piano delle Regole, it "materializes" the strategies contained within the (programmatic) Documento di Piano and, leaving the residual nature inherited from the past, it attempts to give concrete answers to the urban "necessities", either through interventions aimed at upgrading of the existing facilities or with actions to fill gaps in the urban fabric. Its objectives of the fund are promotion of quality and urban liveability.
In addition to radically innovate the spatial planning process, based on the principles of subsidiarity, responsibility, sharing and transparency, the "Legge per il Governo del Territorio" (LR 12/05) reinforces the idea that the effectiveness of government action, at various institutional levels, depends to a large extent by an in-depth knowledge of the spatial phenomena and of the quality of information available, as well as of the possibility of direct participation in decision-making processes of the various institutions and citizens.

2.1 SERVICES PLANNING IN SOME MUNICIPALITIES OF THE LOMBARDY REGION

Eight years ago the regional law of Lombardy Region about the territorial government was enacted, and nowadays the situation of implementing municipal planning instruments is moving towards completion. Among 1,546 municipalities in the region, 1,078 of those have passed their urban plan, 252 municipalities have adopted it and 216 are still in the start-up phase.

Exactly 30 municipalities of Lombardy were examined, 11 of which draw up a schedule of services in an associated manner, in accordance with paragraph 6 of art. 9 of L.R. 12/2005.
All the examined plans emphasize the need to overcome the mere logic of only quantitative standards for quality of services and facilities, in the relationship between urban settlements and public facilities. However, as local governments have to respect some urban standards derived from national and regional laws, all the projects of surveyed plan are characterized by a careful analysis (quantitative) of the relationship between the size of settlements and urban activities and the extension of public facilities.
The Piano dei Servizi, that is one of the three instruments of the Piano di Governo del Territorio, has the task of building the "public city". Therefore it is an interpretation that goes beyond the explicit purpose of that tool. In fact, it should only “plan an overall andowment of areas for public facilities and those for public or general interest". However, the "public city" can be built only by planning and programming the transformation, through which local governments will capture the same areas through procedures of equal distribution and compensatory equalization.
In almost all examined cases, the system for public services is identified and defined in three different phases:

- the first one returns the picture of the actual state of the services, i.e. a mapping of the actual state of the services available, so as to incorporate all the functionality of the facilities;
- the second phase which aggregates the endowment of services, after the consolidation of the planned transformations, to the previous one;
- the third one, which also includes the new public services design.

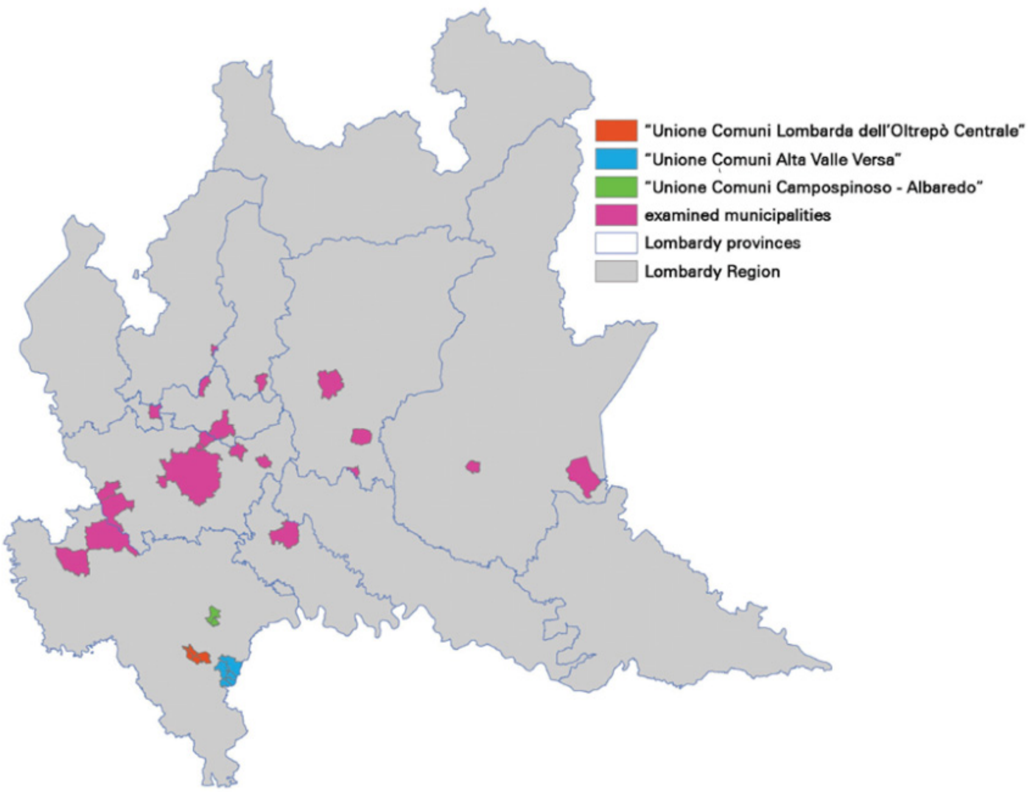

Fig. 2 Examined Municipalities of the Lombardy Region

A table of the examined services plans is following, where it can be highlighted the diversity of definition of territorial units of reference, and the discussion of new urban standards.

MUNICIPALITY	PS [year]	LAND AREA [Sq.km]	POPULATION no.	HAMLET no.	TERRITORIAL UNITS OF REFERENCE FOR "PS" title	n°	NEW SERVICES AND FACILITIES *
Abbiategrasso	2009	47,05	31.146	2	district	8	b - en
Bergamo	2011	39,60	117.518	12	-		g - bp - h - en
Bresso	2007	3,38	26.478	-	-	-	bp - en
Cernusco sul Naviglio	2010	13,33	30.316	-	statistical fields	15	-
Cisinello Balsamo	2008	12,71	75.364	11	local areas	5	g - bp - h
Desenzano del Garda	2011	60,10	27.229	2	areas of equal value of the property	3	-
Flero	2011	9,87	8.360	3	-	-	b
Giussano	2008	10,28	23.464	3	rban unit of inquiry	24	-
Lodi	2010	41,43	44.401	4	constituencies	5	g - b
Martinengo	2011	21,61	10.176	1	historical unit	7	en
Melzo	2009	9,67	18.924	-	-	-	bp
Merate	2012	11,00	14.905	7	-	-	h - c - bp - en
Merone	2007	3,25	4.055	2	urban unit of aggregation	6	bp - h
Milano	2009	182,07	1.342.000	-	cores local identities	88	-
Monza	2007	33,03	122.263	5**	Neighborhoods	26	bp - h
Mortara	2011	52,12	15.673	-	-	-	b - en
Robecco sul Naviglio	2012	20,37	6.866	4	minimum unit comprises a survey	52	b - en
Saronno	2012	10,84	39.161	6	identity cores	7	-
Vigevano	2010	82,38	62.000	5	catchment areas	6	en

* g= urban vegetable garden, b= bicycle path, bp = path for bikes and pedestrians, h= social housing, en= ecological network.

** Constituencies.

Tab. 1 Examined Piani dei servizi

2.2 SERVICES AND INTERMUNICIPAL COOPERATION

Some issues continue to be the center of attention: strengthening of inter-municipal relationships, better use of available resources, a more rational process of planning / programming of urban, environmental, and infrastructural systems.

Sharing in the concrete implementation of services and facilities to different municipalities allows you to identify areas of coordination and to plan policies for services to supra-municipal level and, in general, to define quality parameters and location criteria in common.

With regard to the inter-municipal relationships, attention relates to a broader horizon than the "simple design" and will address issues such as:

- planning and management of the services system, taking into account both the facilities and the equipment, which impact on the area, and the a-spatial services, with regard to local and supra-municipal level;

- ability to overcome the administrative boundaries in the environmental review and evaluation, promoting the involvement of other realities with reference, therefore, to larger territorial systems, which are more appropriate to the consideration of the subject matter;
- capacity of response to the issue of housing, especially social in nature, not only to local scale;
- management of the streamlining of the localization of productive sectors, that should aim to overcome the pulverization of the interventions;
- regulation of relations with regard to local realities with a different service level for mobility infrastructures, with apparent imbalance in the accessibility degree and not only.

There are several examples of associations of municipalities that converse on facilities and services. Three Unions of Municipalities of the Lombard area were examined. They are in the province of Pavia and they are characterized by very small towns, from the point of view of territorial surface and of the resident population.

The individual facilities are evaluated in relation with their actual area, except in the so called union Campospinoso-Albaredo, where a reduction factor is applied to the actual area of each facility, in order to consider a qualitative surface.

UNION	PS	TOTAL LAND AREA	TOTAL POPULATION		MUNICIPALITIES	LAND AREA	POP.	NEW SERVICES AND FACILITIES *
	[year]	[Sq.km]	no.	no.	title	[Sq.km]	no.	
Unione Campospinoso Albaredo	2009	12,91	1.072	2	Campospinoso	3,69	866	en
					Albaredo Arnaboldi	9,22	206	
Unione Comuni Alta Valle Versa	2010	42,80	3.654	5	Canevino	4,74	121	-
					Golferenzo	4,35	216	
					Montecalvo Versiggia	11	577	
					Santa Maria della Versa	19	2.612	
					Volpara	4	128	
Unione dei Comuni Lombarda dell'Oltrepò Centrale	2010	20,05	2.821	4	Corvino San Quirico	4	1.077	en - bp
					Mornico Losana	8	729	
					Oliva Gessi	4	183	
					Torricella Verzate	4	832	

* g= urban vegetable garden, b= bicycle path, bp = path for bikes and pedestrians, h= social housing, en= ecological network.

Tab. 1 Examined unions of Municipalities in Lombardy Region

2.3 SERVICES PLAN IN OTHER ITALIAN MUNICIPALITIES

In addition to the Lombard municipalities, which are forced to adopt the services plan , other Italian cities wonder about the issue of quality of its services and facilities, such as: Bologna, Parma, Modena, Rome, but also smaller municipalities.

Here are defined some of the issues which the cities of Bologna and Modena are trying to solve with the services plan.

The municipality of Bologna is divided into areas, which offer a response to the need to identify a limited size of the territory. In the identification of criticalities it was not considered appropriate to list in a predetermined manner a series of indispensable services for the different territorial levels. In relation to demand for services, the criticalities in the distribution of supply was highlighted, such as the imbalances in different areas. Particular attention has been paid to the issue of accessibility, i.e.: a safe pedestrian mobility, the removal of architectural barriers, easier use of public transport, the continuity of bike paths, etc..

Within the strategic plan for services of Modena, services and facilities can have both public and private management. Because of their overriding public interest, however, they require a role of guidance (upstream) and control (downstream) by the institutionally competent entities, that is, an action of public governance that can only be on a "local" level. Each community, in fact, must be able to determine the specific answers to their significant common needs. The evaluation of the functional equipment of services has been referred to the zoning system. A specific equipment of multifunctional facilities, according to its role, is associated, to each territorial level. Services and facilities are identified with respect to the six issues: education, health/ welfare, culture/ society, trade green public facilities, sports/ loisir.

In general, the analyzed services plans very often take the form of tools that reduce the activity of planning at a simple analytical-descriptive knowledge. In the practices, it becomes a management tool, necessary to the reorganization of the local services, possibly extended to the offer of the private sector, instead of a plan that has to build the development of the city according to a more solid mesh of facilities, with particular attention to environment.

3 GUIDELINES FOR SERVICES PLAN

A methodology must be set up, so that the services plan gets the character of an innovative tool for the design and management of the public city which, by the state of fact of existing services, defines strategies in the medium/long term and proceeds to identify areas to bind for the new realizations.

In a perspective view of quality of urban life, the strictly issue of services is blended with other themes, with the intent to represent and assess the set of elements that make good the quality of a part of the city, i.e.: centralities, meeting and socialization places, the network of pedestrian paths and bicycle trails, the presence of neighborhood trade. A framework of needs and objectives has been outlined, downstream of which the private contribution will insert. In this way private individuals, with their initiatives, will contribute to achieving concrete initiatives of retraining.

However, certain basic factors have to be considered for the real effectiveness of public action in the context of the services, i.e:

- the specificity of each single territory must be carefully evaluate , because it is a fundamental matrix of the collective identity;
- the needs must be considered globally and imply a variety of services and facilities, in order to give them an adequate response. The realizations have to be considered with their interdependencies and with all their possible relationships, considering public/private partnerships;
- the different actors in the process of delivery of services must be involved in a joint action in planning and managing services, which will be much more effective as it will be more respectful of the general interest, even in consideration of the individual interests;
- it is necessary to trigger a listening, participation, and promotion of voluntary initiatives process.

A Services Plan must be developed through the following steps:

- territorial articulation, i.e. the definition of territorial units of study and project, inside of which the presence of a minimum performance level of services can be assessed. In the perspective of the specificity of places, the municipal territory can be divided in relation to: fractions, municipal districts, cadastral sections defined by Istat, physical territorial barriers (presence of rivers, etc.), road infrastructures, catchment areas of certain services (for example, for educational facilities);

- identification of existing services in the territory and their in-depth knowledge. It is necessary to define the unit of measure for the service and its performance and users taking advantage of the service, by taking into account the capacity of settlements and the floating population for reasons of study, work or tourist flows. Performance parameters are those for effectiveness, efficiency, and quality. For each type of service a cost-effective analysis of detail is necessary, taking into account considerations about management efficiency, in order to locate the threshold values, which are considered optimal values, with regard to the number of users, the usable surface area and the lot area. This performance analysis must be conducted for each type of service with reference to its specific characteristics, taking into account several elements, such as the cost of management, the amortization of the cost of investment, the characteristics of the users and the manner of use, and the consequent provision of equipment;
- estimation of the demand for services: each territory is unique and its needs for services are specifically characterized. In addition to the request of the resident population, the estimation must necessarily take into account the needs generated by the flow of people and stakeholders, who gravitate each day in the urban centers for different reasons. Furthermore, innovative services and new facilities must be introduced and highlighted, i.e.: the definition of ecological networks and urban vegetable gardens for environmental system, cycle paths and pedestrian trails for the slow mobility, social housing for residential system. It is necessary to define the evaluation of the a-spacial services, which, for their functional characteristics, do not occupy surfaces. For that kind of service, some parameters of quality should be defined, relating to their level of response to social needs. They are social services, public assistance or for mobility, telephone services, waste collection, cleaning and maintenance of the roads, maintenance green areas and open spaces and network services (such as local public transport), subservices and public lighting. Furthermore, it is necessary the assessment of technological equipment (service stations, installations, ecological areas);
- balance between supply and demand: a number of basic services should be guaranteed to all people, by checking whether the public service was able to take into account of territorial specificity and the characteristics of the population. If shortages occur, the balance allows to invent original solutions, suitable to the territory, and to identify the economic and social priorities. Through a comparison between the potential demand for each facility (with regard to the resident population, the present population and the potentially predictable population inside of the forecasts for the structural plan) and the existing, public or private, services supply, specific elements of attention are defined as a function of the comparison between the current sizing and the potential demand for each facility, and for each urban area of reference. By that assessment of criticality the identification of intervention policies for each urban area derives, which may be one of the following: increase in supply for the urban poor areas compared to the expected demand; consolidation of the current structure for the adequate urban areas ;increase of insediative forecasts or infrastructural reuse where supply is higher than demand;
- elaboration of the project of the services plan. It immediately notifies the expectations that the citizens cast into the future, in the short and medium term, to the improvement of the quality of life. According to a principle of fairness, the organization of services implies, in theory, that the whole of the territory benefits the same degree of accessibility of services, to different levels, aiming also in the reduction of mobility required, i.e. the services must be the minimum distance from homes, compatibly with criteria of efficiency and economy in their distribution on the territory.
- evaluation of the economic feasibility of the plan. In order to give the plan an operational valence, it is necessary to define the mode of retrieval of resources. For this reason, the service plan must be

interrelated with other plans and programs in the sector, and implemented consistently with the three-years program of public works, or with the annual list, including private projects;

- monitoring and control. That last phase defines the flexible character and dynamic nature of the instrument, because needs and services are continuously evolving, as well as the means to implement them.

4 CONCLUSIONS

Lacking a national framework law on services planning, that establishes the principles and the essential guarantees, and without regional measures, municipalities seem to be somewhat disoriented on the matter. On the one hand, local governments are obliged to comply with the quantitative requirements, but, on the other hand, they show sensitivity to a program of services of support to the life of the community. That program is based on territorial specificity and urban identity, depending on the local features, and not according to rigid and abstract classifications, in a framework of great flexibility. In the light of the current economic national and European contingency, there is also a request for a revision of the forms and contents of implementation of the welfare state.

The design and the project of the services is complementary to the land development project , indeed the first often precedes the second and, consequently, the evaluation of the overall budget of a territorial scope, in terms of services rendered to the resident population and the users, is essential to define its structure and attitude.

Nowadays, no community accepts a planning, which ignores or underestimates the need to easily meet the social needs that it expresses, as no local government can circumvent the important function to fulfill them. There is a need of local communities to establish a dialogue with local authorities and agree with them how to meet, at certain times, such needs.

The services and facilities combine to make an area a good place to live, which has to include the availability of political, educational, and social support systems, good relations among constituent groups, a healthy physical environment, and economic opportunities for both individuals and businesses.

The quality of public services helps to meet the growing and evolving needs of citizens, who are now better informed than once and, therefore, able to compare public and private services, by developing social cohesion and the sense of security and belonging to the locals. In fact, the quality of services determines the quality of life and level of territorial, economic and social cohesion.

The solidarity and democratic functioning of society depends from those factors, in addition to the territorial competitiveness, which is essential to attract new investments and new jobs.

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After the high school , he attended the Air Force Academy of Pozzuoli for three years, taking a degree in civil engineering building at the University of Naples (1979) with 110/110 cum laude. He practices to design in first the Urban Plans (1975-78) at the office of Luigi Cosenza in Naples, he participates in the work of post-sismic reconstruction, and works at the service urban planning of the Campania Region (1982-83) and the Commissioner for the flegreo bradyseism (1984-87).

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SOCIAL HOUSING IN URBAN REGENERATION

REGENERATION HERITAGE EXISTING BUILDING: METHODS AND STRATEGIES

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ABSTRACT

The theme of *urban regeneration* has played a strategic role during the last two decades in European and national urban building policies. Current addresses, also defined in *Leipzig Charter on Sustainable European Cities* in 2007, indentify the necessity to invest in requalification of degraded residential assets and not in new developments, individuating in urban regeneration the main tool for development of contemporary city.

Public neighborhoods have developed, historically, a wide set of common problems. They are not only due to wrong planning but also to the concept of "housing for masses".

The original ambition of modern settlment, developed from German*Siedlung*, was to be an autonomous part, on the point of view of morphology, in urban expansion. Joined by new developments, a lot of neighborhoods became benchmarks for suburban areas and now we can define themas "new urban centralities". So theirrole in urbandynamics has changed and they can be individuate dasprecious reserves of public spaces and potential incubators for regeneration of larger areas.

Analyzing some Italian and European case studies, themostinnovative relate to the *densification* of open spaces, inserting new services in a general redesign of green areas; concentration of built surfaces, in order to reduce land consumption and introduction of different residential types in order to improve *mischbebauung.* The reasons for an active recovery are motivated by the criteria of environmental sustainability and saving land, have relaunched compact projects with medium to highdensity.

KEYWORDS

Regeneration, Densification, Development, Recycling

1 DESIGN-RELATED AND FACT-FINDING ASPECTS FOR URBAN REGENERATION

The biggest problem with which our society must confront is the deep crisis of the concept of the distinction between city and country and the problem of redevelopment of public housing neighborhoods. The expansion of the built environment and urban fabric in farm and rural areas has led to a patchwork of hybrid spaces organized according to an alternation of full and empty spaces, cities and countryside, without any apparent connection. The complexity of the areas is formed by the overlapping of different layers sedimented in time according to a mysterious logic of cancellations and permanences that a cursory glance can not classify that as chaotic and incoherent. The gradual domination of the environmental characteristics of the area from the settlements built and networks, which began with the industrial city to another of the eighteenth century, in recent years has reached a high degree of irreversibility.

The address of the research project is measured by the substantial processing activities built that is taking place for several years in Europe, involving many parts of buildings, both old and new. Especially in the context of the progressive tradition has developed a sensitivity to the positive role that public spaces natural parks, gardens, green cities, agricultural areas, gardens metropolitan have in rebalancing the extreme artificiality of urban life by answering logical health benefits and recreation but also as places of practices and mobility alternatives and natural reserve. Similarly the processes of regeneration of the *housing* concern both the adaptation of existing buildings, both new functions and the redesign of open spaces and common areas. All work on the built becoming increasingly expanded and diversified: additions, overlays, *infilling*, inserts, new coatings, *surefit*, remodeling of land.

In particular, the traditional affection of italian culture to the conservation and protection has producedanalysis on public housing and interesting contributions to recovery. The original idea of the modern district, which born from *Siedlung* German, is a morphologically independent part in the expansion of the city.

Fig. 1 Hufeisensiedlung, Berlino

Achieved by the new expansions, many neighborhoods have become points of reference for decisive and peripheral areas that were once considered today as "new urban centers." The quality of the relationship between full and empty, evident within parties often saturated and congested, resulted in a gradual change of their role in the dynamics of urban identifying them as reserves of precious public spaces to redevelop larger areas.

It is necessary to change some of our assumptions, to make a shift of our look on the territories of the urban landscape to identify new ways in making and dealing.

1.1 URBAN PLANNING IN A "SITE SPECIFIC"

The analysis of the materials from which the city inevitably lead to recognize the uniqueness of each urban situation contingent and the specificity of each territory. The historical sequence of topography, river networks, infrastructure networks and agricultural land fragmentation, the morphology of the built and vegetation, has been a progressive sedimentation of materials that are stratified according to temporal logics very slow, unknown to the acceleration of the phenomena of the contemporary . Renew the look of the city means, then, refuse the apology to the city "generic" and get rid of that *habitus* of surface observations that the contemporary city is not understandable if you do not like chaos, homogenization, randomness. Urban problems that confront us today are, of course, essential to this situation. It is the responsibility of the project to recognize the specificity and adapt its operating modes to the complexity of contemporary space refusing to formulate formal models. The project is common ground in many disciplines but it is precisely the disciplines of architecture to give it a result of spatial as well as linguistic.

So the disciplinary specificity of urban design is to be found in the relevance to run in the space of the city, in the "care of form." In particular we want to use here the term "urban design" in the sense of "*projeturbain*" French as a tool that is able to articulate the different scales and in different times both the spatial aspects, figurative and formal and the social intervention planning by means of a "morphological axis" and a "axis of the process", the first reported to the organization of the space, the second to the processing capacity along the time. In this sense, it is then possible to speak, especially in the French tradition of a "culture of urban design" in which some aspects are clear: attention to the context and history of the places the consideration of the temporal component in the process of building the city, the belief in the proposal of a *mixitè* uses with particular attention to social complexity, typological and landscaping. It is interesting to note that in order to address an area suspended between town and country the best ideas come from their own disciplinary fields on the boundary between architecture and landscape, as if the morphological complexity should be reflected in a complex thought and analog.

1.2 THE CITY IN THE LANDSCAPE

Now seems inevitable reversal of perspective that is turning his attention to empty rather than full, open spaces and landscape rather than those built, to the relations between the parties rather than to objects.

The various research methodologies may have a number of basic assumptions and common lines:

- The design as a tool capable of articulating the different scales and in different times both the spatial and the social aspects of the intervention on the landscape.
- The territorial scale in relation to the concept of landscape and its implications in the field of design in its various forms (architectural, urban, ecological, artistic).
- The discourse on the form and, in particular, on the morphology of the territory.
- The emptiness, the open space as the beginning of the project reflection operand fact a reversal on the usual relationship between design and object.

2 RE - CYCLE AND URBAN REGENERATION IN EUROPE

This contribution is about public initiative developments realized in Europe from second post-war period to Eighties. There are many international examples on the topics of recycling, efficiency and sustainability. These include the recent interventions of MVRDV in Rotterdam and Berlin model in the recycling of buildings. The recent proposal for urban regeneration of Robin Hood Gardens (RHG) complex in London, advanced by Sarah Wigglesworth Architects (SWA), can be taken as a best practice in the field of urban regeneration policies for degraded situations in planned developments.

2.1 STRATEGIES FOR URBAN REDEVELOPMENT

French *grand ensambles*, German *siedlungen* and many works by IACP (Autonomous Institute for Public Housing) in Italy (INA casa e 167 plans) are characterized by big extension and their value is more evident in urban structure than in individual buildings. Hypotheses of discontinuity and big dimension of the buildings, taken as urban principles, involve the concentration of built surfaces in few volumes and the presence of big open spaces that stand as green stocks in deregulated and extensive development of contemporary European city. Concentration, as typical character of modern development, can be pursued, considered actual problems connected with land consumption, as sustainable and desirable hypothesis for new urban policies.

We have to overcome the prejudice about big dimension of modern developments, because this feature is not a cause of the decay of this areas. Big dimension must be considered not only as a condition for a sustainable urban project, but also as the representation of a collective idea about housing, that for the second part of Twentieth Century had inspired social housing experiences in the whole Europe.

Intervention in modern neighborhoods should be respectful of developments' specific features and should propose adjustments and improvements adding new contents to existing elements we consider as values, first of all the presence of big open spaces.

Collective buildings are often missing in modern development or their realization is incomplete. First category is about interventions that introduce collective uses and improve conditions of existing services. This kind of buildings, as interaction elements with open spaces, produce new ways of using open spaces, improving safety and social dynamics.

Contemporary regeneration interventions should realize conditions for coexistence, in a common urban context, of different kind of inhabitants. In this way, social dynamics and phenomena connected with control and appropriation of collective places could develop. Coexistence of different house types (simplex and duplexes houses in multifamily buildings, single-family houses, terrace houses and patio houses, ...), that modern architects called mischbebauung, represents the condition for the presence of different typologies of inhabitants.

We can talk about some urban project realized in Italy between 1940 and 1960, built on the hypothesis of typological mix. Between them the most interesting are Tuscolano development in Rome by Adalberto Libera and Via Dessiè development in Milan by Piero Bottoni, Giò Ponti, Luigi Figini and Gino Pollini.

2.1.1 SARAH WIGGLESWORTH ARCHITECTS: ROBIN HOOD GARDEN PROJECT

The demolition of this residential development seems almost certain. It is supported by predisposition of design proposals that are about the realization of 1700 accommodations in substitution of 214 existing duplexes. They have generated a big discussion about second post-war period architecture in UK.

Many urban transformations, changing completely urban fabric of Tower Hamlets, have produced new high density areas (Canary Wharf, Docklands, ...) and RHG looks like out of scale. For public and private actors is better to demolish existing buildings to realize new development quintupling inhabitants, than do complicated and expensive regeneration interventions.

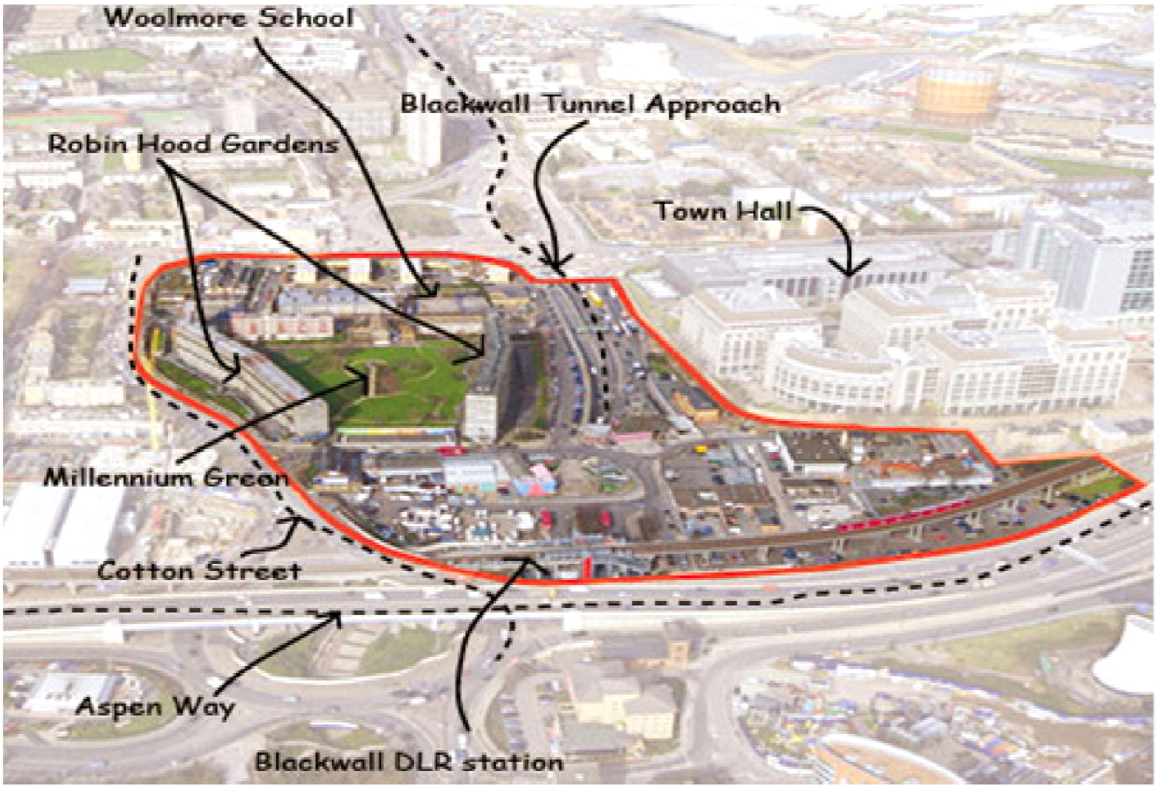

Fig. 2 View of Robin Hood Garden

In these context Sarah Wigglesworth Architects (SWA) has proposed a regeneration project for RHC and it provides different levels of intervention oriented towards improvement of technological performances of the building and increasing of number of inhabitants:

- Re-configuration of existing accommodations
- Introduction of new accommodations
- Improvement of energy performance

The proposal individuates in coverings and perimeter areas the most suitable sites for new accommodations. In this way there are no problems for nucleus of original design, the big central park, that represents a strongly characterized common place. Perimeter blocks host garages and they should be converted into houses obtaining brand-new 33 duplexes. Existing stairs reach cover level and so it could be possible to realize duplex houses with wooden structure at last level of the building, obtaining other 38 houses. Overall RHG would have 71 brand-new houses.

On the technological performance point of view, SWA says that substitution of actual windows with new ones characterized by high thermal performance and inserting of suitable panels for external walls could induce a halving of current costs for air conditioning and heating.

2.3 ROTTERDAM: RESILIENT CITY

The port city of Rotterdam, situated on the banks of the Maas River, with a total population of 615,000 inhabitants, is home to the largest international port in Europe. 90% of the city is built below sea level and then to flood risk. Through various programs, including the Rotterdam Climate Initiative, the city aims to become more and more smart, setting ambitious goals, adopting a program to become the capital of the world with the lowest level of CO2 emissions. Currently the city has one of the highest rates of emissions in the world, approximately 29.8 tons. The RCI provides that, through the collaboration of government, organizations, businesses, knowledge institutions and citizens by 2025 will be reduced by 50% the emissions of pollutants. The central point for achieving these goals is to make sure you adapt cities to climate change in place, so as to also create a new boost to the economy of the city.

Fig. 3 View Port of Rotterdam

There are five major initiatives to achieve these goals, all centered on the concept of resilience:

- houseboats;
- squares of water;
- enhanced water collection systems;
- green roofs;
- sustainable port.

The houseboats. To cope with rising sea levels, Rotterdam plans to build floating urban neighborhoods. To show how this might work, the Rotterdam Climate Initiative has commissioned the "floating pavilion". The three interconnected transparent domes are easily positioned, made with a special plastic 100 times lighter than glass, are energy self-sufficient thanks to solar energy used for heating and cooling.

The squares of water. The water in the city Rotterdam is a ubiquitous element, has certainly contributed to its prosperity but the same can be a threat, especially in view of the projected increases in rainfall due to climate change.

For this urban planning has studied the realization of a system of "squares of water" as a solution to retain excess water and decrease the pressure on the sewage system. After the emergency, the excess rainwater can be channeled towards the sea.

Enhanced water collection systems. The change of the intensity of the rains brings with it consequences on the level of drought. For this reason, the challenge is to know how to avoid problems due to the phenomena of flooding and those of prolonged periods of drought. To do this in Rotterdam are studying a holistic system of collection and storage of rainwater through the roofs and other impervious surfaces, which are then cleaned and stored according to requirements, so as to have a ready supply in the event of long periods without rain.

Green roofs. Rotterdam currently has approximately 100,000 square feet of green roofs, the city plans to cover 160,000 square meters by the end of 2014. The system of green roofs, in addition to increasing the absorption of CO2 is also important for the absorption of rainwater in excess. Many public buildings in the city have already green roof including the Municipal Archives, the Central Library, the headquarters of Unilever Nederland, Maasstad Hospital, Children's Hospital of Sophia.

Sustainable port. To achieve the goal of reducing carbon emissions by half compared to 1990 levels by 2025, the city plans to allocate 80 hectares of land around the harbor for companies that produce energy through renewable sources. Currently, only 10 companies in the port using renewable energy in the face of 45 chemical companies, oil refineries and five different power plants. Another proposal involves the use of new containers for shipping, making it possible to maximize space and therefore reduce the number of trips.

2.4 RE-CYCLE IN AMSTERDAM -SILODAM MVRDV-

The Housing Silo is situated on the IJ River, at the tip of the pier, next to two former grain warehouses (silos) that have been converted.

Fig. 4 Silodam, MVRDV, Amsterdam

The IJ River served as Amsterdam's harbor in the golden age. Then, when the harbor fell into a decline, the buildings, warehouses, and shipyards were left unused. In the 1980s, when Amsterdam had a housing shortage, the city regained interest in the river's potentials and a variety of restructuring projects, where the designers tried to fuse the remaining structure and character of the harbor with new architecture, followed.

The building's public spaces are open to the natural elements, roof gardens, viewing balconies, and also a space under the building where home owners at Silodam can moor their personal boats. To address the

issue of the views of the water from the pier being blocked by the building, the designers penetrated the base of the building with a wide passageway that leads to a pubicly accessible balcony.
MVRDV have explained that the building holds in it neighborhoods. This is clear to see when looking at the diversity of the elements that put together the building. The architects of the building have, in fact, folded and stacked into the building different neighborhoods of Amsterdam. It is important to note that a usual neighborhood holds in it different programs as does the Silodam.

2.5 MODEL RECYCLING OF BUILDINGS IN BERLIN

If there is a city which has made the redevelopment of the buildings its flag, this is Berlin. For historical reasons, certainly, but also a socio-cultural issue, after the fall of the Berlin Wall in a few years has become the laboratory-largest shipyard in the world, beaten only later, in 2000, from Shanghai. The Sauerbruch Hutton was one of the first to innovate on the existing in Berlin, after winning the competition in 1993 to design dell' Headquarter GSW, an example of advanced surgery building. Sauerbruch Hutton designed the 1999 extension and renovation of the GSW headquarters complex in Berlin. The original high rise is remembered as one of the great rebuilding projects after World War 2. The new GSW tower brings a gentle curve and colorful flavor into the downtown. Circulation through the urban corridor easily introduces the visitor to a program of different scales. The building elements tie together the city scale with the pedestrian and individual visitor. Sauerbruch employed the Natural Colour Theory for this project.
Sauerbruch's modern environmental systems use passive means that use less energy and are healthier. Louvre systems and a double-skin facade effectively shape sunlight usage and add interesting complexity to the outside appearance. The entire block was destroyed and the old building stood a few steps away from the middle ground between the two walls. At the old volume, a tower of 16 floors, was juxtaposed with a knife glazed slightly curved shape, the existing building connected via a function block, which is also glazed.
The ventilation system and the outer sheet, corrugated colorful and bright tones, make energy savings of around 40% and the control of natural light input. "I think Italy is open to the architectural theme of sustainability, much more than they are in France or England." Is convinced of their Matthias Sauerbruch, the father of the Berlin studio. The urban and architectural energy of the German capital in recent years has been gradually declining, but anyone wanting to begin today in the re-building must be measured against the Berlin experience.

3 SOCIAL HOUSING: ASPECTS FOR PLANNING

The return of the themes of regeneration and recovery to establish a meter capable of building control to ensure the best levels of living but also techniques and tools to combat sprawl, is the basis of the new model of urban and social development that is characterizing the recent decisions of the metropolis degrees.
The theme of urban renewal and regeneration of tissue, in which the unit of "neighborhood" is established as a physical place and community, is part of a more general process of review and prevention of diseases of metropolitan and regional contemporary art.
In Italy, municipalities and governments, on different scales, they are faced with a choice: to let go forward spontaneous evolution, sometimes wild, employment, land use and the distribution of the different components of urban complexes, or prevent the proliferation of city and plan development.
The theme of social housing is one of the ones that most trigger tensions and interests disparate and conflicting. The regeneration of social housing has been addressed in many cases in recent years through strategies that provide various levels of demolition of the existing, based on a rethinking of the very large

size of the district, criticized the excessive concentration of population, to the poor quality and lack of recognition of places.
The practices of redevelopment are also a symptom of the gradual transformation of urban residence, which act on impulses from various sources: the demographic situation, the housing market prompted by innovations introduced by House Plan which intervenes on procedures and public-private relationships in 'social housing, the search for a Community dimension and sustainable settlement, the change of the idea of living and intervention strategies for the new residence. In this framework, new models and protocols for studies of the transformation.

3.2 INTERVENTION STRATEGIES

Through detailed analysis, elaborating a multidimensional representation of the urban fabric is possible to identify the potential and manage resources such as games of a profit and loss account to be used for the sustainable development of natural and built.
The process of redevelopment and regeneration of housing includes both the adaptation of existing buildings, both new functions and the redesign of open spaces and common areas. The main theme concerns the "densification" of open spaces, adding new equipment and services to both the local level (kindergarten, sports and leisure, business and craft) and the urban scale (community center) within a general redesign of the green and parking.

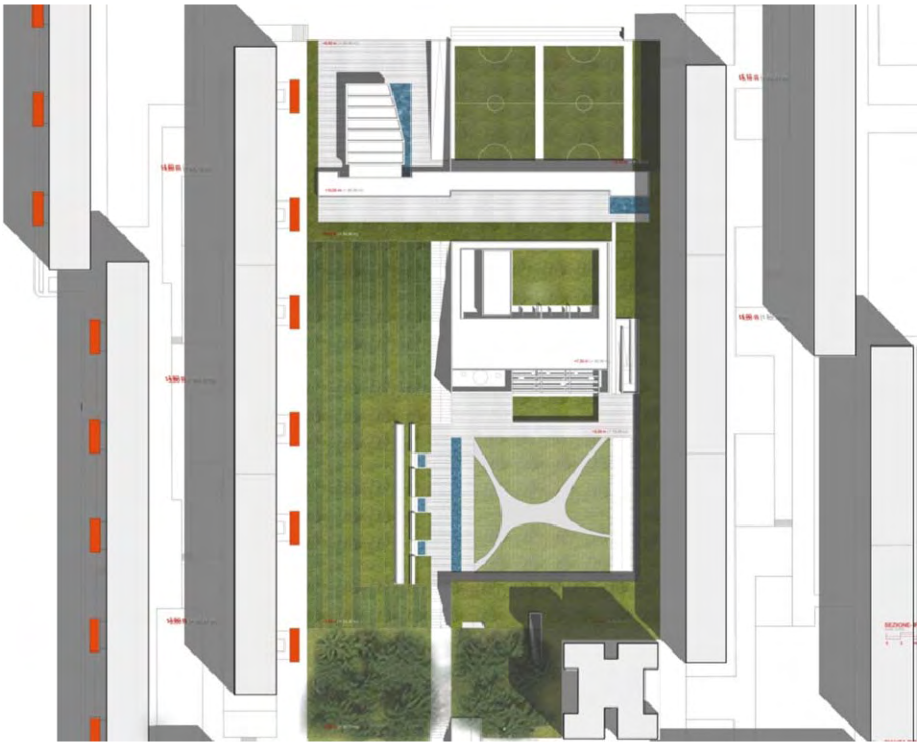

Fig. 5 Design intervention and recovery existing buildings, Neighborhood Vanvitelli, Caserta, Maria Antonia Giannino

The objective is to guide new interventions to revitalize the conditions of use of the large courtyard garden without contradicting the original architectural character of the grand unified space for collective use: the architecture to be included are objects of small size and organically linked to the design of the spaces external to the steps, to the trees. A significant point of the intervention strategy is the location on the south side of a covered market that assumes the role of "front door" in the neighborhood. For the redevelopment of the ground floor, the densification involves the insertion of small volumes to social rooms or shops. The new volumes and open spaces are inserted in a general remodeling of the ground that, by compatible activities in partially underground structures, reduces employment gaps and increase the green surfaces.

A first objective, therefore, is the constant dialogue of the neighborhood with the city, the presence of green areas of relevance that promote livability for different user groups, from infancy to old age; building density contains a balanced land use and effectively draws the spaces between the houses attributing meanings to these precise and consistent with the characteristics of the users.

The formulation of a program of intervention should therefore be focused on a few principles: reuse and optimization of soils already cemented; redesign of the areas pursuing the functional mix, and quality of settlements

So while it is necessary laws regulating the use of land and funds for the maintenance of public administrations, on the other hand you should also upgrade the compact city and make it livable and functional needs of the population.

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USING GIS TO RECORD AND ANALYSE HISTORICAL URBAN AREAS

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ABSTRACT

A significant part of the cultural heritage of towns and cities worldwide is the built heritage. The historic centre of several European cities has been preserved as an important part of the urban landscape. New analytical tools and concepts are thus required, which would enrich and expand the conventional methods and achieve sustainability of cultural heritage in any urban context, among which are Geographical Information Systems (GIS), digital mapping systems that link spatial and non – spatial data of landscape features, and can contribute substantially in documenting different urban features and furthermore in modelling the urban process and its impact on heritage regions. This paper is part of a wider research still in progress and refers to the creation of a specialised GIS, which includes a great range of geometric and descriptive information that can be used for the interpretation, monitoring, visualisation and evaluation of urban heritage areas. The case study of the paper is the Old Town of Xanthi, one of the most important examples of the 19th century's urban civilization in Northern Greece. The paper focuses on the elaboration of the data concerning the built environment and more precisely to its systematic retrieval and import to the GIS system; moreover it examines 17 chosen variables using a combination of Multivariable analysis methods (Correspondence and Hierarchical Cluster Analysis). The analysis has shown the existence of four distinctive and very interesting groups which have their own specific characteristics. Ideas for further research include the collaboration with specialised sophisticated software which would facilitate the thorough examination, analysis and correlation of parameters involved, towards the principles of sustainable and smart city development.

KEYWORDS

GIS, Urban heritage, Built environment

1 INTRODUCTION

A significant part of the cultural heritage of towns and cities worldwide is the built heritage, which has a crucial role to play in all three dimensions of urban sustainable development (environmental, economic and social) (Tweed and Sutherland, 2007). The historic centre of several European cities has been preserved as an important part of the urban landscape, escaping demolition policies related to modernistic and post – modernistic redevelopment. Old towns, increasingly perceived as urban forms from the past, are being restored and moreover, it is attempted to incorporate them in the contemporary urban functions, by recognizing their importance (Nyseth and Sognnæs, 2013).

A key element for protection of historical areas is acquiring access to all information related to them. Traditional research methods are not able to meet successfully the need of collecting, elaborating and analysing mass data (Rui, 2008). New analytical tools and concepts are thus required, which would enrich and expand the conventional methods and achieve sustainability of cultural heritage in any urban context. Among these are Geographical Information Systems (GIS), digital mapping systems that link spatial and non – spatial data of landscape features, and can contribute substantially in documenting different urban features and furthermore in modelling the urban process and its impact on heritage sites (Al – kheder, 2009). Generally, multi-disciplinary data can lead to a correct assessment only providing that they are well integrated; GIS technology combines database management with geometrical and spatial referencing (Carver, 1991; Webster, 1994; Crosetto and Tarantola, 2001; Malczewski, 2006; Fabbri et al., 2012). Therefore, GIS tools contribute to the simplification of the inventory, evaluation and preservation of sites with historic or cultural value (Duran et al., 2003).

The objectives of a GIS used for the aforementioned purposes include the following: organisation, management and visualisation of the unique aspects that characterize each built heritage urban core, as well as the creation of thematic maps in order to make the system easily conceived and user friendly. Its use could lead to efficient ideas for urban transformations and relevant plans for the use of heritage assets, leveraging the existing heritage and territory potentials towards the principles of sustainable and smart city development (Restussia et al., 2011).

Central and local authorities responsible for cultural heritage in many cities tend to increasingly use i GIS technology as a basic component in their attempt to build corporate information systems (Petrescu, 2007). Elements with an inherent spatial dimension comprise cultural heritage. The spatial aspect of heritage elements is essential for their management; thus, the fact that several of such systems are based on GIS – related technology should not be a surprise (Parcero – Oubina et al., 2013).

This paper is part of a wider research still in progress and refers to the creation of a specialised GIS, which includes a great range of geometric and descriptive information that can be used for the interpretation, monitoring, visualisation and evaluation of urban heritage areas. This GIS system can provide the basis for comprehensive interventions in the area, within a process of ongoing planning and monitoring of the evolution and the evaluation of the effectiveness of measures and projects in order to ensure the best outcome with the most efficient allocation of the available resources. The potential of the system's cooperation with specialised software is particularly interesting; it could facilitate the thorough examination, analysis and correlation of parameters involved in relevant practices of urban space's upgrade and renewal, towards the principles of sustainable and smart city development (Multicriteria Analysis, Bioclimatic design and planning etc.). The case study of the paper is the Old Town of Xanthi, one of the most important examples of the 19th century's urban civilization in Northern Greece.

2 AREA OF RESEARCH

2.1 GENERAL DESCRIPTION AND CULTURAL VALUE

The Town of Old Xanthi is located in the heart of modern Xanthi, one of the most important urban centres of the Thrace region in the northern part of Greece, with 55.000 inhabitants. Old Xanthi is a unique pole of attraction surrounded by places of exceptional cultural, historic and ecological value.

Old Xanthi covers an area of 31 Ha, occupying 1/7 of the total city's area. It extends along the foothills of Xanthi, bounded by a thick forest to the west, a river valley to the east and by the centre of the modern city to the south (Figure 1). The flexibility of the urban pattern with its irregular street system and hilly terrain provides a pedestrian environment full of sights and landmarks (Giannopoulou et al., 2012).

The public and private buildings are excellent examples of several periods of the late 19th and early 20th century architectural styles', mingled with a variety of examples of vernacular architecture. The older buildings, most of them built by traditional craftsmen, are easily recognised by their masterful combinations of masonry and wood construction – heavy and solid on the ground floor with a light frame on the first floor. Nineteenth century's eclecticism influenced most of the buildings in the urban centres of Northern Greece, borrowing styles from all over Europe. Old Xanthi followed this pattern, adapting a rich variety of styles and building systems to the local needs and its unique microenvironment. By 2011, Old Xanthi contained about 10% of the city's total population.

Fig. 1 a) Area of research; b) Urban tissue

2.2 HISTORICAL BACKGROUND

The Old Town was founded in the third decade of the 19th century as revealed by the age of many churches around which the first neighbourhoods were developed. Between 1870 and 1910, the town became the major commercial, administrative and military centre of a region the economy of which was shaped by tobacco production and manufacturing; its history mirrored the economic rise and fall connected with single industry. During the period of economic growth, tobacco merchants, builders and technicians settled in the town from all over Northern Greece. A complex urban fabric evolved rich in community buildings and imposing private mansions erected by the emerging wealthy class.

The dawn of the 20th century found the centre of Old Xanthi unable to support further growth. New housing and manufacturing sectors emerged further south and, along with the influx of refugees fleeing Asia Minor in 1924, created a new city, double in population, while the centre gradually shifted southward.

After World War II, the drastic decline of the tobacco industry combined with weak regional economic policies, forced most tobacco entrepreneurs to relocate to greater urban centres and a large portion of the workforce to emigrate to the industrial centres of Europe. Abandoned by the original wealthy settlers, Old Xanthi became a typical example of a declining, low income residential area. In 1970s, a relative recovery in the city's economic life took place, determined by the emergence of new economic activities. In 1993, the "Plan and Program for the reservation – restoration and growth of Old Town" (TEAM4, 1993), defined main institutional measures concerning building regulations, land use and protection. In this context, the Municipality of Xanthi has implemented individual interventions in buildings and public spaces.

3 METHODOLOGICAL FRAMEWORK

The creation of the specialised GIS was based on the structure of the existing GIS that had been created to cover the needs of the aforementioned Plan and Program. The existing GIS included geometric information (blocks, lots, buildings, streets etc.) and very limited descriptive information that specified only a few properties of the objects (mainly from the urban analysis), without covering the full range of the collected primary data the majority of which was not coded, while a wide detailed field recording is ongoing. Therefore, the full data retrieval and its systematic recording at the new redesigned database were considered necessary, combined with the application of suitable transformations in order to fit the current National Reference System, and to allow comparisons with up to date data. The present paper focuses on the elaboration of the data concerning the built environment and more precisely its systematic retrieval and import to the GIS system; moreover it examines 17 chosen variables using a combination of Multivariable Analysis methods (Correspondence and Hierarchical Cluster Analysis) (Markos et al., 2010) for the data interpretation and evaluation.

3.1 THE EXISTING PRIMARY DATA

The analysis of the built environment was based on detailed fieldwork recording. A card was completed for all the buildings of the region. Every main building that is located within each property was recorded at this unique card. For the out auxiliary buildings and the additions no separate card was completed; these are mentioned as part of observation and description of main building's changes. The card contains the building's code, its address, name (if any), owner and ownership status, brief description of its configuration and construction, height, condition of the structural system, façade and roof, potential additions, deteriorations of the façade's elements or morphology, map extract (scale 1:2000) where the contour and coverage of the building are pointed out, and finally, a representative picture of it.

For the remarkable buildings, and for some less interesting, additional information was recorded at an extra card, with the aim to fully identify the built environment, such as: more representative pictures of the building, observations of typological and/or morphological nature, decorative elements, plans, and relevant literature.

The Plan and Program also included quantitative and qualitative recording of the region's urban data (indexes that can be systematically coded, analytical inventory of local and hyper local uses and environmental data, mainly at public spaces). Moreover, a sampling survey took place by distributing a questionnaire to a 10% of the total population for recording data concerning housing conditions (household size etc.) as well as certain demographic and socioeconomic characteristics of the residents (age, sex, geographic origin, educational level, job).

3.2 CHOICE AND ANALYSIS OF VARIABLES

The description of the 17 variables that were used, concerning 1088 recorded main buildings, follows: Variable XX1 refers to the Code of the block, while variable XX2 describes the ownership status of each building. Variable XX3 refers to the classification of buildings depending on their period of construction (it was based on the existence of age on the facades, on the ownership titles, on the typical way of building and use of specific materials or to historical data directly related to the construction activity). Variable XX4 gives an estimation of the buildings' height based on the number of storeys, whilst Variables XX5 – XX8 present the original as well as the current use of the ground and upper floors of the buildings. Variables XX9 – X11 describe the condition of the structural system, the façades and the roof respectively. Variable X12 refers to the architectural typology of the building and X13 indicates the existence or not of additions of any sort. Variable X14 refers to deteriorations of the original building in relation to the potentiality of recovery and return to the initial condition. The existence of outer or/and inner decoration and other special morphological elements is described by the use of variable X15. Variable X16 is used for the qualitative assessment of the building based on criteria such as its architectural value, its morphological and typological elements and their degree of conservation, the symbolic or historic value of its use or its inclusion in an interesting residential complex or characteristic street façade. Finally, variable X17 presents the legal protection status of the building.

The classification for all the aforementioned variables is presented at Table 1.

The cartographic representation of several of the variables, which are grouped later with the aid of Multivariable methods, through the production of thematic maps consists a first approach of the basic characteristics of the built environment and contributes to achieving a complete overview of it (Figure 2 – 6).

3.3 CORRESPONDENCE AND HIERARCHICAL CLUSTER ANALYSIS

Correspondence and Hierarchical Cluster Analysis are two of the most well – known and widespread methods of data analysis which belong to the wider area of Multivariable Statistical Analysis and have experienced rapid development mainly in France, after 1970. The advantages of these methods include the following: processing of large tables that contain heterogeneous data, elaboration of qualitative data, identification of the existence of both linear and non-linear relationships among variables, depending on the data used. Both methods are used in cases where the researchers' objective is to reveal the secret structure of a dataset, without distinguishing the variables in dependent and independent and without the existence of strict a priori assumptions or conditions. Correspondence Analysis allows the reveal of correlations among categorical variables which cannot be detected by successive comparisons of pairs of variables. Thus, the method concludes in the graphical data representation or visualization by the use of simple geometric representations (point clouds, factorial lines and levels). Through these, the natural interpretation of possible interactions, correlations, trends, similarities or contrasts among points may be revealed, which are not obvious or easily perceived. Hierarchical Cluster Analysis is complementary to the results of the aforementioned Correspondence analysis. The objective of the method is to create, as much as possible, internally compact and at the same time disparate groups of variables (Blasius and Greenacre, 2006).

CODE	VARIABLE	CLASSIFICATION
XX1	Block Code	1-76
XX2	Ownership type	Private, Public
XX3	Construction period	-1880, 1881-1900, 1901-1920, 1921-1950, 1951-
XX4	Buildings' height	One - storey building, two - storey building, multistorey building
XX5	Original ground floor use	Residential, Public, Commercial
XX6	Current ground floor use	Residential, Public, Commercial
XX7	Original upper floors use	Residential, Public, Commercial
XX8	Current upper floors use	Residential, Public, Commercial
XX9	Structural system's condition	Very good, Good, Average, Bad - Ruined
X10	Façade's condition	Very good, Good, Average, Bad - Ruined
X11	Roof's condition	Very good, Good, Average, Bad - Ruined
X12	Architectural typology	Traditional type, Eclectic influenced type, Vernacular type, Contemporary construction
X13	Additions (of any sort)	Existence, Non - existence
X14	Deteriorations	Non - reversible, Reversible, Non - existence
X15	Decoration - Morphological elements	Existence, Non - existence
X16	Qualitative assessment of buildings	Highly remarkable, Remarkable, Interesting, Neutral, Disharmonious
X17	Legal protection	Existence, Non - existence

Tab.1 Classification of variables

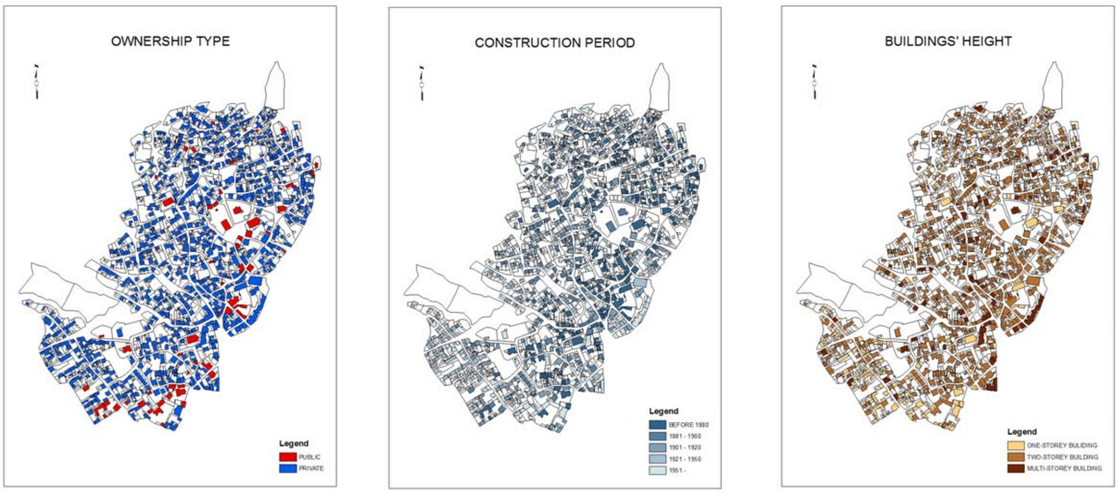

Fig. 2 a) Ownership type; b) Construction period; c) Buildings' height

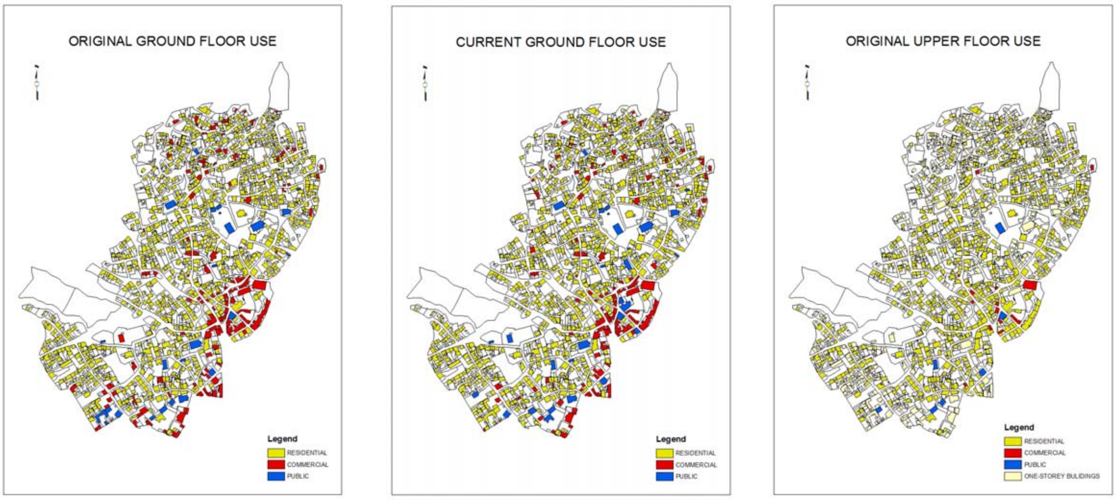

Fig. 3 a) Original ground floor use; b) Current ground floor use; c) Original upper floor use

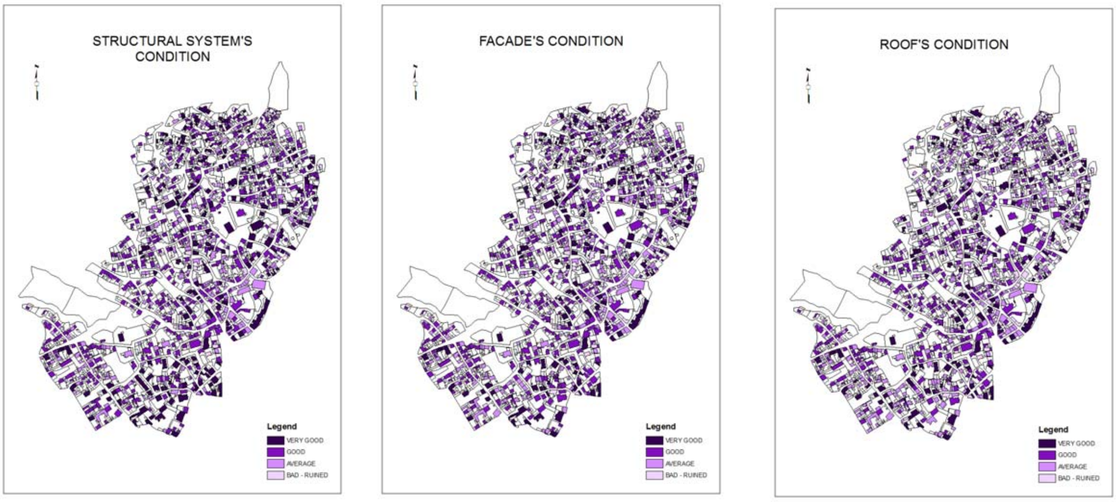

Fig. 4 a) Structural system’s condition; b) Façade's condition; c) Roof's condition

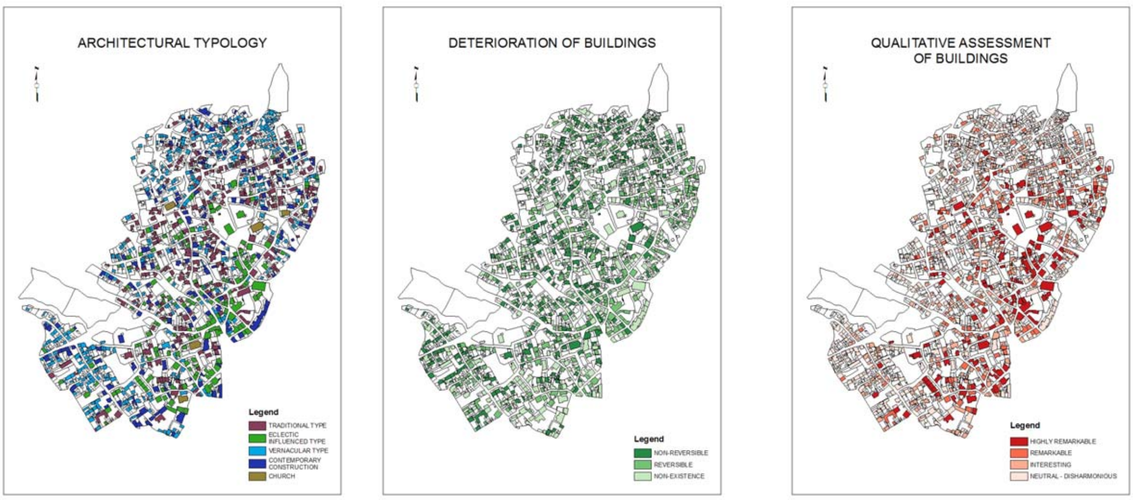

Fig. 5 a) Architectural typology; b) Deterioration of buildings, c) Qualitative assessment of buildings

4 RESULTS AND DISCUSSION

The Hierarchical Cluster Analysis with the aid of Correspondence Analysis has shown the existence of four (A, B, C, D) distinctive and very interesting groups which are presented at Table 2 and are analyzed in the following part. Every group has its own specific characteristics.

CODE	GROUP A	GROUP B	GROUP C	GROUP D
XX1	8, 9, 7, 91, 16, 64, 13, 21, 97, 92, 14, 68, 1, 83, 61, 96, 63, 66, 10, 15, 12, 95, 48, 45, 82, 59, 60, 81, 41, 47, 18, 69, 87, 70, 72, 17	90, 76, 20, 94, 93, 50, 86, 77, 79, 71, 80, 52, 67, 44, 53, 51, 54, 74, 98, 73, 88, 55, 42, 78, 75	65, 57, 43, 2, 6, 62, 49, 3, 4, 5	46, 40, 39, 37, 38
XX2	Private	-	Public	-
XX3	-1880, 1881-1900	1901-1920, 1921-1950	-	1951-1970, 1971-1993
XX4	Two - storey building	One - storey building	-	Multi - storey building
XX5	Residential	-	Public, Commercial	-
XX6	Residential	-	Public, Commercial	-
XX7	Residential	-	Commercial	-
XX8	Residential	-	Commercial	-
XX9	Average	Good	Bad - Ruined	Very good
X10	Average	Good	Bad - Ruined	Very good
X11	Average	Good	Bad - Ruined	Very good
X12	Traditional type	Vernacular type	Eclectic influenced type	Contemporary construction
X13	Non - existence	Existence	-	-
X14	Reversible	Non - reversible	-	Non - existence
X15	Non - existence	-	Existence	-
X16	Highly remarkable, interesting	Neutral	Remarkable	Disharmonious
X17	Non - existence	-	Existence	-

Tab. 2 Clustering of the built environment

Group A occupies an important part of the historic center which includes remarkable buildings with interesting morphological and typological elements, which represent the architectural production of the second half of the 19^{th} century. Interesting buildings of a more vernacular architectural production with simpler characteristics, which nevertheless are linked harmoniously with the aforementioned ones, are situated in the outskirts of the area.

The traditional type of two-storey house dominates the area, in which category the earliest constructions of the Old Town belong and the use of which is almost exclusively residential.

From a constructional and morphological perspective, this building type incorporates the elements of the common architectural tradition of the northern Greek and Balkan area during the Ottoman period, with great freedom in order, which allows for excellent adaptation of the block's shape and of good orientation requirements, as well as for a noteworthy series of variations. This type also suffers from several maintenance problems at the main structure, the roof as well as at a large part of the façades.

Changes or deteriorations of the initial shell are not reported, while the deterioration of the façades is reversible and mainly refers to the replacement of the original wooden frames with metal ones, the addition of medal sheds, staircases and barriers, the blocking of old openings and the creation of new ones.

The protection of the building's shell and façades is proposed; currently, the majority of buildings are not under official protection by any relevant public authority.

Group B is situated at the northern and south-western part of the Old Town. It is characterised by simple ground floor buildings with small size and cheap materials, without any special morphological elements, well – maintained, which follow types and constructional ways of the local tradition of the first half of the 20th century. They may belong to the period between 1900 and 1920 as well as 1920 – 1950.

They are architecturally indifferent buildings, greatly distorted by contemporary changes and conversions which are not limited to auxiliary buildings and additional residential spaces, but also include illegally built independent units. Moreover, they are combined with radical deterioration or demolition of the façades and the original buildings, which makes them incompatible with the general character of the area.

Group C is located in the central core and the south-eastern part of the Old Town and includes buildings which represent the most remarkable examples of mainly neoclassical forms. The buildings' typology and morphology follow the relevant western patterns of the end of 19th century and they are distinguished from the traditional ones due to the use of industrialised materials (industrial bricks, tiles, metal reinforcements).

The main characteristics of the traditional eclectic styles are the symmetry in the organisation of the façade and the plan, the emphasis on the central axis, the strict geometric outline etc.

Figg. 6, 7 (6) Built environment; (7) Clustering of the built environment

Elements borrowed from different architectonic styles, basically neoclassic but also eclectic, decorate the buildings' facets, while several buildings are decorated by paintings. The majority of them are residential buildings with a commercial store at the ground floor or commercial or public buildings.

The public buildings' category involves buildings with administrative, religious, educational use, or buildings which currently accommodate public functions (city hall, nursery school etc.). The commercial buildings' category includes commercial stores, work crafts, leisure and social gathering spaces and is characterised by a special morphology directly related to customer service and the space function. The bad condition of buildings does not represent the whole group but it is due to the recording of certain cases of remarkable and rare buildings which have undergone significant but reparable changes and deteriorations.

Group D enters linearly the southern part of the Old Town and includes buildings of the latest period that were built using reinforced concrete. They are three or four – storey buildings, disharmonious with the region's image, which have not been subject to further changes or deteriorations.

The spatial allocation of the aforementioned Groups of buildings reveals a noteworthy concentration of remarkable buildings at the largest part of the traditional area, which, in combination with the presence of intermediate buildings that play a connective role, gives clusters of single character and high quality architecture. Certain cores with less remarkable buildings, but in general interesting character and only a few negative interventions, are located mostly at the foothills of the remarkable areas and as result the traditional character of the historic centre is preserved.

The deteriorated and indifferent areas are gathered exclusively at the northern and western part, with only exception a linear intervention of new buildings in the southern part that is directly linked to the surrounding area of the city center.

5 CONCLUSIONS

The complexity and interaction of information issues posed by modern urban planning needs, especially when considering urban heritage regions, require the use of Geographical Information Systems technology. The use of an integrated GIS environment not only contributes to improving the quality of research but also offers the possibility of continuous updated information and monitoring of the factors that influence development policies' implementation.

Therefore, the adoption of a GIS system has direct qualitative and quantitative benefits, due to the facilitation of access to and updating of the archive data during the development of urban planning processes, while at the same time the historic data that refers to the same region of interest is maintained. In the present paper, the information database of an existing GIS system was enriched in the context of the upgrading process of the Old Town of Xanthi, by the introduction of its administrative continuity.

The final results and the created geodatabase will be used for further analysis and research in the field of application of GIS for conservation of urban heritage areas. Ideas for further research include the collaboration with specialised software which would facilitate the thorough examination, analysis and correlation of parameters involved, towards the principles of sustainable and smart city development. More specifically, Multiattribute Decision Analysis Models (e.g. Analytical Hierarchy Process and Ideal Point Methods) could be used concerning urban planning policy issues in order to extend the analytical framework of historic centers' GIS.

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NETWORK SCREENING FOR SMARTER ROAD SITES

A REGIONAL CASE

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ABSTRACT

Road safety has been a main societal and policy issue in many European countries since the early years of last decade. After the 2000-2010 Road Safety Programme launched by the European Commission, in 2011 the Commission adopted the new 2020 programme, even more demanding than the previous.

As the societal consequences of road casualties are increasingly perceived as a core dimension of smart mobility, road safety system is now facing new challenges. Current mobility shifts to softer and greener transportation means raise new safety concerns for an increasingly larger share of vulnerable road users. The need to integrate road safety requirements with other residential, mobility, and environmental policies calls for a more detailed understanding of the phenomenon at different spatial levels and with different observation lenses.

The pilot study described in this paper is a contribution to this end.

It aims at identifying the accident prone sites of the regional road network to help prioritizing safety interventions, by the regional administration having road planning responsibilities.

The study develops a screening approach to select hazardous road locations, outside urban premises, from the Piedmont provincial and state roads. The most recent data for the 2010-2012 years were considered, drawn from the ISTAT road accident database, managed by the CMRSS.

The procedure consists of the following steps: identification of the elementary road sections to be screened, through a GIS analysis; definition of the screening groups (road sections have been subdivided in 4 length classes); definition of the selection criteria, with two severity thresholds based on the crash density; classification of the elementary road sections by severity thresholds.

KEYWORDS

Road Safety, Road network screening, Regional monitoring centre, Crash data

1 INTRODUCTION

Since the launching of the 2000 Road Safety Programme by the European Commission, road safety has become a main societal and policy issue in most European countries. By 2010, the final year of that programme, several policy initiatives at national and regional levels were carried out and road deaths considerably reduced, although the target of halving road deaths was not achieved.

In 2011, the Commission adopted the 2020 programme which aims, as the earlier one, to cut by half road deaths in Europe by the end of the decade. It also sets out a mix of initiatives, focusing on improving vehicle safety, the safety of infrastructure and road users' behavior.

In Italy, improvements in road safety between 2001 and 2010 have been significant: road deaths reduced by 43%, and a decrease in the number of accidents was recorded for the first time.

The European initiatives had a main role in stimulating research on the various aspects involved in road safety, concerning road users, vehicles and infrastructures (see the DG move website[1]). They raised questions of data availability and comparability across countries and helped to establish a European road safety observatory[2], stimulating similar initiatives at national and regional levels.

In Italy, for example, an inter-institutional agreement was signed which involved representatives of the Transport, Health and Defense Ministries, as well as of the National Statistical Office (ISTAT) and local government Associations (ANCI and UPI)[3]. It made it possible for sub national governmental bodies to directly engage in road safety monitoring activities, seeing to the data gathering and quality control operations, as well as to the analysis of the collected evidence.

Road safety research is now facing new challenges. As the societal consequences of road casualties are increasingly perceived as a core dimension of smart mobility, it is realized that approaches currently used to probe into road casualties need refinement both on the methodological and practical grounds (see Hakkert and Braimaster 2002; Maibach *et al.* 2008; OECD/International Transport Forum 2008, Antoniou and Yannis 2012).

This is even more apparent at local level, where primary responsibilities to take actions for road safety usually lie. Many indicators conventionally used in studying road accidents, in fact, need to be detailed or better specified according to situated contexts in order to support stakeholders in identifying effective countermeasures.

The study discussed in this paper is a contribution in this direction. Its motivations stem from the activities carried out by the Piedmont Road Safety Monitoring Center (RSMS) (see Boero et al. 2010, Occelli, 2013), which has a main commitment to provide road safety evidence and research support to regional stakeholders.

More specifically, the study aims at identifying the accident prone sites of the regional road network to help prioritizing safety interventions, by the regional administration having road planning responsibilities. In the following, section 2 describes the pilot approach to road screening which has been investigated in the study region. Section 3 presents the main results of its application and comments on the findings. Finally, section 4 makes some general recommendations for next research steps.

1 http://ec.europa.eu/transport/road_safety/index_en.htm.
2 http://www.erso.eu.
3 http:// www.sicurezzastradalepiemonte.it/it/documentazione/normativa/italia/Protocollo%20intesa%202011.pdf.

2 AN APPROACH TO ROAD SCREENING AT REGIONAL LEVEL

2.1 BACKGROUND

Improving road crash data gathering and reporting have been at the core of the RSMS activities since its establishment. As a result, the regional road crash database has progressively got better over time, and the quality of casualty and location data considerably improved as well. Reliable information about the location of a crash event is a fundamental requirement in any approach meant to identify road sites where countermeasures have to be realized.

This is the main goal of network screening which aims at selecting from a large number of road sites (including intersections and sections), a relatively small subgroup which merit deeper investigation from an engineer and/or economic point of view (Hawer *et al.* 2002; Cheng and Washington 2008).

Network screening is the first stage in the development of appropriate and cost-effective treatments to reduce the frequency or severity of accidents. As shown in Fig. 1, the overall process for site improvement consists of three stages (Hawer *et al.* 2002): a) examination of the road network in order to obtain a list of sites ranked in order of priority, which will be subsequently subjected to Detailed Engineering/Economic Studies (DES); b) generation of “prospectively cost-effective” projects, based on DESs and c) evaluation of the road screening methods and DESs.

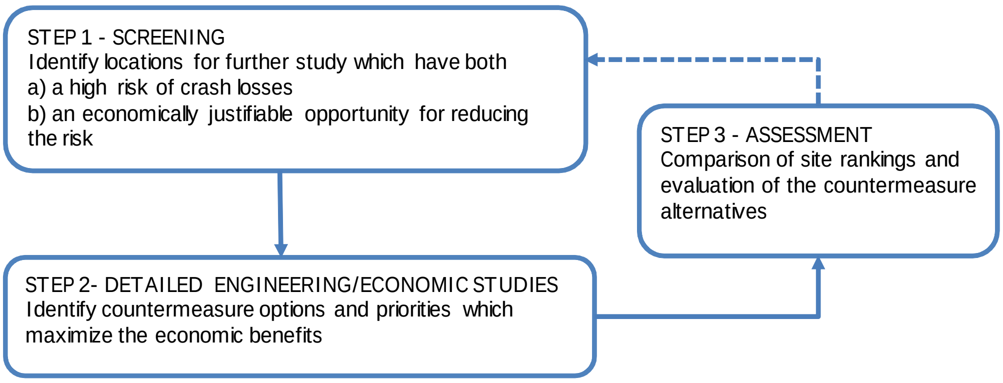

Fig. 1 Main stages in approaches to road site improvement

The present study develops a screening approach to select hazardous road locations, outside urban premises, from the Piedmont provincial and state roads, which are under the jurisdiction of regional and national authorities. Municipal roads and highways are therefore excluded from the analysis.

The information basis is drawn from the ISTAT road accident database for Piedmont, managed by the CMRSS. It stores the elementary crash data collected by the police since 1978, through a data gathering protocol which records information concerning people injured, vehicles involved, and rescue team, type of crash, accident likely causes, and crash location.

The latter, in particular, is specified according to several descriptors such as road type, municipality code, road site (intersection or section), premise (in urban or rural area), address, and more recently geo-code coordinates. The most recent data for the 2010-2012 years were considered; they account for about 20% of the crashes which occurred in the region in that period and were responsible for more than 40% of the deaths.

2.2 THE PROCEDURE

The approach is motivated by institutional responsibility in managing road infrastructure. It extends an earlier investigation of hazardous roads (see CMRSS 2013), although it has still to be considered as a work in progress in the development of road screening approaches at regional level.

The implemented procedure exploits the existing material and namely the crash information basis, mentioned above, and a descriptive profile of road sections obtained by means of a GIS analysis of the regional road network. Other information often used in road screening techniques such as the road functional level, accident exposure level or risk was not available. The procedure consists of the following steps:

- A. *Identification of the elementary road sections to be screened*. These are identified through a GIS analysis as the extra-urban road sections delimited by municipal boundaries. By considering the road name, municipality code, and specification of premise, road crashes in the 2010-2012 are assigned to the identified road sections (see CMRSS 2011). Besides its ID (formed by joining the road and municipal code), an elementary road section has three type of descriptors: i) spatial indicators such as length and population density of the municipality in which the tract is situated; ii) accident variables, such as the total number of crashes, and casualties, the number of accidents and casualties by road users, type of collision and site; iii) accident indicators such as crash density, defined as the ratio between number of crashes and section length.
- *B. Definition of the screening groups*. Road sections have been ordered by increasing length and the resulting ranking subdivided in 4 length classes, according to a twofold criterion of having meaningful length classes and a balanced distribution of the number of road sections in each group. The elementary road sections are then classified according to these length classes.
- *C. Definition of the selection criteria: severity thresholds on the crash density*. Within each screening group the Crash Density Mean (CDM) is computed. Because of the high variability in the end to end of road sections, two severity thresholds are distinguished taking into account the value of the Standard Deviation (SD) of the crash density in each group. T2, the higher threshold value is calculated as CDM+SD, and, T1, the lower one, as CDM+SD/2.
- *D. Classification of the elementary road sections by severity thresholds*. For each reference groups, the elementary road sections are then classified according to a threefold value, S0, S1 and S2, depending if their crash density value is less then T1, between T1 and T2 or higher than T2, respectively.

Table 1 below outlines the road safety descriptive profile for the 4 screening groups, obtained from the A-C steps of the adopted procedure. Not unexpectedly, longer road sections (screening group 4) account for the largest share of crashes (44%) and for nearly half of those occurring in the most densely populated areas.

Screening groups. Length classes (km)	N. road sections	N. Crashes	N. Deaths	N. Injured	% Crash by population density less than 150 in/skm	 from 150 to 500 inh/skm	 greater than 500 inh/skm
1) shorter than 1,5	435	934	57	1425	10%	14%	19%
2) from 1,5 to 2,5	452	1310	68	2016	18%	21%	12%
3) from 2,5 to 4,1	452	1706	121	2660	28%	22%	20%
4) longer than 4,1	452	3120	184	4967	43%	43%	49%
Total	1791	7070	430	11068	100%	100%	100%

Tab. 1 Descriptive account of the Piedmont road sections by screening groups

Crash density and severity thresholds, however, have maximum values in the screening group concentrating the shortest road sections, see Fig.2. Longer or moderately long road sections (screening groups 3 and 4) have relatively lower values of crash density and severity thresholds.

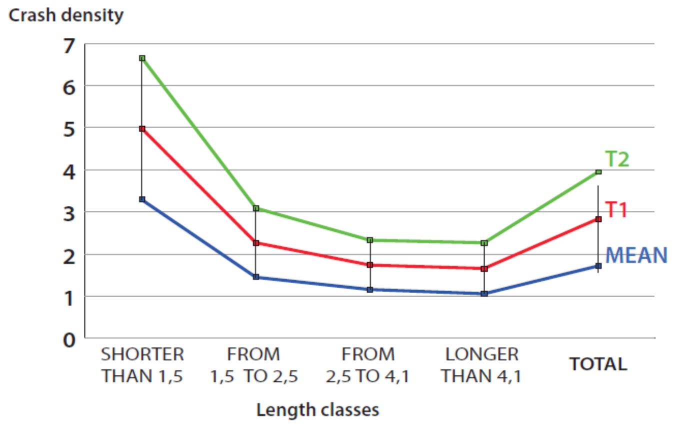

Fig. 2 Mean crash density and severity thresholds by screening groups (length classes) and for the overall network

3 RESULTS OF THE SCREENING PROCEDURE

3.1 AN OVERVIEW

The results of the above procedure can be appreciated from a twofold perspective. First, from an analytic point of view they allow us to outline a multi faceted profile of the hazardous situations of the regional road network. Second, on the operational ground they make it possible to draw a list of road sections filtered by severity thresholds which can inform more detailed analysis.

The analytic focus, in particular, shows that, overall, 34% of the Piedmont road sections are S1 hazardous, and concentrate 13% of crashes. Only 10 out of 100 road sections are S2 unsafe but these account for 36% of accidents. As shown in Fig. 3, the largest share of the most dangerous (S2) road sections belong to the group with longer road sections.

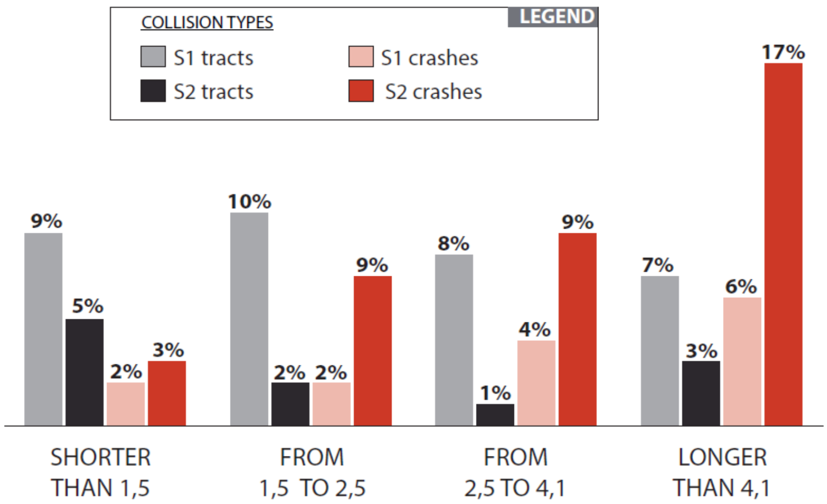

Fig. 3 Share of S1 and S2 dangerous road sections by road length classes

A comparison of the crash distribution by type of collision for the unsafe road sections (S2) and the safe ones (S0), Fig.4, reveals that head-on collisions tend to concentrate on medium length road sections. Front-side collisions and sliding accidents occur to a larger extent on longer road sections.

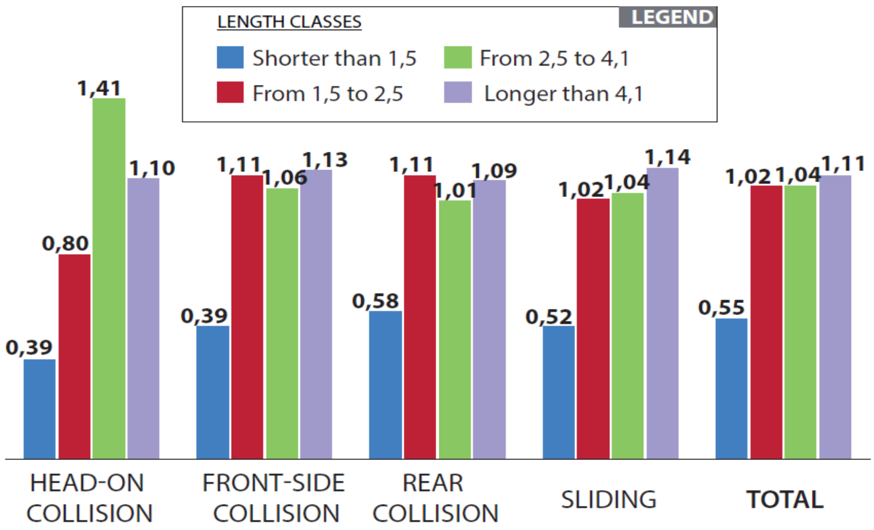

Fig. 4 S2 crash concentration index by type of collision and road length classes

Crashes involving vulnerable road users (pedestrians, cyclists and motorcyclists) account for 18% of the accidents occurring on S2 road sections, Tab.2. The percentage is rather homogeneous across the reference groups, although slightly higher for the shorter road sections.

Motorcyclists account for the largest share of crashes involving vulnerable road users (70%). This is even larger within the screening group including longer road sections.

	Number of crashes				% crashes		
Reference goups. Length classes (km)	All road sections (a)	On S2 road sections (b)	Vulnerable road users on S2 road sections (c)	Motorcyclists on S2 road sections (d)	S2 (b/a)	S2 vulnerable road users (c/b)	S2 Motorcyclists (d/c)
shorter than 1,5	934	231	47	30	25%	20,3%	63,8%
from 1,5 to 2,5	1310	516	90	58	39%	17,4%	64,4%
from 2,5 to 4,1	1706	632	122	86	37%	19,3%	70,5%
longer than 4,1	3120	1193	208	154	38%	17,4%	74,0%
Total	7070	2572	467	328	36%	18,2%	70,2%

Tab.2 Shares of crashes for vulnerable road users (pedestrians, cyclists and motorcyclists) and for motorcyclists by screening groups

An overview of the location of the unsafe road sections is offered in the map of Fig.5, where the population density by municipality is also shown. The map reveals a concentration of the most dangerous road sections (S2) in high density municipalities and particularly in the metropolitan area. One out of 4 of the accidents occurring on the most unsafe road sections are in high density areas.

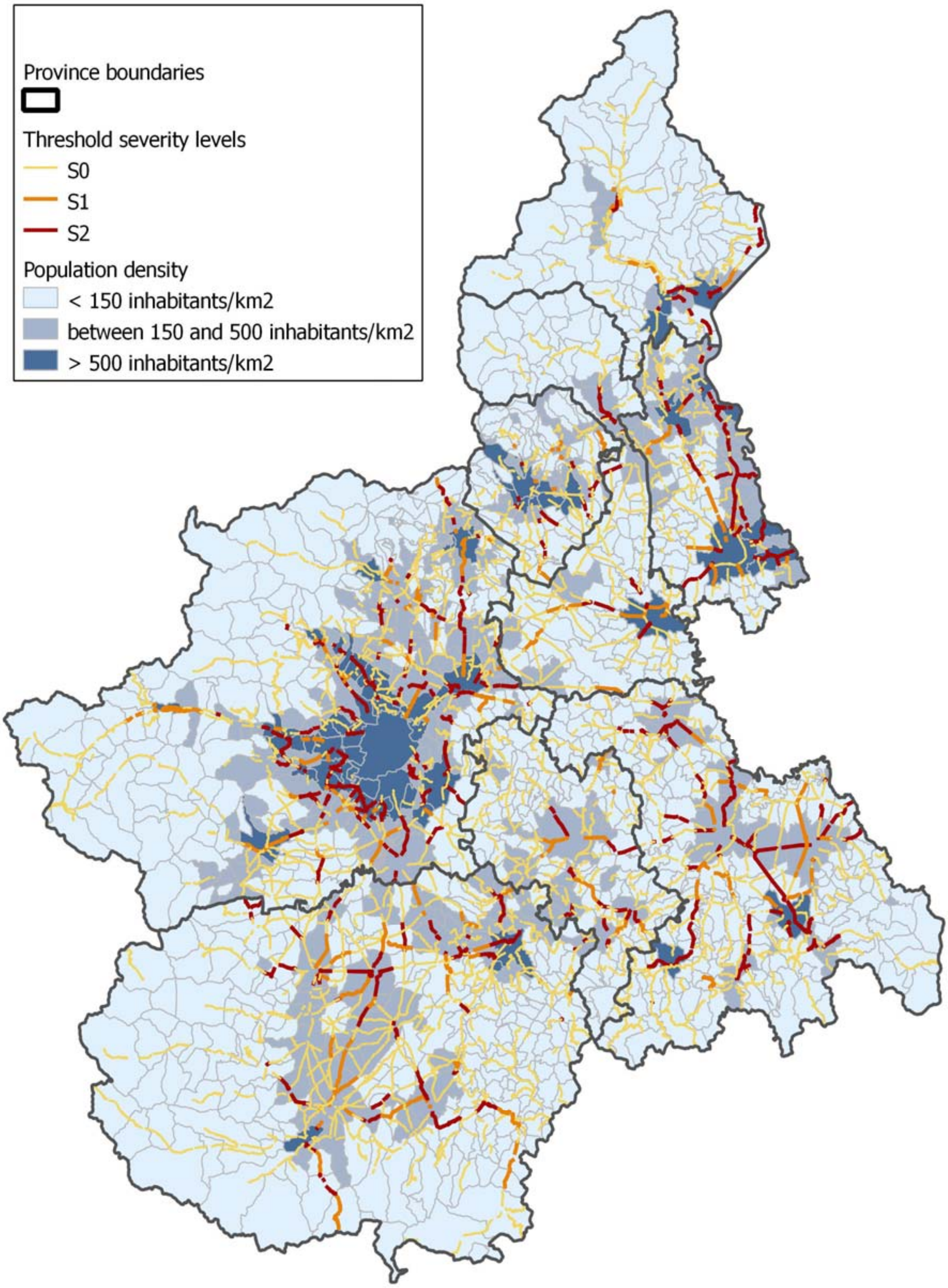

Fig. 5. Unsafe road sections by severity thresholds on the Piedmont road network (2010-2012)

3.2 A FOCUS ON THE MOST UNSAFE ROAD

The first 10 most hazardous road sections ranked by number of accidents is presented in Tab.3.

Road ID	Municipality code	reference group	population density (inh/km^2)	crash density (N. crashes/km)	N.Crashes	N. Deaths	N. Injured
006SP010	006003	4	439,6	7,2	109	2	193
006SP035bis	006114	4	500,1	10,2	54	1	85
001SP143	001171	4	1011,1	7,4	43	1	66
004SP020	004215	4	188,9	4,4	43	3	67
103SS034	103072	4	808,8	6,7	38	0	64
003SP011	003149	4	519,3	5,3	38	1	54
001SP002	001063	2	639,7	20,0	37	0	50
004SP662	004215	4	188,9	4,3	35	1	73
001SP006	001194	4	452,7	7,2	33	2	61
004SP007	004029	3	487,5	8,4	32	3	55

Tab. 3 The 10 most unsafe road sections (S2) by number of crashes

In order to appreciate the potential of the tested procedure in the following a diagnostic profile for the road on the top of the ranking is summarized in Tab.4.

SP 10 - ALESSANDRIA	Total	S0	S1	S2
N. crashes	177	9	0	168
Injured	288	12	0	276
Dead	5	0	0	5
Length (km)	39,1	8,1	0	29,8
N. road sections	7	2	0	4
Crash density (crashes/km)	3,63	1,16	0	4,87
Collision Types:				
Head crash	6	1	0	5
Head-side crash	37	1	0	36
Collision	65	5	0	60
Sliding	32	1	0	31
Crashes at intersection	35%	33%	0	35%

Tab. 4 Descriptive profile of SP 10 road in Alessandria province (2010-2012)

An examination of the types of crash collision can be appreciated by comparing their distribution on the whole SP10 road and on the S2 sections, Fig. 6.

Four collision types are considered: head crash, head-side crash, collision and sliding. Distribution of crashes is made by comparing the SP10 as a whole with the totality of the provincial roads of the region, and then the more dangerous sections of SP10 (S2) with the totality of dangerous stretches of the entire region. The distribution of whole SP10 reflects the distribution of the sections belonging to thresholds S2; a comparison with the region shows a greater concentration of collisions in SP10 road.

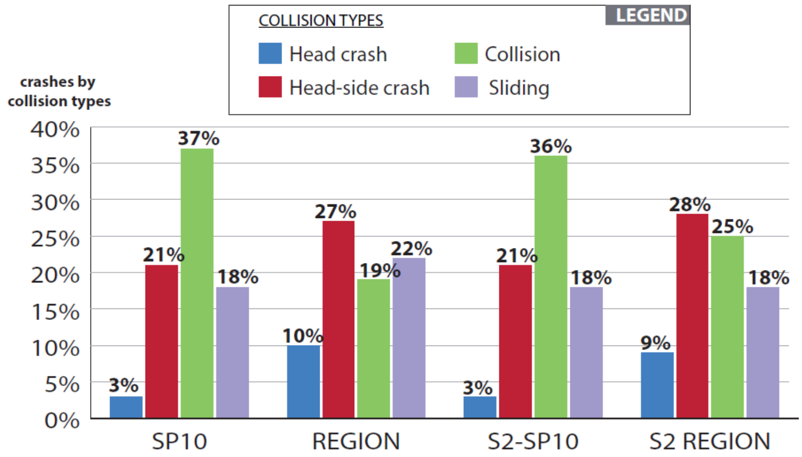

Fig. 6. Crash distribution by collision types on SP10 road and its sections

Fig. 7 shows the four municipalities which are crossed by the S2 road sections. It allows us to visualize that the most dangerous sections belongs to Alessandria. This tract is the longest and has the highest value of the density crash.

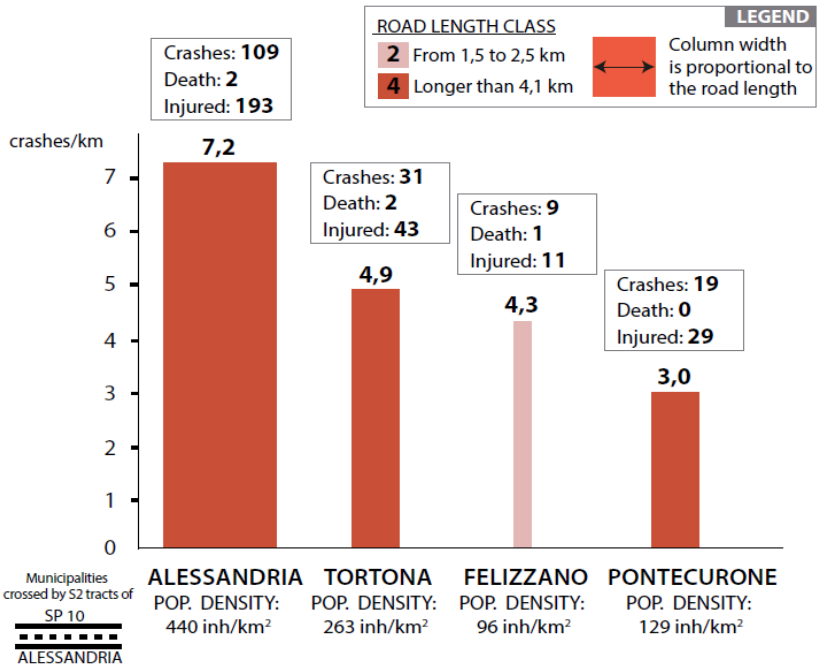

Fig. 7. Municipalities crossed by S2 tracts belonging to SP10 road

This kind of statistical overview can be complemented by a GIS visualization of the crashes provided by the TWIST GIS application. An example is shown in Fig. 8 which visualizes the road sections of SP10 connecting the municipality of Alessandria with that of Tortona.

Fig. 7. Crashes on SP10 between the municipality of Alessandria and Tortona. The red dots represent the crashes on extra-urban provincial roads. Only crashes which have been geo-referenced are shown

4 CONCLUDING REMARKS

Nowadays, the need to integrate the demands of road safety with the other territorial policies, with mobility and environmental issues requires a deeper understanding of the phenomenon at different spatial levels and with different points of view.

The transition to softer mobility styles and greener means of transport raises new concerns about the safety of an increasing proportion of vulnerable road users (pedestrians, cyclists, motorbike and moped riders).

In the current framework of increasingly limited economic resources, it becomes essential to implement effective screening procedures to identify dangerous roads, in order to select a list of sites ranked in priority order to conduct a more detailed engineering and economic investigation.

The pilot study described in this paper is a contribution to that goal.

Of course, additional research is required to establish the basis for a systemic approach oriented to road safety and for the development of effective network screening techniques.

According to the adopted selection procedure about 200 unsafe road sections have been detected, far too many to allow us to carry out a deeper investigation. It will be therefore necessary to sharp the approach and identify more selective filtering criterion.

This calls for a refinement of the network screening technique, to avoid mis-allocation of resources due to the randomness of accident counts. It further requires building a firmer background of the network profiles in the region against which to appreciate the results of the network screening procedures by the different stakeholders.

In this regard other information should be used to support the analysis: in addition to the population density, used here, it is possible to analyze the types of accidents, the morphology of the areas crossed, the vehicular traffic flows (when available), the social costs of accidents, and other variables.

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IMAGES SOURCES

Fig. 1: ISTAT and Regione Piemonte.

Figg. 2, 3, 4, 5, 6, 7, 8: processing CMRSS on ISTAT data.

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LI-FI FOR A DIGITAL URBAN INFRASTRUCTURE

A NOVEL TECHNOLOGY FOR THE SMART CITY

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ABSTRACT

The process of "building a smart city" implies that the way a urban area provides its traditional functions be properly re-designed, in order to meet the often conflicting requirements of furthering the economical development and of improving the quality of the life. ICT can make available methodologies and tools able to support such process, as far as the new solutions are carried out within a global vision of the task to be carried out i.e. within a system approach.

In such context, even traditional infrastructures as the streetlamp system of a city can reveal interesting opportunities, when coupled with updated technologies. Here, the potential benefits of moving to the LED technologies are presented. The relevance of Li-Fi technology is pinpointed. in relation to the ability of efficiently install wireless links for data transfer without increasing (or also reducing) the microwave background in a urban area.

Also the data collection can be improved leveraging upon the already installed streetlamps: the ever increasing amount of sensors (required for many functions, from street security to environment protection) can be deployed without further waste of urban 3D space.

KEYWORDS

Li-Fi, Sensors, Smart cities, Urban environment.

1 INTRODUCTION

"Smart city" is a concept practically ubiquitous in the scientific literature. This is a clear signal of interdisciplinary nature of the related researches, ranging from urban planning to ICT applications and to new hardware systems (sensors, processors, etc.).

Such relevance basically derives from the following points:

- the urban areas are steadily and quickly expanding, because they are able attract and include both people and economic activities;
- some estimates indicate that by 2030 urban areas will globally host about 5 billion people (UNFPA, 2007); out of a foreseen world population of about 8.4 billion, the share of urbanized population will be in the range 78% to 85% in America and in Europe while 48% to 55% in Africa and in Asia, as shown in Fig. 1 (UNDESA, 2012; UNDESA, 2013);
- on the basis of such estimates, the urban population will grow by 100% in Africa and Asia during the time interval from 2000 to 2030, even if the rate of urbanization is steadily declining in every region since 1960; the governance of the city has to meet new challenges at unprecedented quantitative and qualitative scales (UNFPA, 2007);
- among such challenges, the most relevant ones appear to be those related to the quality of citizens' life and to the environmental management; any new development in such fields provides significant improvements to the many facets of the urban governance.

As a matter of fact, the urbanization process is two-faced:

- it provides more job opportunities, on the basis of the many relationships that can be established in the city; the economic development has been constantly based upon the enlargement of the urban areas;
- on the other hand, it challenges the social and ecological resilience of the interested areas; the city usually tends to have a footprint greater than the area delimited by its own borders.

The key point is that the city (from the megacities to the small neighborhoods) is a system of systems with its own dynamic features. This implies that any "local" solution has to be designed taking into account the "global" context. Specifically, the deployment of new “smart” solutions both is caused by and impacts upon the evolution of the urban ecosystem in its amplest meaning (Bonomi and Masiero, 2014).

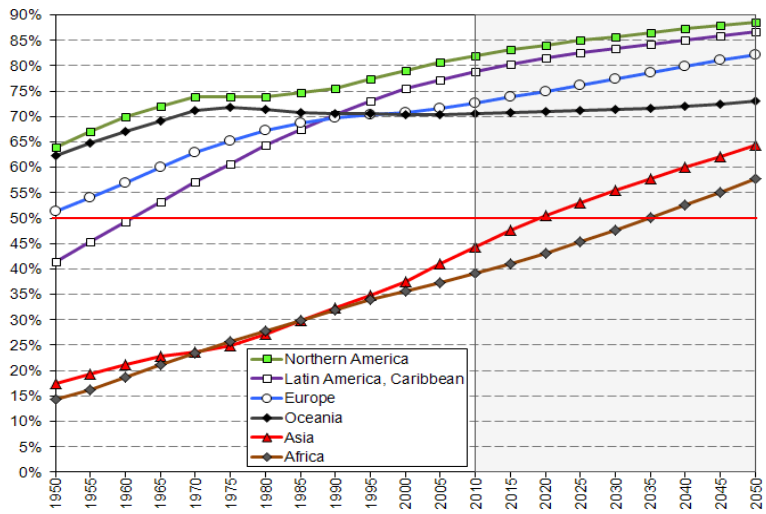

Fig. 1 – Ratio of the urban population to the total population, 1950 - 2050, by major geographical areas

2 SMART CITIES AND ICT

It should be noted that the concept of "smart city" is not completely defined in itself; however, such concept is necessary, in order to correctly evaluate the technological developments (as those here dealt with in the following). The term "smart city" started to show up in the literature in the last quarter of the past century. Since then and up to our days, so many definitions have been suggested that Nam and Pardo (2011) claim the term "smart city" is definitely a fuzzy one. Papa et al. (2013) provide a global review of such definitions, analyzing the scientific literature on an interval of more than thirty years.

Nam and Pardo (2011) aim to set up an operational definition through the observations of the relevant features of what appears to be a "smart city". Basically, they observe that the following factors are necessary for a "smart city":

- technology (infrastructures of hardware and software);
- people (creativity, diversity, and education);
- institution (governance and policy).

It is easy to recognize that such list include all and only the components of an abstract information system, as usually described by IT scholars. A direct link appears to emerge between urban planning and informatics. As well known, ICT is the application side of informatics; from such point of view, ICT is the enabling component of the migration of an urban area to the status of "smart city".

However, in order to establish a smart city (or to recognize an already established one), even if necessary such factors become sufficient if and only if some sort of threshold is reached. Given the interrelationships among the above mentioned factors, a city is "smart" when such factors are able to provide sustainable growth and to improve the quality of the life. Therefore, adopting a systems view (on the basis of the seminal works of Forrester, 1969 and of Mc Loughlin, 1969; the ideas of Batty and Longley, 1994, could also be taken into account), it can be said that in its development the city "diverges" along a new path and evolves to the state of "smart", only if the combined pressure of such ICT-enabled factors is modulated over a certain amount.

Furthering the earlier work of Fistola (2001), namely the vision of *M.E.-tropolis*, Annunziato (2012) suggests a three-level framework for the structural analysis of the "smart city" including:

- *city government*, where the administrative services are made available;
- *city operation*, where the management of the different utility networks is integrated;
- *city life*, where the citizens interact with the administration and access the utility networks.

As far as ICT is referred to as the enabling technology of the "smart city", a special role is given to the data acquisition, to the decision support and to the feedback loops that carry out command and control actions. Specifically, the *city operation* level requires an extensive exploitation of sensors, distributed over the territory of the city and able to provide data flows whose time- and space-frequencies are dictated by the rate of evolution of the urban processes. The information carried by such data fluxes links the citizens' needs (the *city life* level) to the administrative decisions (the *city government* level), improving the global system performance. The sheer amount of data to be collected and processed can be intimidating; accordingly, many R&D efforts have already been devoted to such issue (labeled as "Big Data") and various solutions (often derived by a fruitful cross-fertilization of different scientific sectors) are being available for concrete applications (Manyika et al., 2011). However, it should be noted that the problem has to be dealt with from, at least, two different points of view:

- the data collection from the real world;
- the extraction of the information content from the collected data.

The latter point relies upon the balance of the (steadily decreasing) processing and storage costs vs. the (quickly increasing) available amounts of Big Data. Such balance is mostly carried out in the virtual world (i.e. it mainly involves knowledge) and therefore it is not physically bounded. On the contrary, as far as the involved sensors require physico-chemical interactions, the former point is strongly influenced by the finite amount of available matter and energy, whose eventual shortage will be experienced in the real world and firstly in the urban areas. Moreover, the spatial dimension too is a finite resource in such context. In relation to the ever increasing spectrum of urban processes to be monitored, it cannot be assumed an unlimited proliferation of sensors. The technological efficiency of the sensors appears to be a limiting factor on the path to the "smart city", at least on the medium to long range. Therefore the relevant stakeholders (from city administrators to urban planners and to final users) should be aware of the actual opportunities of deploying "multi-targeted" or "clustered" sensors and, moreover, of embedding such sensors into already existing utility networks. In the following, reference will be made to the urban street lighting, for sake of brevity. However, such reference can be easily extended to other utility networks. Anyway, it should be noted that the ICT-enabled management of the urban street lighting is currently assumed as necessary for the "smart city", aiming to the environmental protection in terms of reduced energy consumption (Gargiulo et al., 2013).

3 NETWORKING THE SMART CITY

In the following, it will be outlined how new streetlamps can improve the life experience in the smart cities of tomorrow. The different lights source technologies (gas, mercury light, sodium light, etc.) adopted in the past have a low energy performance and a long switch on/off time (of the order of minutes) as their a common characteristic. Therefore, R&D efforts have been focused on removing such constraints. US DoE (2013) has analyzed the various light sources, whose capabilities are shown in the following Fig. 2, where the black rectangles represent the efficacy (in terms of lm/W) of conventional lamps or LED packages. The luminaire efficacy (depicted by the shaded regions), refers to the whole system (including electrical, thermal, and optical losses).

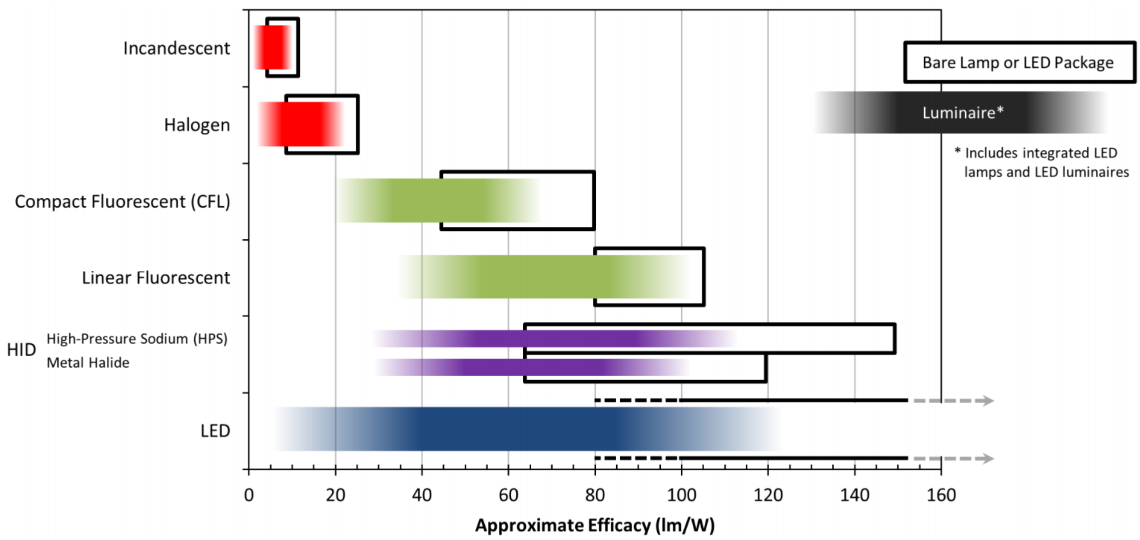

Fig. 2 –Range of efficacy for various light sources.

Among the technologies referred to in Fig. 2, only LED is expected to substantially increase the efficacy in the near future. The forecast of efficiency of white LED lamps has also been investigated by US DoE (2012) in its multi-year Program Plan. It should be noted that white color can be provided relying on two basic approaches: PC (Phosphor Coated) packaged LED and CM (Color Mixed) LED.

In the past years (up to 2005) there weren't differences between CM- and PC- based solutions; the efficacy differences were based on the color temperature. On a 10-year horizon, the CM-based solution will reach more than 250 lm/W and will be the dominant one. It should be noted two interesting features:

- in the past, the efficacy of a LED source was dependent on the color temperature (warm or cool); on the medium term, the efficacy will depend only on the adopted solution (CM or PC);
- for a given color temperature, in the past the efficacy was irrespective of the solution (PC or CM); on the medium term, the best efficacy will be provided by CM.

A LED light source can achieve very short turn on/off time and can be easily dimmed. It is useful to clarify that in the LED technology the flux is assumed to be either absolute or relative. The absolute flux is measured in lumen (lm), according to the international system of units (SI). The relative flux is measured as a ratio of the actual value to a reference value; such reference value is established on the basis of standard conditions: lifelong continuous service, room temperature, forward current intensity, etc. Therefore, the relative flux can achieve values greater than 100%, if the reference conditions are modified.

For instance, a commercial LED lamp (CREE, 2013) has a reference value of 260 lm. Such reference value implies a forward current of about 710 mA and a voltage of 2,9 V. Its voltage can be increased up to 3.35 V, achieving a relative flux of 325% (obviously, this value can be hold for a very short time interval). On the other hand, its voltage can be decreased, up to 2.65, with a corresponding relative flux of 15%.

With a view to signal modulation, it is important to pinpoint that the relative flux is a quasi-linear function of the forward current.

Therefore, the LED lamp shows two characteristics:

- the relative flux is a quasi-linear function of the forward current;
- the relative flux can be modulated over a quite wide range of values.

Those two characteristics, coupled to the other ones (in particular, the short switch time), allow the exploitation of the LED light as an information carrier at *access network* level.

Telecom services are provided by 2 infrastructure levels: *access network* and *core network*. Wireless or radio technology are the best solutions, at *access network* level, to meet the needs of mobile information sharing (of utmost relevance for the "smart city", where the amount and the topology of the users to be connected are always subjected to quick and substantial changes). In the literature, the term *radio* pertains to GSM, UMTS and LTE technologies utilized on distances from 100 m up to 35 km (Pini, 2010) while with the term *wireless* refers to transmissions on distances up to 100 m (as those commonly involved in a urban area). The high-speed links at the *core network* level are mostly provided by optical fibers.

The wireless transmissions usually exploit the frequency bands of 2.4 and 5 GHz of the electromagnetic spectrum. The related wireless technology is based on the IEEE 802.11x set of standards and it is known as Wi-Fi. However, it has to be noted that such frequency bands are heavily accessed, for voice as well as data networking. Therefore, even if many cities have already installed extensive Wi-Fi networks on their territory, such frequency bands can be seen as a quite limited resource, with possible service problems on the medium-to-long term.

Some other solutions, globally referred to as NFC – Near Field Communication, can be of value on the very short distances (Iannucci and Pini, 2013). However, the scarcity of available band has to be globally dealt with. This appears to be feasible by relying on the high spatial resolution of the physical mesh whose nodes are exactly the thousand of streetlamps above mentioned. With such approach, the streetlamps host the wireless access points. Usually, a Wi-Fi technology is exploited; however, as far as the streetlamps are equipped with LED sources, wireless web access points can efficiently be based upon a more novel technology: Li-Fi (Light-Fidelity), whose name was coined in 2011 by Harald Haas of the University of Edinburgh.

Li-Fi is the emergent technology that uses the fast light variations to transmit data, instead of radiofrequencies. From 2012 to 2016 EPSRC, the main UK government agency for funding research and training in engineering and the physical sciences, is devoting 4.6 million GBP to a large project targeting such technology (UP-VLC, 2012).

The light is the portion of the electromagnetic spectrum that can be received directly by human eyes. Its wavelengths range from 380 nm to 760 nm, i.e. a bandwidth from 400 to 790 THz (1 THz = 1000 GHz). Light has been used to transmit information since many centuries, by fire signals and later also by lamps and Morse code. More recently, since the sixties of the past century, light is being used in optical fibers with a bandwidth from 100 Mbps up to 1 Tbps; light is also exploited for point-to-point wireless transmission in LoS (Line of Sight) up to few kilometers using laser-based, stabilized optical systems; the associated costs can often be an issue.

Nowadays, LED lamps have opened a new scenario. LED can achieve a much faster switch on/off time than traditional lamps and this characteristic is compliant with the request of broadcasting solution. LED-based services are available in a fraction of price, weight and volume required by other solutions.

The lesser useful range of LED is not really an issue; on the contrary, when the access points are hosted by the streetlamps (therefore in a high-density mesh) the interferences are much less in Li-Fi than in Wi-Fi. This aspect allows a novel usage of the thousand of streetlamps already installed in each medium-sized city: mainly relying upon its much faster switch on/off time, LED technology can be exploited in order to support the data networking (Daukantas, 2014). The usage of LED source in streetlamps has been reported achieving up to 500 MBps, i.e. 4 Gbps (Rani et al. 2012; Dutta et al. 2013, Sharma et al. 2014). In the above, the relevance of data networking for a "smart city" has already been pointed out.

The communication channel can be depicted in a very simplified way on the basis of the following 5 main elements: a) *Channel coding device* (data stream to light levels); b) *LED*; c) *Medium* (between LED and the Receiver); d) *Receiver*; e) *Channel coding device* (light levels to data stream).

A) CHANNEL CODING DEVICE (DATA STREAM TO LIGHT LEVELS)

This element adapts the info stream to the LED behavior. An info stream typically is a continuous flow of bits (0 and 1) coded with 2 voltage levels (for example 0 is coded with 0 volt and 1 is coded with 3 volt) that has to be adapted to flickering required for the LED.

The impulse to drive the LED are defined symbols and are obtained through a process called modulation. The starting point is a simple level conversion, according with two light level (L0 and L1) that have to be correlated to 0 and 1 bits. So if the *Info flux* is 1 Gbps the *Light flux* is 1 Gsps (Giga symbol per second). If the environment and the receiver support multi-level lights, the light levels available to transmit the info can be more than 2; for example 4. If 4 levels (L0, L1, L2, L3) are used while maintaining the same symbol rate, the info flux can be double. To achieve this symbol-to-level conversion the LED driver chip has to be more complex because it has to store 2 bit and to allocate the right impulse level for the LED. This modulation technique can be enhanced up to 256 levels.

According to signal theory, the numbers of symbols to be adopted in the modulation process is function of number of bits that every symbol has to carry. This can be expressed as:

$$\#S=2^{\#b}$$

where #S is number of symbols and #b is the number of bit to be carried for each symbol.

The modulator is flexible and can performs several MS (Modulation Schemes) according to the number of symbols adopted. Usually MS1 uses 2 symbols, MS2 uses 4 symbols and so on.

B) LED

In this paper, the term LED can refer to a single LED device or to a set of LED devices arrayed in a given pattern. Anyway, each LED can be described in terms of:

- frequency of emission (color);
- intensity of emission (discrete light levels described before);
- relative position within the LED pattern.

For instance, the pattern of LED, according with the utilization of the streetlamp, can be a 10 x 10 matrix or greater.

The LED emitter device is equipped with *ad hoc* mirrors and lens to optimize the light flux. Mirrors and lens are passive component that address and focus the emitted energy in the direction designed. They, as the antenna in radio wave communications, play a key role in defining the signal attenuation from the transmitter to the receiver (i.e. the link budget).

C) MEDIUM (BETWEEN LED AND THE RECEIVER)

The medium between LED and receiver is very important because it determines the throughput of the system; it is obviously the air (when dealing with streetlamps) and its main parameters are distance and weather conditions. The distance and the weather conditions constrain the choice of the modulation technique to be adopted. Gebhart et al. (2004) carried out test measurements in order to evaluate the FSO (Free Space Optic) in fog conditions.

It was found that fog can cause an attenuation of about 200 dB/km (attenuations up to 500 db/km have been reported). Taking into account the typical height of a street lamp, the above implies a fog-related attenuation of about 5 dB. On the basis of the foreseeable interval of attenuation, the *Channel coding device* has to adapt the numbers of levels to be used in the modulation scheme. If the *Medium between LED and the Receiver* produces a low attenuation (in the best weather conditions), the modulation scheme can use several light levels; on the contrary, if the attenuation is high (e.g. during fog phenomena) only 2 light levels can be used.

To achieve this smart modulation scheme it is necessary to predefine an attenuation measure tool. To such purpose, a *Dedicated signal* or a *Check attenuation pattern* are usually set up. A *Dedicated signal* can be provided by a dedicated LED of a color not used for info transmission or by a shared (on a time basis) LED of a color used to transmit. The *Check attenuation pattern* is a pattern not used for user info exchange. Typically, a Li-Fi application exploiting the streetlamps is a Point to Multipoint; accordingly, the smart application scheme has to be adopted for each link of each user.

D) RECEIVER

The receiver is the sensor that converts the optical flux into an electrical signal (as a webcam). The sensor element is provided by a photodiode; it is built as a LED but it works in the opposite mode. In this contest, it is worth noting that the receiver is a pattern of photodiodes that reconstruct the n-dimensional signal. Nowadays, low price web cams have a resolution of 16 Mpixels; the transformation from optical signal to electric impulse is simply a commodity.

E) CHANNEL CODING DEVICE (LIGHT LEVELS TO DATA STREAM)

This component performs the reverse function of the correspondent one in the transmission phase.

4 SENSING THE SMART CITY

As pointed out in the above, Li-Fi is able to provide a valid solution to the problem of the scarcity of available band, moving from radio-frequencies to the visible portion of the electromagnetic spectrum, thus relaxing a strong physical constraint to the data exchanges related to the life of a smart city. Accordingly, the network can support a higher number of users. However, another physical constraint has to be dealt with: the footprint of many different sensors. As far as the capture of data and the information generation is entrusted to automated sensors, the 3D space required by such sensors in a city cannot be neglected or given for granted, even if the new generations of the devices are steadily increasing their level of miniaturization (Borga, 2014).

It should be taken into account that the recent IPv6 protocol (based on 128 bits) allows to assign about 3.4×10^{38} addresses; therefore, the IoT (Internet of Things), where every object of the real world can be uniquely identified and the interaction M2M (Machine –to-Machine) is natively supported, is going to be an operational ecosystem. The plenty of possible IPv6 addresses translates into a density of about $6{,}6 \times 10^{23}$ objects potentially indentified per square meter of Earth surface; as a consequence, there is no more a ICT limit (inside any horizon of interest) to the amount of sensors (static as well as mobile) deployable in a urban area. Therefore, a proper planning and design of the sensors is mandatory.

Again, the infrastructure of the streetlamps can be of help, at least as the static sensors are concerned. It can be safely assumed that each streetlamp is *de facto* connected to a power grid of some sort or to a bank of solar cells, thus meeting the basic requirement of the power source needed by every static sensor. Moreover, each lamp has to be designed to bear dynamical stresses related to various natural or man-induced phenomena (temperature, wind shear, road traffic, etc.). The necessary mechanical structure shows in general many unused surfaces, where it is easy to implant the needed sensors (possibly, without expanding the global footprint.

As a result, it can be envisaged an enhanced streetlamp with several add-ons, e.g.:

- sensors: weather measures (temperature, humidity, pressure, ..), pollution measures (PM10, CO, ..), audio and video surveillance, localization monitoring (GPS);
- network devices: electricity connection, solar cells, batteries; Ethernet link (copper or fiber);
- access point devices: Wi-Fi; LTE base station (additional cellular operator coverage), Li-Fi.

Relying upon the available surface (also clustering the add-ons in suitable ways), the configuration of each streetlamp can be tailored in order to meet the local requirements. In the following, more information is provided about some add-ons.

4.1. SOLAR CELLS

The solar (photovoltaic) cells are designed to convert the energy of solar light into electricity, therefore they are useful where a power source is not available or reliable. The solar cells are quickly evolving. either in technology and in performance. In the eighties, about five different solutions were available, with a conversion efficiency of about 8 to 13%; currently, the efficiency is usually about 18% (as in the case of Panasonic HIT – Heterojunction), while very high performance solar cells can achieve an efficiency of more than 40%.

Thermophotovoltaic cells exploit heat differentials, instead of the direct light. The device has two layers. The first layer converts the sun light into thermal energy and emits the thermal energy based on black body emission frequency, i.e. according with its temperature, mainly in the infrared bands of the spectrum. This first layer has a very high conversion efficiency. The second layer is a traditional solar cell but optimized to work with a single frequency radiation, i.e. the one emitted by the first layer. This tuned solar cell has theoretically a conversion efficiency higher than traditional ones. Multijunction solar cells are solar cells composed of one layer over the others where each layer is optimized for a single optical band. A 5-junction solar cell can achieve an efficiency of up to 38.8% (NREL, 2014).

4.2. WEBCAMS

Webcams (i.e. videocameras sending live or still images over Internet protocols) can be used to capture information for many purposes, e.g. traffic monitoring, accident signaling and video surveillance. Their quality parameters can vary in a wide range: number of dimension (2D or 3D); view format (16:9 or 4:3); image resolution (from 640 x 480 to 1280 x 800 and over); frame recording (from 30 - 60 to over frame per seconds); minimum illumination (up to zero lux). Most of webcams currently have a color depth of 24 bits, i.e. 8 bits for each fundamental color of the RGB scheme (Red, Green, Blue).
If equipped with infrared LED (standalone or as backup of LED on streetlamps), webcams can capture information also during the night hours. When combined with LED lights, a webcam can be used (as a receiver) to communicate in Li-Fi technology. In order to achieve high speed transmissions, the color depth of the webcam is crucial, as well as the turn on/off time of the LED light.

4.3. GPS (GLOBAL POSITIONING SYSTEM)

The GPS system (as well as its analogous GLONASS and Galileo systems) provides positioning services, supporting the assessment of the geo-coordinates of a given point on the Earth surface. The telecom industry exploits GPS also for network synchronization at nanosecond level. It is worth noting that deploying the GPS on the streetlamps helps to minimize the interference among Wi-Fi hotspots and allows an easy tool to keep updated the database (the infrastructure components are tagged with their geo-coordinates that are steadily provided by the GPS; any change of such tags implies a modification of the infrastructure and vice-versa).
Another very important application is the development of the Ground-based Regional Augmentation System (GRAS) using GPS-RS (GPS Reference Stations) (Loiacono et al. 2009). GRAS is meant to increase the precision of GPS localization and to reduce the TTFF (Time To First Fix) of the users near a given streetlamp. The basic concept is that the GPS-RS deployed over the streetlamp assesses its position through the GPS satellite constellation and compares it with its nominal position, as detected at the installation phase (measure of position via topographic technique). This comparison produces the error measurement that can be uploaded to a database and be available to others GPS utilized by users in the area of the streetlamp. The final results are that the users reduce the TTFF and achieve a greater precise positioning measure.

4.4. SMARTPHONES

A mobile phone in itself is not a sensor; however, when augmented with the advanced functionalities that are implied by the term "smartphone", it constitutes a fundamental component of the system described in the above. Apart from managing the interface between the system and the human users, the smartphone carries sensors, interacts with the hotspots hosted by the streetlamps and therefore produces data that can be sent over the network and shared with other users (both humans and machines), e.g. the accelerometer sensor can be exploited to measure wind shear or vibration in the street caused by heavy vehicles or earthquakes.

Sensor	Current [mA]	Resolution
Accelerometer	0.3	0.0006 m/s^2
Gravity	12.4	0.0006 m/s^2
Linear acceleration	12.4	0.0006 m/s^2
Gyroscope	3.1	0.0003 rad/s
Light intensity	0.8	1 lx
Magnetic field	6.0	0.06 μT
Orientation	6.0	0.06 μT
Atmospheric pressure	1.0	1 mB
Proximity	0.8	8 cm
Temperature	0.3	0.01 °C
Relative humidity	0.3	0.04%

Tab. 1. List of sensors carried by a Samsung Galaxy S4 (Operative System Android 4.3)

Tab. 1 lists the sensors carried by a typical smartphone, together with the level of relevant electrical currents. Being the voltage given (it depends on the model of the smartphone), such currents are proportional to the energy demands and therefore provide the relative load of the sensors: it can be noted that the energy demands are quite low and therefore the sensors can easily be deployed in clustered or packed arrays.

4.5. LTE ENB (RADIO ACCESS POINT)

The network technology called eLTE (evolved Long Term Evolution) is the state of art of commercial mobile phone services. As other previous technologies (GSM, UMTS, ..) it is based on BTS (Base Transceiver Stations) that set up bidirectional links with mobile phones. In the eLTE terminology, the BTS are called eNB (enhanced Node B). The streetlamps can be equipped with eNB to increase the radio coverage, to reduce the average radio pollution and to increase the bit capacity.

5 CONCLUSION

Li-Fi shows very interesting features that can usefully exploited in order to support the networking and the sensing of a “smart city”. Together with other technological developments (as those mentioned in the above), Li-Fi provides a consistent set of tools apt to increase the quality of life in a urban environment, mainly in terms of available information and of accessible services of interest of the citizens. The relevant financial investments appear to be of limited amount; in any case, some of the investments can have an actual return (in terms of added value of the provided services) and therefore public-private partnerships can be envisaged.

However, as already pointed out, paving the path towards the “smart city” implies also the mobilization of the human factors (from a local political leadership to a diffused entrepreneurship) as well as the improvement of the rules governing the system. The technology can play its role, but nothing more than this role.

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IMAGE SOURCES

Fig. 1: UNDESA (2012); Fig. 2: US DoE (2013).

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OPEN SPACES AND URBAN ECOSYSTEM SERVICES

COOLING EFFECT TOWARDS URBAN PLANNING IN SOUTH AMERICAN CITIES

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ABSTRACT

Open space (OS) is a key element in the provision of ecosystem services (ES) in urban environments. Under a land cover-land use perspective, cities are incorporating into the expansion process to different types of surfaces: sealed, paved surfaces and OS. The first corresponds to a land cover change while the second, which includes bare soil, grass, forest or any other type of non-sealed surface, corresponds to a land use change, without physical transformations. As a land use change OS is able to keep fundamental pre-existing ecological properties. However, besides specific ecological characteristics, the overall capacity to provide ES depends also on the size, number and spatial distribution of OSs within the urban fabric. Those aspects which can determine the very ecological performance of urban ecosystem services (UES) are not yet included in the current urban planning in Latin America. OS is still understood mainly as green infrastructure and related mostly with aesthetic and cultural benefits. On the contrary, under an ecological point of view, OS is capable to provide fundamental UES, which can be spatially assessed and analyzed. In this paper the provision of cooling services (CS) is assessed in 2 South American cities: Lima and Santiago de Chile. The provision of CS is measured by means of a Remote Sensing-GIS-based method. Two aspects of CS are explored: (1) the current amount of existing OS; and (2) the trend of increasing/reducing CS within the urban tissue, in a dynamic assessment of spatial distribution and rates of OS incorporation to the continuous urban tissue. The aim is to analyze the CS generated by OS in those two cities. The analysis discusses the role of OS in the provision of CS, considering the current urban development trends and planning practice in these specific Latin American cities, highlighting the need to keep unsealed surfaces and increase in trees coverage, to retain the CS provision in certain levels.

KEYWORDS

Open space, Urban ecosystem services, Cooling effect, Santiago, Lima

1 INTRODUCTION

The global future will be dominated by urban development and driven by urban systems. On the regional scale, urban systems are a powerful force which transforms landscapes and affects the provision of ecosystem services (ES), both out and within urban areas. Cities evolve in a world pervasive urban expansion context, where the urban expansion is not likely to be put under control. Under the identified trends of expansion (Inostroza *et al.* 2010; Inostroza *et al.* 2013) Latin-America will be inevitably and deeply transformed at fast rate. The urban sprawl, fragmentation and discontinuity will impact on several scales. Under market conditions and without an adequate regional planning, these impacts can be even intensified (Inostroza *et al.* 2013), and several ES like water infiltration, carbon sequestration and cooling effect are might be lost. As a result of the process of rapid urbanization the urban heat island (UHI) arises as a relevant – hybrid – ecological urban phenomenon. Urban areas tend to have higher air temperatures than their rural surroundings as a result of gradual surface modifications that include replacing the natural vegetation with buildings and roads.

Open space (OS), understood as areas free of development left behind by the process of urbanization, with or without vegetation coverage and including or not green infrastructure, arises as an important ecological asset of cities, in terms of their capacity to provide ES and reducing the UHI effect. Connecting this positive ecological effect with the ES framework, in this paper the cooling service (CS) of OS is analyzed for two Latin American cities: Lima and Santiago de Chile. The aim is to understand the CS generated by OS within those urban areas. In the first part a dynamic assessment of urban expansion is provided to calculate the relevance of OS within the urban areas of 10 important South American cities in 20 years period of time. This analysis gives an overview of the dynamic spatial process affecting OS in the continent. In the second part land surface temperatures (LST) was calculated for both cities. Provision of CS provided by OS was explored in terms of their spatial distribution in both cities. Using LST as UHI proxy the thermal difference between open spaces and their surrounding urbanized areas was estimated. In the conclusion some recommendations for urban planning and policy making, looking specifically to green infrastructure in Latin American cities, are proposed.

1.1 THE UHI: AN HYDRID URBAN ECOSYSTEM FUNCTION

The UHI effect is a global regularity present in almost every cities. UHI it has been recognized as important negative effect of urbanization on local weather. Within the urban fabric temperature varies mainly due to two important reasons: (1) differences in the thermal properties of impervious surfaces and (2) a decreased rate of evapotranspiration (Streutker 2002).

Urban blue and green space regulates local temperatures (Hardin and Jensen 2007). Water areas absorb heat in summer time and release it in winter (Chaparro and Terradas 2009) and vegetation absorbs heat from the air through evapotranspiration, particularly when humidity is low (Hardin and Jensen 2007). Urban trees moderate local temperatures by providing humidity and shade (Bolund and Hunhammar 1999).

The share of impermeable surface is the most important factor determining urban sensitivity to heat. Large water bodies are important as well. Less important factors include the vegetation index (NDVI), the share of traffic infrastructure and shade. As such UHI emerges as the combination of preexisting geographical conditions, i.e. local climate conditions, altitude, etc. and artificial conditions resulting from the urbanization process, i.e. land cover, morphology of urban tissues, percent cover of buildings, etc. As it is depending on both types of factors, UHI can be characterized as hybrid ecosystem function. This is an ecological property and will constraint the possible control over the UHI effects. The concept it has been used to describe the phenomenon of altered temperatures in urban areas compared to their rural hinterlands. The UHI effect is characterized as the influence of urban surfaces on temperature patterns in urban areas as opposed to surrounding areas (Oke 1982). The increase in the urban temperature shows higher temperatures in urban than in rural areas (e.g., Jin i 2005) and depends on a variety of factors, such as latitude, height above sea level, topography, city size (Wienert and Kuttler 2005) and atmospheric stability (Tomlinson *et al.* 2010; Sun *et al.* 2011).

Remote sensing is one of the most common techniques to map magnitude and spatial extent of UHI, allowing assessments without expensive and time demanding in situ measurements. Remote sensing techniques are focused on the surface urban heat island (SUHI), i.e. the surface temperatures of the emitting materials and not the air temperature as in situ measurements often are. Remotely sensed data and above ground air temperatures are not identical, but related (Mostovoy *et al.* 2006; Prihodko and Goward 1997). Thus, a very high correlation between surface temperatures and temperature comfort exists (Inostroza and Csaplovics 2014). The term SUHI is often used to explicitly distinguish SUHIs measured using land surface temperatures (LST) from air temperature patterns (e.g., Voogt and Oke 2003). LST modulates the air temperature of the lower layer of the urban atmosphere and is a primary factor in exploring surface radiation and energy exchange, the internal climate of buildings, the spatial structure of urban thermal patterns and their relation to urban surface characteristics, surface-air temperature relationships, and human comfort in cities (Liang *et al.* 2012).

Remote sensing data use the thermal emissivity of land surfaces to derive land surface temperatures (LSTs). Remotely sensed LST records the radiative energy emitted from the ground surface, including building roofs, paved surfaces, vegetation, bare ground, and water (Arnfiel, 2003; Voogt and Oke 2003). Therefore, the pattern of land cover in urban landscapes may potentially influence LST (Arnfield 2003; Forman 1995). The percent cover of buildings arises as the most important land cover feature increasing the magnitude of LST. From the side of mitigation, percent of woody vegetation is the most important factor (Zhou *et al.* 2011).

1.2 STUDY AREAS

Lima is the capital and the largest city of Peru situated in the central coastal part of the country in front of the Pacific Ocean (Fig. 1). The city is located in the 12°2′36″S Latitude and 77° 1′42″W Longitude, in the valleys of the Chillón, Rímac and Lurín rivers. With a population of over 7 million, Lima is the most populated city of Peru, and the fifth largest city in the Americas.

Lima has two distinct seasons, summer and winter. The Peruvian Humboldt Current, cold water, giving rise to the phenomenon of inversion defined as the increase in temperature with increasing altitude. Hence the presence of cloud type layers (not give rise to precipitation) throughout the year. The inversion height varies between 1,000 m and 1,500 m in winter and summer, respectively, for which Lima is a city with the presence of clouds all year (SENAMHI 2009).

The climate is characterized as semi-warm and moderate humidity conditions (SENAMHI, 2009). The average annual temperature ranges between 18.6° C and 19.8° C, with temperatures ranging between 15° C and 20° C in the winter months and between 19° C and 27° C during the summer (SENAMHI 2009). The humidity varies between 81% and 85% for the year, which intensifies the thermal sensation of heat or cold, depending on the season. The temperature is sinusoidal, varying from low temperatures in the months of June to September with peaks from December to April, causing the city to register two well defined, one cold and one warm. Minimum temperatures vary between 15° C and 21° C, depending on the season and recorded in the areas closest to the coast. In the summer ranges from 17.1° C and 20.5° C in the winter between 10.7° C and 15.4° C. The maximum temperatures ranging between 17° C and 29° C, recorded lower values during winter (June to August) and higher during summer. In turn, the maximum temperatures are lower in areas close to the coast, while in the areas closest to the Andes with values of 25° C to 30° C.

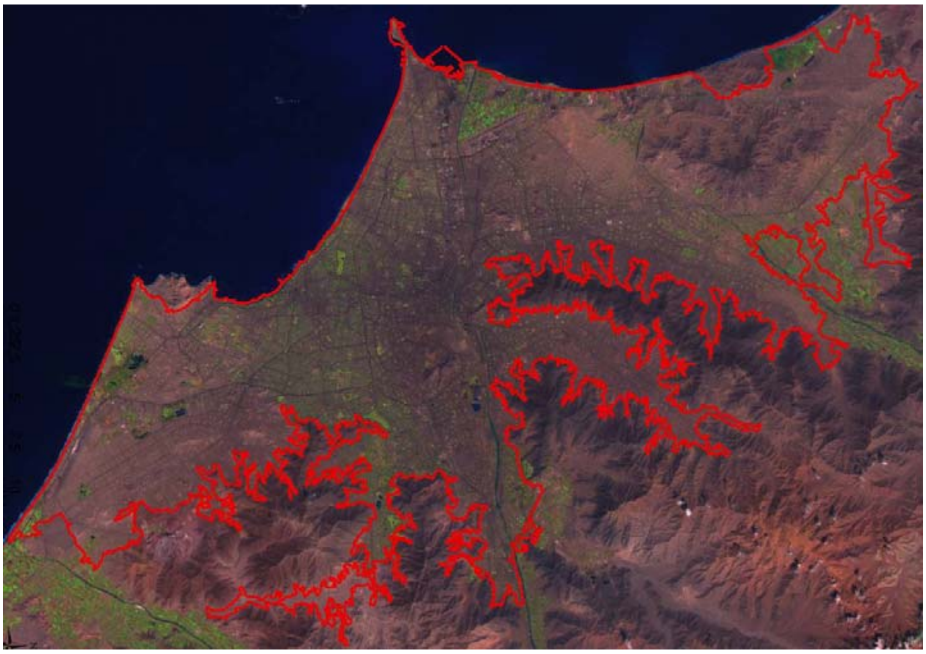

Fig. 1 Lima, continuous urban area (red line) over a 742 LANDSAT image FILE_NAME = "L5CPF20090401_20090630_09". 2009-04-02

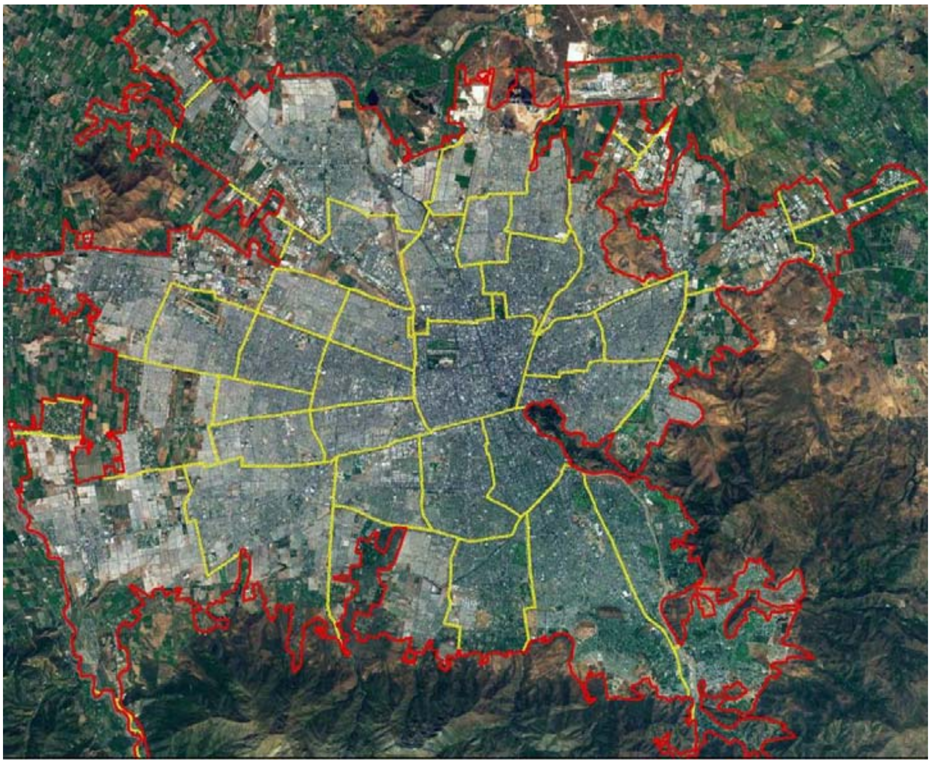

Fig. 2 Santiago de Chile. Continuous urban area (red line) and municipalities' divisions (yellow line) overlaying an IKONOS RGB image

Santiago is located in the central valley of Chile in the coordinates 33°26'16"S latitude and 70°39'01"O longitude, is the capital of the country concentrating the economic and political power (Fig. 2). It concentrates more than 43% of the countries´ population and more than 40% of the GDP is produced in the city. With an estimated population of 6,5 millions it has been suffering a strong process of urban expansion during the last decades, adding more than 1,300 ha per year to the continuous urban fabric (Inostroza et al. 2013). Politically administrative speaking the city contains 40 municipalities, which represent the local administrative level (commune).

2 MATERIAL AND METHODS

The methodology is spatially explicit and quantitative at city scale. An important aspect to consider is the spatial delineation of the urban area under study and its rural counterpart. For the purposes of this research the spatial scope of the analysis is the continuous urban fabric (red line in Fig. 1 and Fig. 2). For the definition of this area see (Inostroza *et al.* 2013). Calculation of sizes gains and loses and spatial distribution of the incorporated OS in a 20 years time period was performed. Over that basis, the provision of CS was explored under an Ecosystem Services perspective.

2.1 LAND SURFACE TEMPERATURE (LST) ESTIMATION[1]

In order to determine the SUHI within the continuous urban fabric, LST was calculated using the thermal band of the Landsat 5 TM. Even though the spatial resolution of the thermal band is 120m x 120m, resampled to 60 m x 60 m per pixel, a rescaling to 30 x 30 m. was performed. The extension of the image was fitted to the extension of the continuous urban fabric.

The Landsat -5 & Landsat-7 Thematic Mapper sensor systems contain a thermal band that collects data in the wavelength interval of 10.40 – 12.50 µm. This band can be converted to temperature by using the calibration information from the Landsat manual. LANDSAT 5TM band 6 is produced by a 120 m resolution thermal detector capable of sensing radiant temperature differences of approximately 0.6°C (Avery and Berlin, 1985; (Aniello et al. 1995).

At-satellite temperature can be determined for TM thermal data in a two step process (Markham and Barker, 1987; Sun et al. 2009). The first step is to convert the digital number (DN) into spectral radiance (Lλ). In the original LANDSAT image pixels are converted to units of absolute radiance using 32 bit floating point calculations. Pixel values are then scaled to byte values prior to media output. The spectral radiance Lλ of each DN value is calculated using the following equation:

$$L\lambda = Grescale * QCAL + Brescale$$

Lλ	Spectral Radiance at the sensor's aperture in watts/(meter squared * ster * µm).
Grescale	Rescaled gain (the data product "gain" contained in the Level 1 product header or ancillary data record) in watts/(meter squared * ster * µm)/DN.
Brescale	Rescaled bias (the data product "offset" contained in the Level 1 product header or ancillary data record) in watts/(meter squared * ster * µm).

Which is also expressed as:

$$L\lambda = ((LMAX\lambda - LMIN\lambda)/(QCALMAX-QCALMIN)) * (QCAL-QCALMIN) + LMIN\lambda$$

QCAL	the quantized calibrated pixel value in DN
LMINλ	the spectral radiance that is scaled to QCALMIN in watts/(meter squared * ster * µm)
LMAXλ	the spectral radiance that is scaled to QCALMAX in watts/(meter squared * ster * µm)

[1] http://landsathandbook.gsfc.nasa.gov/data_prod/prog_sect11_3.html.

QCALMIN the minimum quantized calibrated pixel value (corresponding to LMINλ) in DN
1 for LPGS products
1 for NLAPS products processed after 4/4/2004
0 for NLAPS products processed before 4/5/2004
QCALMAX the maximum quantized calibrated pixel value (corresponding to LMAXλ) in DN
255

QCAL, LMIN, LMAX, and QCAL, are obtained directly from EOSAT for each LANDSAT sensor system.
LMIN and LMAX values for conversion to radiance units are in the metadata file (header file) of each image.
The second step is to convert the spectral radiance as described above to at-sensor brightness temperature. This is the effective at-satellite temperatures of the viewed Earth-atmosphere system under an assumption of unity emissivity and using pre-launch calibration constants listed in Tab. 1. It is carried out by using the following conversion formula:

$$T = \frac{K2}{\ln\left(\frac{K1}{L_\lambda} + 1\right)}$$

T = Effective at-satellite temperature in Kelvin
K2 = Calibration constant 2 from Tab. 1
K1 = Calibration constant 1 from Tab. 1
L = Spectral radiance in watts/(meter squared * ster * µm)

	Constant 1- **K1** watts/(meter squared * ster * µm)	Constant 2 - **K2** Kelvin
Landsat 5	607.76	1260.56

Tab. 1 ETM+ and TM Thermal Band Calibration Constants

Now the ETM + Band 6 imagery was converted to a more physically useful variable. Last step is to transform temperature from Kelvin to Celsius degrees. Once calibrated, surface temperatures can be determined at any LANDSAT pixel location. Temperatures were grouped into appropriate ranges and color-coded to generate a thermal pattern distribution map of both studied areas (Fig. 3 and Fig. 6).

3 RESULTS

3.1 URBAN EXPANSION AND THE INCORPORATION OF OPEN SPACE

Cities are expanding as a matter of fact. The pace of urban expansion in South American cities is fast. An average of 360 ml/year growth rate has been observed in main cities during the last 20 years, this means around 40 m^2/minute as average for the continent (Inostroza *et al.* 2013).
Under a land cover-land use perspective, cities are incorporating into the expansion process to different types of surfaces: sealed, paved surfaces and OS. The first corresponds to a land cover change, suitable to be detected by remote sensing techniques. The second one, OS, corresponds to a land use change, without physical transformations. It could be bare soil, grass, forest or any other type of not-sealed surface. However, OS not necessarily correspond to green infrastructure; part of it is the result of the

suburbanization process, not sealed surfaces within new urban plots or the passive inclusion of fragmented large areas without development. In some cases those areas are targets for infilling urban development. If land surface is not sealed, OS is able to keep most of their pre-existing ecological properties.

The ecological value of OS it has to be assessed regarding specific urban ecosystem services (UES) it provides. There are at least three UES provided by OSs: rainfall infiltration, carbon sequestration and cooling effect (UHI mitigation). The provision of each ES is determined by the type of land coverage of the area.

OS as remaining land within the urban expansion process can be, in some cases transformed into formal green areas. However in the context of Latin America this is not the common situation; many OSs remain in initial conditions for decades and or they are urbanized (sealed). If not sealed, OS keeps its potential provision of UES, which can hardly be substituted by other urban elements without increasing vulnerability to other hazards, such as floods or heat.

In quantitative terms, the incorporation of OS into the urban areas is a key factor considering the fast expansion process of South American cities. In table 2 an overview of the overall incorporation of OS in 10 South American cities is presented. The incorporation of OS is relevant in all cities.

In average core areas (continuous urban fabric) increased in 200 km^2 between T1 and T2; 50 km^2 where of OS, this is 24%. There is a net increase in the overall average surface of OS in the 10 cities, from 140 in T1 up to 190 in T2, which represents a net increase of 35%. However, in relative terms, this is considering the growth of core urban areas, the overall percentage has decreased from 34% to 31%. This because despite the increase in OS's surface, the increase in core areas and built up areas has been faster, 47% and 52% respectively. This means that in 2010 most of those cities they have less open space in proportion to the urban area, than they had in 1990.

CITY	YEARS	CORE T1	CORE T2	BUILT T1	BUILT T2	OS T1	OS T2	OS T1 %	OS T2 %
Asunción	23	336	534	190	327	146	207	43%	39%
Bogota	22	297	362	224	281	74	81	25%	22%
Brasilia	21	406	718	140	370	265	348	65%	48%
Buenos Aires	21	1577	2,103	1,127	1517	450	587	29%	28%
Cordoba	24	252	337	164	230	88	107	35%	32%
La Paz	23	113	236	83	169	31	67	27%	28%
Lima	**22**	**446**	**695**	**374**	**547**	**71**	**149**	**16%**	**21%**
Montevideo	24	291	310	167	201	124	109	43%	35%
Santa Cruz	25	88	287	61	186	27	101	31%	35%
Santiago	**24**	**479**	**710**	**353**	**568**	**126**	**142**	**26%**	**20%**

Tab 2 Overall urban core values and open space in 10 South American cities for circa 1990 and circa 2010. Values are in km^2

As a result of the persistent expansion process fundamental ecological functions are changed or eventually lost. Thus an important question for urban planning and policy making is to determine how much of this surface has to be maintain free of development to ensure the provision of certain Ecosystem Services eventually lost due to the urbanization process. To ensure the maintenance – ideally the increase – in the environmental quality of new urbanized areas, a portion of this open space has to be kept free of development in the long term, under an ecosystem services perspective. Open space is a passive incorporation of areas with higher ecological value than standard urbanized areas.

3.2 SANTIAGO

There is a pattern in the spatial distribution of LST in Santiago. Lower temperatures follow the Cordillera in the east part of the city. Higher temperatures are concentrated in the centre and in the western part as well. Big OS are playing an important cooling role (Fig. 3). Municipalities in the west part of the city they have higher values of LST, while municipalities located at piedmont they have lower LST values. Considering that western municipalities are poor while eastern municipalities are richer, it is clear that the LST has an uneven socioeconomic spatial pattern as well. In some cases the cooling islands are associated with higher shares of vegetation, i.e. the presence of consolidated green areas, parks or other historical green areas. In some others cases the dismissing in the amount of sealed surfaces accounts for the lower LST (Fig. 3). At smaller scale the spatial correlation between big OSs, and lower LST (Fig. 4) is more evident. On the contrary, lack of green areas is correlated with higher LST, like in the central and western areas of the city.

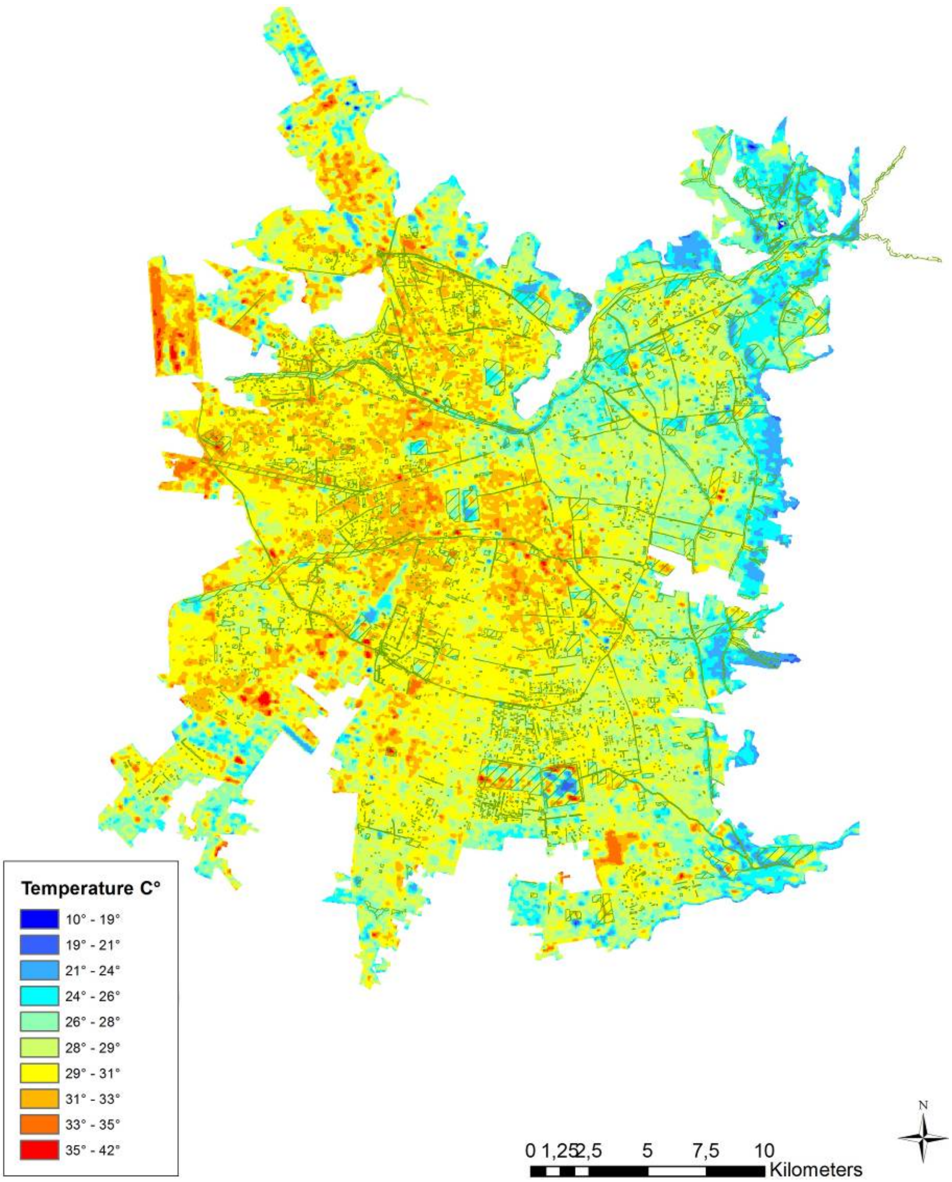

Fig. 3 Land Surface Temperature (LST) patterns and green areas in Santiago de Chile. Cooling islands within the continuous urban fabric are clear

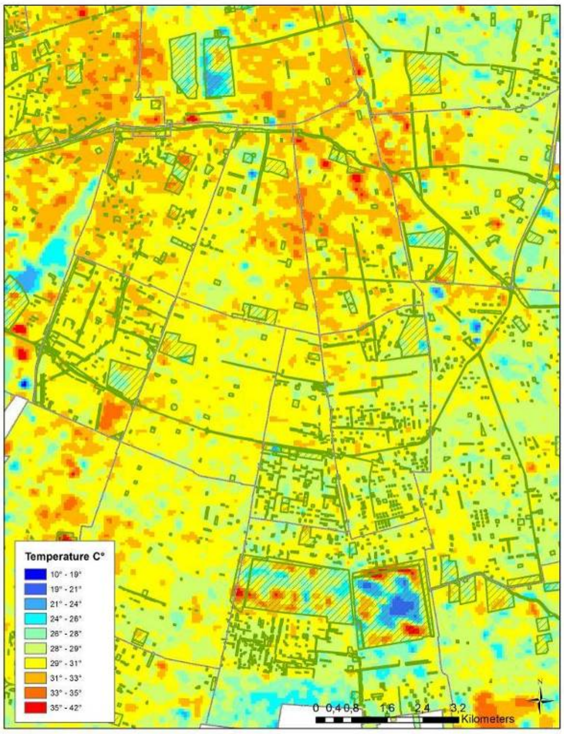

Fig. 4. A zoom into Land Surface Temperature patterns and green areas in Santiago de Chile

3.3 LIMA

Higher LST values are located in the north and south part of the city (Fig. 6), related to the presence of hills and barren soils. This is a typical pattern of a desert city. Presence of green areas, but mostly the presence of river basins (Rimac, Chillón, and Lurín) are helping to decrease the LST in the central parts of Lima (Fig. 5). Higher temperatures within the urban fabric in the central part of the city respond to barren soils and hills, as is shown in Fig. 5, where San Cristobal hill shows the highest temperatures.

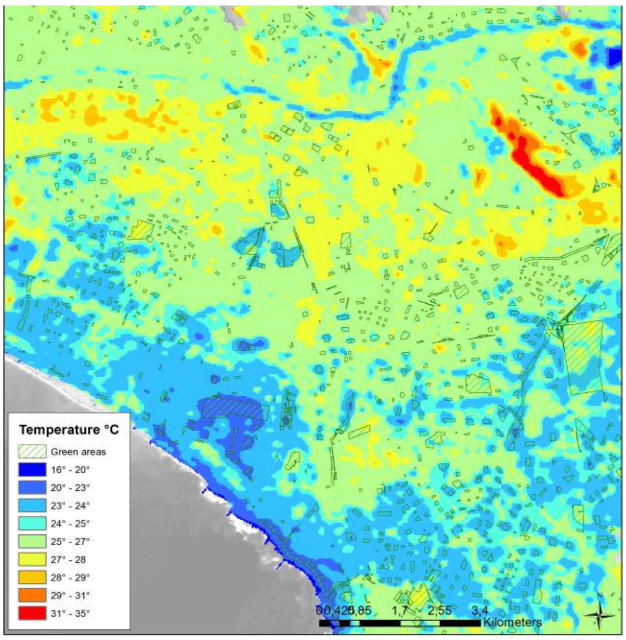

Fig. 5 A zoom into Land Surface Temperature patterns and green areas in Lima

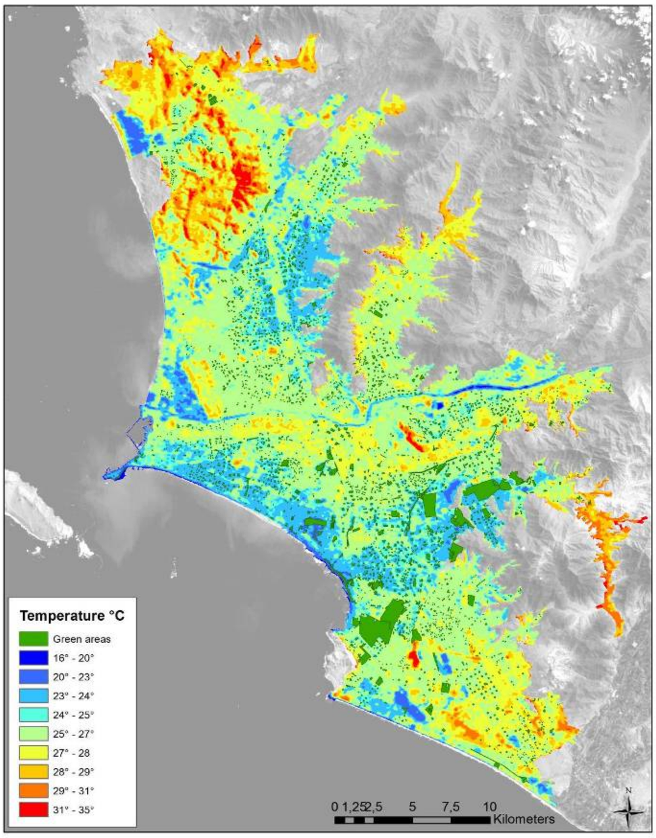

Fig. 6 Land Surface Temperature (LST) patterns and green areas in Lima

4 DISCUSSION AND CONCLUSIONS

UHI is a typical effect of urbanization present in most cities. There is a growing awareness to develop strategies to cool urban areas (Mackey *et al.* 2012), specially when it is expected that the urban temperature will increase due to climate change. Vulnerability to heat waves is high in Latin American cities. However UHI remain out of the scope of urban adaptation strategies. New spatially explicit approaches are needed to cope with the expected impacts of heat waves (Inostroza and Csaplovics 2014).

To understand the relevance of the OS regarding the CS, it is necessary to understand not only the specific mitigation it can be provided. The locally generated UES have a substantial impact on the quality-of-life in urban areas and should be addressed in land-use planning (Bolund and Hunhammar 1999). It is also important to account for specific ecological features of such spaces. To produce large cooling effects, grass – or lawn - is not effective, as other studies have also shown (Mackey *et al.* 2012). Vegetation must be dense and include shrubs/trees in order to have an affect on an urban scale (Mackey *et al.* 2012; Bowler *et. al.* 2010; Chang *et. al.* 2007; Potchter *et. al.* 2006). This is a fundamental consideration for urban planning not yet well accounted for the design of green areas in Latin America. But at the same time open space is under strong pressure. Due to increasing urbanization, combined with a spatial planning policy of densification, more people face the prospect of living in less green residential environments, especially people from low economic strata. This may lead to environmental injustice with regard to the distribution of (access to) public green space (Groenewegen *et. al.* 2006).

The exploration of the potential roles in the provision of UES it is also being done considering urban form properties, specifically those regarding compactness. In terms of Latin American cities the aim of a compact urban development is highly necessary (Inostroza *et al.* 2010). How this aim will not negatively affect the current provision of CS in targeted OS's is an important question for planners. When developing such OS's UES assessment has to be done to ensure that current provision will be maintained.

However planning practice in Latin America has been largely overcome by the contingency of urban development: fast growing rates, poverty, informality and land markets. It is necessary to ensure that the passive provision of UES of OS's is not threatened by lack of awareness and appropriated assessments. If the provision of CS will be included in cost-benefit analysis, the positive impact would be of great interest. For instance 17 municipalities in Santiago with the highest temperatures they reach over 2 million persons. The direct CS benefits of those populations it can be determined in economic terms by using available spatial methods. Normally it has been accepted that parks and lawns they have positive impact in terms of reducing the effects of the UHIs. However looking at NDVI the stronger and valuable CS resides on trees, but not in green areas in general and not at all in lawns in particular. This is an important fact to keep in mind for the design of green infrastructure and the identification of the very CS of existing OS.

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IMAGES SOURCES

All images are own elaboration.

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FROM RLP TO SLP:

TWO DIFFERENT APPROACHES TO LANDSCAPE PLANNING

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ABSTRACT

The concepts of governance and sustainable development are concepts related to complex systems and processes, in terms of problems and implications, with a variety of people involved in different ways and whose number has increased over time. In the processes of regional governance, the concept of sustainability interacts with the environment and to the territory.

Since 2006, year of approval of its Regional Landscape Plan (RLP), the Region of Sardinia, has been experiencing a new era of regional governance characterisedcharacterized by a new understanding of environmental resources; and by a different relational approach among regional government bodies, as well as between them and local communities.

In 2009 began the revision phase of the plan recently concluded with the approval of the Sardinia Landscape Plan (SLP). This paper will highlight a comparison between RLP and SLP focusing on three aspects: i) the concept of protection and safeguarding of the territory; ii) the institutional governance; iii) the application of the Strategic Environmental Assessment.

KEYWORDS

Regional Landscape Plan, Sardinia Landscape Plan, Strategic Environmental Assessment

1 INTRODUCTION

The concepts of governance and sustainable development are concepts related to complex systems and processes, in terms of problems and implications, with a variety of people involved in different ways and whose number has increased over time.

In the processes of regional governance, the concept of sustainability interacts with the environment and to the territory. In accordance with the European Landscape Convention (Florence, 2000) part of territory is the landscape as perceived by local people or visitors, which evolves through time as a result of being acted upon by natural forces and human beings. "Landscape policy" reflects the public authorities' awareness of the need to frame and implement a policy on landscape. The public is encouraged to take an active part in its protection, conserving and maintaining the heritage value of a particular landscape, in its management, helping to steer changes brought about by economic, social or environmental necessity, and in its planning, particularly for those areas most radically affected by change, such as peri-urban, industrial and coastal areas.

Based on these principles the Region of Sardinia, in 2006 approved[1] its RLP that in according with the regional Law n. 45/89 "Norme per l'uso e la tutela del territorio regionale" had the function of coordinating and directing the organizational choices of the entire regional territory.

The Legislative Decree of January 22, 2004 n. 42 "Codice dei beni culturali e del paesaggio" (Urbani's Code) introduces the RLP as the main tool for regional planning. The RLP's expectations are binding for the plans and are immediately predominant over other regulations that might be contained in the urban tools themselves. Regarding landscape preservation, the regulations contained in it are predominant over the orderings of other planning deeds according to the sector's norms, including those, if more restrictive,[2] concerning nature reserves boards. Municipalities, provinces and nature reserve boards, must adapt their respective plans to the RLP's expectations, by specifying and integrating the contents.[3]

With the RLP the Region of Sardinia, has experienced a new era of regional governance characterized by: a new understanding of environmental resources; and by a different relational approach among regional government bodies, as well as between them and local communities. This paper compares some key governance aspects of the RLP with that of its revision was completed in 2014 with the approval of SLP.[4]

The first paragraph examines the concept of protection and safeguarding of the territory in the planning process in the Region of Sardinia, especially in the RLP and in the SLP. The second paragraph examines the institutional governance in the processes of formation of RLP and SLP. The third paragraph examines the application of the Strategic Environmental Assessment in the processes of formation of both plans.

The conclusion holds some reflections about the various decision-making models applied to landscape planning in Sardinia.

2 PROTECTION AND SAFEGUARDING OF THE TERRITORY IN THE PLANNING PROCESS IN THE REGION OF SARDINIA

The RLP is the first plan in Italy, which proposes a new method of interpretation of the regional territory through an innovative process of knowledge, redesign and management of available resources; it was innovative in terms of operational approach to regional and urban transformation.

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1 With Resolution by Regional Council n. 36/7 of 05/09/2006.

2 Sardinia RLP, Technical and implementation norms, art. 4, c.1 and 2.

3 Sardinia RLP, Technical and implementation norms, art. 105, 106, 107.

4 With Resolution by Regional Council n. 6/18 of 14/02/2014, recently canceled with Resolution by Regional Council n.10/20 del 28/03/2014after the change of political leanings of regional government.

In the RLP the legislation governing twenty-seven Landscape Areas that constitute the first homogeneous areas, corresponding to the total coastal territory.

Passed in 2006 as a tool for directing the sustainable development of the Region, it faced multiple political and cultural issues that following political changes, resulted in beginning a revision process in 2009, that ended with approval of SLP.

The RLP has interpreted the concept of environmental sustainability by defining legislation aimed at protecting the environment. The SLP instead defines protection less restrictive.

The regulations framework of the RLP and the SLP is essentially based on the distinction of two normative classes:

- The first one refers to the single territorial elements which need to be conserved according to articles 142 and 143 of the Urbani's Code ("goods regarding preset categories whose elements can be picked out within jure criteria's"), as well as to the components which, although they are not goods, need to be kept under control in order to avoid damage to the territory and favor its requalification;
- the second class refers to territorial areas whose natural and ecological characteristics are defining, and will be the starting place for establishing directions, directives and prescriptions also for urban areas. They will become operative through subsequent planning, in particular for defining landscape quality objectives, conservation directives and relational directions, which aim at preserving or recreating specific relational systems between the different components.

The most relevant element, among those of the first category, is the coast in all of its parts. Even though it is made up of different types of goods (sand dunes, cliffs, ponds, headlands) it is a territorial resource of huge relevance: not only for the value of each single part, but for the superior, uncommon quality determined by their composition. In particular, the 2 km wide preservation belt, transiently granted by the regional Law 8/2004, becomes a strip of variable width called "bene paesaggistico d'insieme" (collective natural heritage) on the strength of the territory's structural and morphological qualities.

The norm sets twenty-seven different territorial areas, which constitute the first homogeneous area of expertise the coastal landscape. The purpose is to protect a part of the Sardinia considered economically strategic and environmentally sustainable at the same time.

Through this division, based on unclear and coherent standards, the RLP and the SLP propose to safeguard the coastal landscape.

The plans require on all municipalities the obligation of having a city Masterplan as a tool for rules and rights, in step with the general legislative directions. Thanks to the approval of the city Masterplan, municipalities will have prerogatives that were not within the jurisdiction of local authorities, such as those concerning the management of territorial waters, through the approval of the Coastal Plan of use, and those regarding arrangements with the provinces, via the planning of urban and industrial development.

The RLP and the SLP, however, interpret in different ways the concept of sustainable development and this can create confusion in the adaptation of the city Masterplans.

The RLP aim at better preserving the landscape. It refers to nondescript system policies and to a coastal landscape project headed towards sustainable tourism and the territory's preservation rather than housing growth.[5]

The RLP guides directives and prescriptions towards safeguarding the territory by binding multiple transformations against the "rush for the privatization and exploitation of the territory and its resources". This approach clashed with the Sardinian pattern of development based on the "Brick culture", which counts

[5] RLP, Report of the Science Committee in the General technical report of the RLP, p.157.

on construction for development. In particular, the RLP promotes the “protection of undamaged areas”: the identification of those areas, which are still untouched by unbridled coastal housing.
According to many, a flaw in the RLP was focusing its regulation framework on the so-called “preventive control” of human activities in relation to the preservation of the territories value. This tied-way of acting did not really prove to be successful as it phased out the plan's practicality; there is no reference to the types of transformative interventions or simply its correct usage. In other words, more relevance is given to the environment’s sustainability and in particular its preservation, than to rules and instructions for guiding the project itself.
The SLP instead defines protection less restrictive. Referring to the new version of the Urbani’s Code,[6] the SLP defines different rules concerning the various territorial, depending on the value of the landscape.
The difference in approach of the two planes can be seen by comparing the rules as well as coastal areas even those agricultural areas.
According to many SLP is a critical aspect of the building and the transformations in areas of environmental value that change the rural landscape. The rule proposed by the SLP, about the new building in areas with extension of an acre (Regione Autonoma della Sardegna, 2013, art.65, paragraph 2), is deemed inconsistent with the protection of the rural landscape as it may lead to a wide urban sprawl scattered in areas of environmental value, as well as in agricultural areas.[7]
The SLP inspite of most parts suggest the concept of protection of landscape allows the implementation of the urban tourist areas as provided for in city Masterplan in force at the date of approval of the RPL (SLP, Technical and implementation norms, art. 72), returning in this way, in fact, to an old orientation coastal planning development-oriented building more than to that sustainable.

3 THE MULTILEVEL GOVERNANCE OF THE PLANNING PROCESS IN THE REGION OF SARDINIA

As stated above, territorial planning in the Region of Sardinia has been going through a phase of extraordinary relevance, characterized by a process of adaptation of all its planning tools at different levels and in different fields; this has been a very complex project because it concerns different fields of activity on the territory as well as numerous social, economic and cultural fields.
In fact, the RLP is the first plan in Italy that proposes a new method of interpretation of the regional territory through an innovative process of knowledge, redesign and management of available resources. In addition, it was innovative in terms of operational approach to regional and urban transformation despite multilevel governance is ignored in the general and implemental design of the first draft of the RLP as its legislation lacks a close examination of questions regarding the planning of a wide area; But the problems related to multi-level governance are, however, also present in the new phase of the revision of SLP
In the analysis of the governance workings that led to the formation of the first version of the RLP and those concerning its current realization and revision, there have been two fundamental elements: the presence of different corporate moments concurrent with both the plan's stages, and an educational experience in the regional offices where the main plan's application problems by privates, municipal and provincial authorities were encountered.

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6 The Code has been modified by Legislative Decree n. 63 of 2008.
7 In RLP buildings were permitted in agricultural areas with a size of at least three acres for activities related to an agricultural enterprise (Regione Autonoma della Sardegna, 2006, art. 83).

The collective process which led to the definition of the normative framework and to the first draft of the RLP was characterized by choices not agreed on by local authorities and by inadequate institutional cooperation: the Region of Sardinia called conferences (the Planning Conferences of 2006) with municipalities and provinces, to present a plan which had already been written down and adopted.

The multi-level governance has been ignored in the early design of the first draft of the RLP, as its norms lacked an in-depth examination of questions regarding the planning of a large area. In the implementation of the plan, the territorial areas did not actually represent a link between regional and urban planning. It should be noted that among one hundred and two coastal municipalities, which should have adapted their urban tools, only four have concluded their adjustments and eight have obtained an unbounded act for the SEA from their province. Evidently, there is a great difficulty for local authorities in applying the prescriptions and directions of the RLP, and to conciliate them with their low financial and cognitive resources

Through the revision process started in June 2009; the regional administration organized a series of provincial conventions called "Sardegna Nuove Idee", in order to listen to the criticisms regarding the first draft of the Plan in particular the aims was to guarantee loyal cooperation between the various government bodies within institutional relations, which were totally absent during the Planning Conferences of 2006.

This attempt, however, has not pursued because even in the new revision of the SLP the issues concerning the cooperation between institutions have remained the same. In the Technical and implementation norms, there is no reference to the bureaucratic simplification and reduction of bureaucracy, despite being guaranteed greater ease in applying the rules.

Also, the SLP has been contested constitutionally by the Ministry of Cultural Heritage for violation of the practice of planning coordination e prescribed by Urbani's Code. The unilateral revisions of the RLP to landscape have been justified by the Regional administration by virtue of the powers conferred by Special statute of the Region of Sardinia. In fact, the ratio of devolution enshrined in the reform of Title V of the Italian Constitution, as well as by Urbani's Code is that the regions can expand the level of protection by national law, while the regional legislature is precluded the reverse, namely the introduction of restrictions on the scope of protection. The Urbani's Code requires, in articles 135 and 143, the principle of cooperation in planning (State-Region) on the landscape heritage. This principle is a fundamental norm of socio-economic reform in the Italian Republic.

The State's participation in the planning cooperation procedures is essential for the value of the environment and landscape of Sardinia has for the national and international community, and for the specific expertise of the Superintendents to build a framework for shared protection. Moreover, the cooperation planning procedures with the state had been successfully undertaken by the Protocol signed of 19 February 2007, and confirmed in the Technical Regulations of March 1, 2013.

Among these criticisms, some interpretations about landscape planning are found which suggest territorial cooperation. The weakness of the governance system and the lack of coordination between normative tools and regional development policies are the most criticized aspects for the enacting of new regional landscape policies. Only by solving these problems, can the regional planning become a key tool for the governance, as a strategic process for a new normative, administrational and organizational framework for the regional territory.

The critical elements highlighted in the Sardinian case study are the cause of a long planning period that comes from a variety of different approaches, which caused a hard and complex institutional process that eventually defined shared decisions. In the future, a scale of responsibility is desirable between the different economic, social and institutional bodies, new interests in decisional processes and new regional

development policies. This might be the cause of new intra-institutional conflicts and, therefore, must be adequately governed.
This is what territories expect from the SLP, as only through the correct redesigning of territorial areas in regards to the environment and infrastructure, from agriculture to tourism, industries and services, it is possible to integrate these issues in order to improve positive aspects and reduce negative impacts. It is at this level indeed that a regional tool can permit an overall view over the fragmented processes enacted by plans, programs and policies, which in fact act in a relevant way and need to be governed by an adequate institutional plan regarding all of them.

4 SEA

An important governance tool, useful in guiding the plan of action to the paradigm of sustainable development, is the Strategic Environmental Assessment (SEA). Compared to its relationship with governance, the SEA could be defined as a set of rules, principles, techniques and tools with the function of continually supporting the decision making process in order to generate consensus on actions to be taken and, above all, to ensure that such consent will last over time and become a network of stable relationships that can ensure continuity and consistency in the planning process.
The 2001/42/EC Directive has introduced a change of perspective in approaching spatial planning, which views the SEA as a flexible, transparent, participatory and systemic tool for building knowledge. The integration of the SEA within the planning process and programming, participation, sharing, acceptance and consideration of environmental concerns, are aspects that should characterize the SEA, but as we shall see in later, in practice they are often lacking or ineffective.
The cause is attributed primarily to the lack of culture regarding environmental assessment, intended as a further complication of decision-making processes rather than as an essential tool for planning and programming. Its widespread use in several countries much earlier than in Italy should make us reflect on the potential of this tool.
There are multiple criticisms for the first draft of the RLP, starting with the rejection of the development policy imposed by the Plan itself, and the not application of the SEA to the Plan that was meant to conciliate regional planning with territorial government tools and with national and regional economic development programs. The Plan's revision was submitted to the SEA, but it did not follow the directives regarding the beginning of the evaluation process and the approval of the plan that has taken place without the "reasoned opinion" issued by the competent authority required by the procedure of SEA (art. 5 Legislative Decree 152/2006 letter m-ter).[8]
The participatory aspects, important elements in the SEA's process, which are seen as missed in the preparation of LRP, were much emphasized in the preparation of the SLP. On this occasion the workshops of "Sardegna Nuove Idee" represented the moments participatory prescribed by SEA's regulations.
The SEA's document (Scoping document and Environmental Report) of the SLP do not take into account the results obtained from the workshops of "Sardegna Nuove Idee", and therefore it is unclear what their role has been, in terms of objectives for the revision of the RLP.
A criticism found in the Scoping Document concerning the multi-level regional governance and in particular the relations between the Regional Administration of Sardinia and the other government bodies. In relation

8 For lack of "reasoned opinion" the SLP was not in force following approval the Resolution by Regional Council n.10/20 del 28/03/2014. This is one of the reasons for the decision of Regional Administration to cancel the Resolution n.10/20.

to this, it was said that "the implementation of the RLP is realized by city Masterplan" (Regione Autonoma della Sardegna, 2011, p.12), but it is different of what was stated by the norms for the plan's realization: "the predictions of the RLP are implemented via the provincial and municipal planning and the plans of nature reserves (art. 11, c.1). The provinces, according to what was indicated in the Scoping Document, not to be helpful in the implementation of the RLP, even though they had encountered difficulty adapting themselves to the plan. As a matter of fact, only one in eight has finished the adapting process for the RLP, and therefore it should be stated, as reported in the Scoping Document, that there is a need for an "accurate control for the problems relative to the realization of the RLP, also on a local planning level" (Regione Autonoma della Sardegna, 2011, p. 5).

There are other critical aspects of the Environmental Report of the SLP regards ~~the~~ not comprehensive assessment of the impacts on the environment and on the landscape; would have to clearly compare the predictions of the RLP and SLP, in terms of legislation and in terms of mapping and lists of protected areas and property. The SEA is the tool set up with the aim of assessing the impacts of the implementation of the Plans, and as the Plan in force is option number zero, respect to the new proposal, it would be necessary to compare the two planning tools to understand the differences content and impact on the environment and make their assessment of the expected effects. Also, would have to consider other options that would increase the level of protection of environmental and landscape values, rather than decrease it, obviously proving incontrovertibly, and not merely to declare it.

5 CONCLUSION

Compared to the experience of landscape planning in Sardinia, the RLP has proven to be, from 2006 to today, the main reference tool for regional planning.

Compared the concept of protection and safeguarding of the territory, the RLP interprets this concept in a more restrictive manner than SLP. The RLP and the SLP have two different models of protection and preservation of territory and a different concept of development.

The RLP is characterized by a form of protection of the environment very binding and by an alternative idea of development to building growth (this approach takes into account, for example, of the population growth and of the pressures on coastal areas). However, RLP defines, only theoretically, interventions on the landscape as a planning tool, of "shared transformation" as well as in its actual safeguard, in order to offer the opportunity for a new sustainable development. The directions for application are not well explained in the RLP. As far as economic sustainability, the Plan does not address the economic issues of the territory, in particular those related to each single area. Nevertheless, the RLP theoretically aims at reconciling landscape planning with the territory's governmental tools and with the national and regional economic development projects (art. 145 of Urbani's Code).

Building the plans on valuable and innovative principles is of little use if the appropriate tools and resources for their implementation do not support them.

The absence of an effective relationship between the means of protection, enhancement and transformation has considerably weakened, and partially undermined, the innovative capacity of RLP.

One cannot make concrete the sustainability of the choices at the planning level through an exclusively limiting approach. An approach of this type does not have much chance of success from an operational standpoint, since it covers only the environmental dimensions and not the economic and social sustainability.

These problems were caused by three elements that have characterized the formation, implementation of the RLP: insufficient institutional coordination, the lack of involvement of local communities and the lack of integration between policies and the requirements of the RLP with the instruments of the regional and sectorial government, in accordance with art. 145 of Urbani's Code.

These problems have led to the revision of the RLP. While reviewing the Region of Sardinia tried to overcome these problems trying to set up on a shared concept more protection. Through "Sardegna Nuove Idee" the Sardinia Region has aimed to build up shared scenarios with their relative action strategies by proposing a collective agreed on regional planning.

The result, in the SLP case, are decisions not shared by the community but only interest groups. The contrasts between the Region of Sardinia and the Ministry of Cultural Heritage show that even in the case of the formation of SLP there has been a multi-level territorial governance inadequate. In this case, due to a confusion about the legislative powers of the Region of Sardinia in the field of landscape. There is also confusion in the application of SEA to the SLP in terms of procedure and assessment of the effects on the environment. In particular, as seen, the SLP was approved without the reasoned opinion required by legislation on SEA and the Environmental Report regards not comprehensive assessment of the impacts on the environment and on the landscape.

In conclusion, based on the experiences in the formation of the RLP and the SLP, we can say that it is necessary a dynamic balance, among the choices of governments, communities and groups (Hardy and Zdan, 1997). The equilibrium can, therefore, only be achieved through decision making moments, characterised by a greater coordination between the levels of government, the consistent involvement of the community and careful evaluation of all aspects of sustainability. In this sense, the ability to make concrete the "mirage" of sustainable development and of the sustainability depends crucially on the ability to implement incisive forms of territorial governance (Gambino, 2005).

It is possible to affirm that a model of public decision-making based on the conceptual and methodological approach set out in SEA can be inserted into a broader model of regional governance oriented towards a paradigm of sustainability. According to this approach, the SEA is not only the method of verification of the environmental compatibility of choices, but a fundamental support for the construction of the same. In it, the words of Khakee (1998), governance, planning and evaluation are inseparable concepts, in which the participation of all stakeholders (environmental experts, the public and the interested public) become an "immaterial learning infrastructure" (Micelli, 2001), which should reduce or eliminate the distance between those who make choices and those who implement the choices (Mazzucato, 2009).

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REVITALIZATION AND ITS IMPACT ON PUBLIC SPACE ORGANIZATION

A CASE STUDY OF MANCHESTER IN UK, LYON IN FRANCE AND ŁÓDŹ IN POLAND

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ABSTRACT

Process of deindustrialization of downtowns in most of well-developed Western European countries has been undertaken since 1960's while in post-socialist countries just from last 25 years, after political and economic transitions in Central and Eastern Europe. As far as urban structure is concerned, a new type of inner-city sites has appeared as a consequence of the collapse of industrial activities in second half of 20th century. In vast majority of cases newly developed morhological units (e.g. run-down post-industrial) have been unavailable to the public. As a reult, "classical" public space organization of European cities has been significantly changed. However, revitalization of post-industrial urban areas creates opportunities to reorganize public space according to current inhabitants and other urban space users' needs. All transitions undertaken as a part of re-developement of brownfields sites are focused on impovements in physical and functional dimension of urban space quality to increase the standard of living condition. According to the concept of smat cities it is relaeted to "smart living" in sustainable urban environment. As a matter of fact, post-socialist cities in Central and Eastern Europe where interval of central planning was present in second half of 20th century and "classical" capitalist cites of Western Europe represent different patterns of public space transitions due to distinct historical development process of central space. In the paper a comparative study of Manchester, Lyon and Łódź is presented. The aim of the research is to indicate the reorganization of historically shaped public space structre in central space of analyzed cities after revitalization of post-industrial urban areas and new central space creation.

KEYWORDS

Revitalization of post-industrial urban areas, Public space organization, Central space

1 INTRODUCTION AND RESEARCH PROBLEM

Industrialization of a large number of European cities in 19th century commenced new stage of cities growth that formed urban environment where millions of people are living nowadays. One of the most significant dissimilarity between pre-industrial and post-industrial cities is public space system coherence due to industrial sites developed in downtowns that disturbed "classical" model of public space organization (Kostof, 1991; Słodczyk, 2012). As far as current brownfield's revitalization projects are concerned, they bring a great opportunity to stimulate new phase of public space growth as a coherent and attractive structure for urban users. This challenge is common for all former post-industrial cities in Europe. However, process of disintegration of public space was strengthen by communist's authorities in most of Central and Eastern European cities in second half of 20th century by implementing new industrial activities in downtowns and zoning central areas according to modernism concept of city building. In this context, comprehensive revitalization process of run-down districts, including post-industrial sites, can be understood as some kind of *panacea* for disruption of public space structure in Central-Eastern and Western European cities, as well.

This paper is concerned with revitalization of post-industrial urban areas and its impact on central space and its public space reorganization. This is a cause-and-effect process of urban development of European cities in the beginning of 21st century and essential part of morphological transmutation to adapt public space to current needs of inhabitants and urban space users. This process is associated with so called "smart living", that is one of most significant dimension of the concept of smart cities. According to this, smart cities provides for its inhabitants: friendly environment, in particular by providing broad access to public services, technical and social infrastructure, a high level of security, appropriate cultural and entertainment offer, as well as care for the environment and green areas (Stawasz, Sikora-Fernandez, Turała, 2012). Revitalization of post-industrial urban areas is important element of "smart growth" of current European cities as it prevents urban sprawl and inhabits development process on green areas. It also contributes to creating multifunctional areas for live, work, entertain and rest inside the area of downtown where public space system is modernized and extended. Creating new public squares and pedestrian precinct (including cycle lines) of high physical and functional qualities encourages inhabitants to spend more time in the city centre that can limit, e. g. cummuting to work and home during the day and week as well as power consumption in houses or flats. Increase the surface of pedestrian area in the city centre also can reduce car use and embolden public transport (trains, tramways, trolleybuses) or cycle (including urban bike systems) use, especially when it creates coherent system.

Public space is considered as crucial attribute of city centre as a place integrating key areas of "city life". Thus, its transitions have been one of the crucial areas of planners, architects as well as geographers' interests, especially in the context of re-development post-industrial cities (Kaczmarek, Marcińczak, 2013; Kochanowska, 2002; Lorens, 2010; Paccione 2010; Roberts, Sykes 2008; Sttot, 2012). For current researchers from Central and Eastern Europe, revitalization of inner-city brownfield sites as a way for public space reorganization is essential, mainly due to:

- functional (institutional) underdevelopment of central districts that have been developed mainly as a residential areas during socialist period (capitol cities were exceptions);
- far reaching degradation of central areas of post-socialist cities as a result of economic and planning decline after political transitions of 1990's;
- emergence of post-industrial urban areas as an integral part of downtowns structure after the collapse of industrial activities in 1990's.

As a consequence, significant share of central areas (downtowns) of a great number of former industrial cities have been covered by urban fallows as well as post-industrial run-down lands of various size and density (or dispersion). It affected fundamentally on public space organization in central areas of post-socialist cities (Ziobrowski, Domański, 2010). Quite similar problems also appeared in a great number of Western European cities in 1960's and 1970's (Jones, Evans, 2009). However, the different economic, social and cultural background of revitalization of post-industrial urban areas in Western and Central-Eastern European countries leads to various goals and then to distinct repercussions on central space and public space organization. While in Central-Eastern cities the main aim of revitalization of post-industrial sites is usually creating new central and multifunctional areas in run-down downtown, in most of Western European cities it is enlargement of central space and propulsion for renewal of whole downtown as a coherent area.

According to this brief introduction, the crux of the research problem is to answer the question: how change public space organization in Western and Central-Eastern European cities as a result of revitalization of post-industrial urban areas and new central space creation? The objectives of the paper are as following:

- characterize the process of central space development on post-industrial urban areas as a result of revitalization process;
- indicate and compare the results of post-industrial urban areas revitalization and its impact on public space organization in Manchester in UK, Lyon in France as a Western European "classical" capitalist cities and Łódź in Poland as an example of post-socialist city from Central Europe.

Analysis undertaken in this paper is based on *in situ* studies realized in two stages concerned on:

- central space transition as a result of revitalization of post-industrial urban areas: in May and June 2010;
- public space re-organization as a consequence of revitalization project: from July to September 2013 and in December 2013 as a part of research project financed by National Science Centre grant (NCN 2011/03/N/HS4/03145).

2 RELATION BETWEEN REVITALIZATION, NEW CENTRAL SPACE AND PUBLIC SPACE ORGANIZATION

Process of central space development is permanent. It is connected with transformation of existing morphological units that can be run-down areas or creating new districts in "new" locations. Regarding revitalization of post-industrial urban sites, it can be related to both types of mentioned spatio-functional transmutations. According to this approach one can indicate dichotomous character of central space and it is possible to distinguish: "old" central space that is associated to pre-existing central area (older than areas developed as a consequence of e.g. post-industrial areas after revitalization) and mentioned "new" central space. The second type of morphological units is an opposition to "old" central space and it has three meanings:

- new as young;
- new as this one which is developed in new location;
- new as modern, it is characterized by concentration of new buildings constructed according to the newest trends in architecture, often with use of original forms, new functions and institutions refers to current needs of urban space users and to create new and modern public space that meets the aesthetic requirements for a given period when it was created.

All of them are crucial for public space reorganization in the process of revitalization of post-industrial sites as the formation of new central space leads to:

- relocation of metropolitan institutions that demand high quality of public space – old that is modernized and new one that is designed for new central districts;
- enlargement of existing public space and its individual elements like public squares, public parks or some of pedestrian precinct;
- change of old public space functional equipment and its use by urban space users (e.g. inhabitants, tourists) as a consequence of creating new elements of public space structure.

Revitalization of post-industrial urban areas is qualitative as well as quantitative morphological transition. This is the essence for understanding how process of new central space formation can also change public space organization as a significant element of urban structure.

3 CASE STUDIES OF REVITALIZATION AND PUBLIC SPACE REORGANIZATION

This section is concerned with comparative case studies of public space transitions in Manchester, Lyon and Łódź. In all of these cities a new central space has been developed as a result of revitalization of downtown's post-industrial areas. There are some other criteria of selection of these cities, especially as:

- they are former principal cities of textile industry in England (Manchester), France (Lyon) and in Poland (Łódź, it was also localized in Russian Empire before 1918);
- the collapse of textile industry initiated there a long-term crisis of centrally located areas;
- they have similar number of inhabitants (at least 450,000);
- they are one of the most significant complementary cities to the capital city in: United Kingdom, France and Poland.

In spite of presented similarities, the impact of revitalization of post-industrial urban areas on organization of public space in central area can be distinct, mainly due to morphogenesis of central space and the objectives of spatio-functional transmutations of re-developed brownfields sites and other central districts.

3.1 CASE OF MANCHESTER

Manchester growth up rapidly during 18th and 19th century as "first industrial city in the World" and "industrial jewel in the crown of the British Empire". As a matter of fact, Manchester developed much more as a regional trade centre of raw and finished material than classical industrial city. The importance of the city as a capital of British and in fact World cotton trade capital was reflected not only in large scale, impressive buildings of warehouses, banks and insurance companies and public institutions (e.g. town hall, libraries and universities) but also well developed and complex public space consisted mainly of public squares, public gardens and exclusive commercial streets. This area was situated in the central and northern part of nowadays downtown of Manchester and it is possible to indicate it as current old central space of the city. The decline of industrial (textile, chemical, engineering and some other) begun in 1930's and its collapse was in 1960's. Revitalization of post-industrial urban areas in central Manchester hes been initiated in 1980's mainly in southern part of the downtown along canals (Bridgewater, Rochdale and Ashton) and rail tracks. All of former industrial (production, transportation and stocks) units of Castlefield, City Centre, Gaythorn, Whitworth and Piccadilly was implemented housing as well as central functions: retail, offices, education, culture, tourism and laisure. Thus, all southern part of the downtown has been developed as a new central space of Manchester of 155 ha. It also consists of new CBD of Manchester in former industrial and residential district of Spinningfield transsformed in 1990's. Along old central space of 174 ha there are two retail and housing areas of Millenium Quarter (re-developed in 1990's after Irish Republican Army bomb atack in 1996) and still renewaled Northern Quarter.

As a one of crucial tasks for the projects of revitalization of post-industrial urban areas and renewal of run-down districts of southern downtown in Manchester, a new organization of public space was undertaken. The aims of re-devlopment masterplan were to: develop business, retail, leisure and entertainment base of the core of the city; create outstanding landscape of central area, consists of distinct spatio-functional units; and create high quality public infrastructure that can encourage urban space users to spend more time in public space. As far as public space transitions as a part of revitalization of post-industrial urban sites and new central space formation are concidered, they are related to:

- create of 7 new public squares of total surface of 27869 m^2 (fig. 1) – all in current central space of Manchester;
- modernization of 2 old public squares situated in Spinningfields of total surface of 10924 m^2 (fig. 1) – 27% of total surface of all modernized public squares in central space of Manchester;
- create 110892 m^2 of new pedestrian precinct including 67675 m^2 of waterfronts (61%) of all new pedestrian precinct, that gives 49% of all pedestrian precinct in central space, and 65% of only new pedestrian precinct in the analyzed area;
- modernization of public parks of St. John Gardens, Stockville Gardens and creating Roman Gardens in the site of ancient Roman fort (Mancunium or Mamuncium) and its vicus.

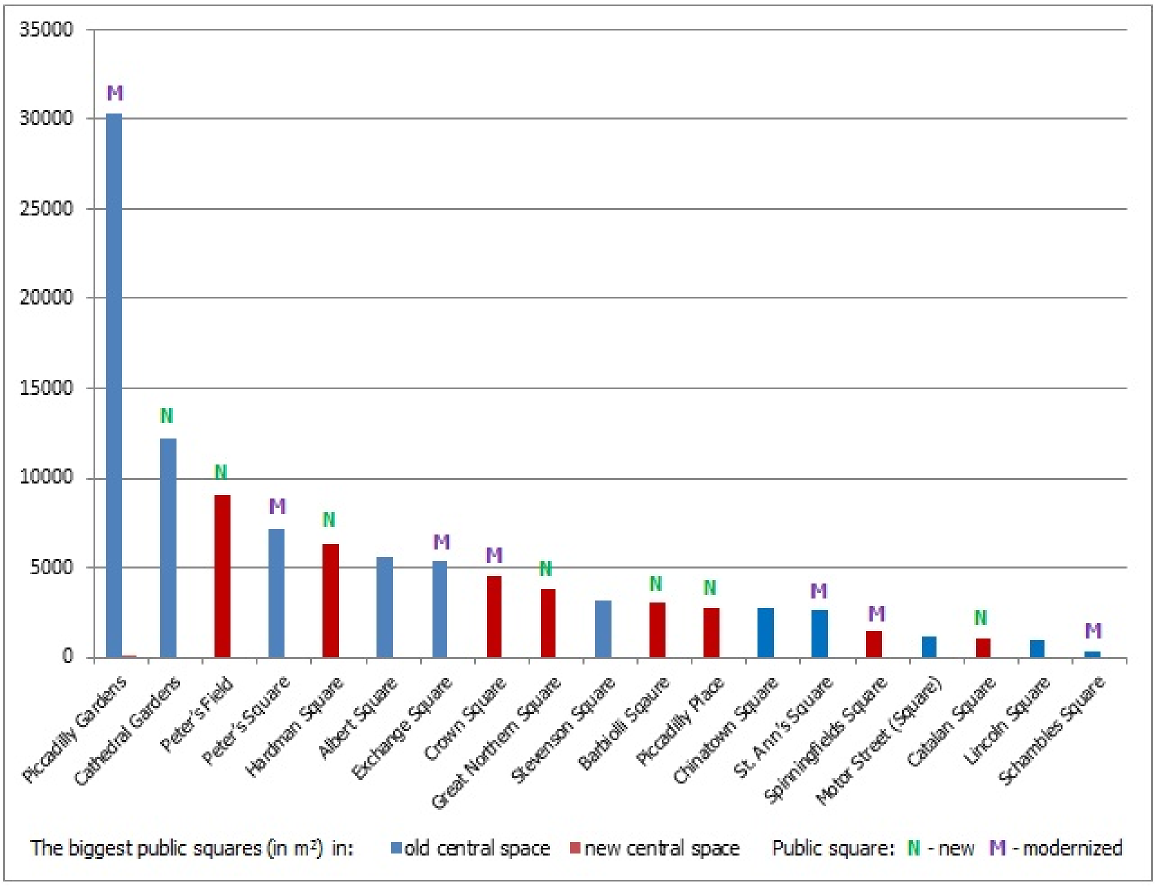

Fig. 1 The biggest public squares in central space of Manchester

All of noted spatial changes significantly extend well developed public space system of old central space to the southern and western part of the downtown. This result was reinforced by: modernization of 5 public squares of old central space of total surface of 40081 m^2 (fig. 1) including the biggest one – Piccadilly Gardens where transportation node of regional bus and tram (Metrolink) system was created as well as creating of 23435 m^2 of new pedestrian precinct that is 52% of all pedestrian area in old central space and 15% of all pedestrian area in whole central space in Manchester in 2013.

3.2 CASE OF LYON

The origns of Lyon are Roman (as Lugdunum) like in the case of Manchester. However, the morhogenesis of central space in this French city is far distinct in comaprison to previously analyzed. While central space of Manchester was formed rapidly just through two centuries (before 18^{th} century it was limited only to the area of medieval city next Cathedral church), current central space structure of Lyon has evolved from 3^{th} century. Initially, it was associated with Old Lyon (Vieux Lyon) on the Western bank of the Saône river where public space is represented by 19 public squares of total surface of 19373 m^2 and average of 1020 m^2 linked by 22783 m^2 of pedestrian precinct in 2013.

Since 13^{th} century (current old) central space has been developed on so called Presqu'île situated on peninsula between the Saône and the Rhône river. It is the the most important area of central space where 37 public squre are located of total surface of 106943 m^2 (55% of total surface of all publis squares in old central space) and average of 2890 m^2. The youngest district of old central space is Part-Dieu, constructed in 1970's as a Central Business District (CBD) of Lyon. There are only 8 public squares of 32176 m^2. However, the average of its surface is the biggest in old central space and it equals 4022 m^2. This analysis shows how well developed is historical central space and its public space system in Lyon. It has been equiped by a large number of metropolitan instututions like: town hall, opera house, museums, universities, banks and many international companies' headquarters characteristic for modern metropolis.

Industrial activities such as manufacturing and small workshops have been dispersed in the downton of Lyon, especially on its edges. The biggest area of industry concentration was Confluence, occupied mainly by enineering, chemical, food and transportation companies. Crucial for transportation of this district was Port Rembaud on the Saône river banks and rail station of Lyon Perrache (still working also as a TGV station). The collapse of industry in this area initiated a process of re-developemnt projects in 1990's. The main goal of revitalization in Confluence was extension of retail of old central space, connected with large investments of housing and central functions as offieces, hotels, media, cinemas, regional administration. As a result of revitalization some of metropolitan institutions was located in Confluence as: Hôtel de Region and headquarters of Euronews and Le Progress. This spatial and functional transitions entailed reorganization of public space in post-industrial area. Before revitalization and new central space formation there were only 2 public squares: Place de l'Hippodrome and Place General Delfosse of is 12255 m^2 of total surface and average of 6128 m^2. As a part of Confluence revitalization project 6 new public squares of 17851 m^2 (average: 2970 m^2) were created (fig. 2). Old public squares in this district haven't been modernized yet.

Essential for public squares integration in Confluence was creation of 122385 m^2 of new pedestrian precinct (87% of all pedestrian precinct of Confluence in 2013). It includes 108470 m^2 of waterfronts and boulevards of the Saône river (89% of all pedestrian precinct in Confluence in 2013). New pedestrian precinct developed in revitalization project gives 34% of all pedestrian precinct (76% of new ones created after 2000) in the whole central space in Lyon, while waterfronts and riverside boulevards – 62% (91% of new ones created after 2000). Significant for new public space system in Confluence are new green areas with restored riverside vegetation typical for the peninsula. They cover total surface of 34344 m^2 and bring favorable conditions for leisure.

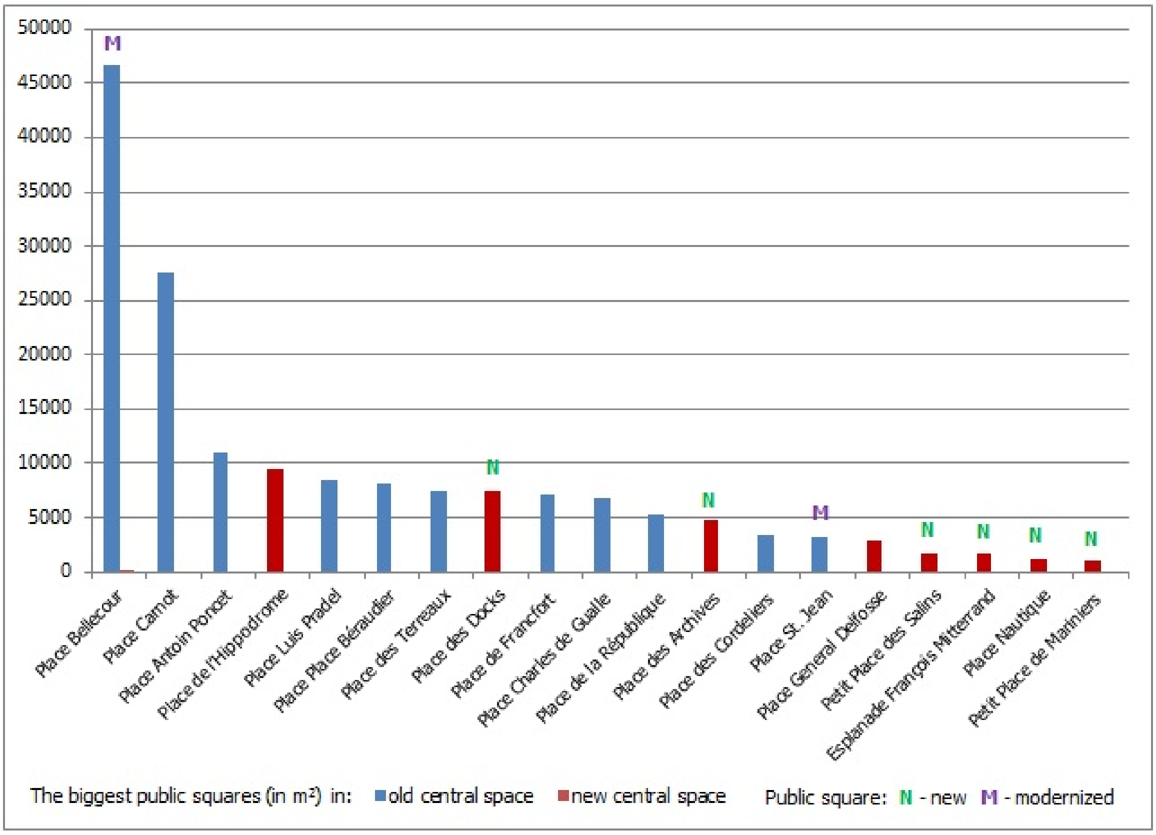

Fig. 2 The biggest public squares in central space of Lyon

In addition, new public space system formed in Confluence was complemented by pedestrian precinct in Cité Internationale, new central space developed in 1990's on the nothern edge of Lyon downtown, on the bank of the river Rhône. It covers 29200 m^2. This is to say new public space of new central space equals 170355 m^2. While new central space has being developed, investments in old central space have been concerned mainly on: modernization of Place de Jacobins and Place Bellecour (fig. 2) which is the biggest and principal public square in Lyon, as well as creating 187148 m^2 of new pedestrian precinct.

3.3 CASE OF ŁÓDŹ

Łódź is the youngest city through all of analyzed. Its origins deleve 14th century, but before 1820's it had developed as a small rural town. Łódź grown up rapidly in 19th century as a one of the crucial industrial city of Russian Empire and whole Central and Eastern Europe.

Because of its importance and some similarities of a great number of new inhabitants' increase it was called "Polish Manchester". However, this comparison was far exaggerated as it wasn't trade city as Manchester and in fact it was typical industrial city which urban structure was dominated by textile factories and other industrial and technical objects. Even along the main axis of Łódź urban development process and its principal street – Piotrkowska Street, some of industrial buildings have been located. Due to economic and political conditions of growth (firstly, radical restriction of urban space expansion imposed by Russian authorities, than 1st and 2nd World Wars, and lack of metropolitan investment during the period of socialist related to permanent industrialization and decapitalisation of the downtown) central space of Łódź in the beginning of 21st century was strictly limited to urban blocks along Piotrkowska Street.

The collapse of industrial activities in Łódź downtown was a consequence of political and economic transitions in Central and Eastern countries in late 1980's and early 1990's. Post-industrial urban areas was dispersed in whole downtown as a small complexes. They were leased for different services, mainly by wholesalers or stayed abandoned as urban fallows. Many of them were demolished. Some other, individual buildings were adapted for new functions. There were also some large-scale post-industrial complexes as situated in the Valley of river Łódka where Manufaktura shopping mall was created in the beginning of the 21st century and some other in the Valley of river Jasień in so called Manufactory permisses of Łódka that is still under re-development. Due to the lack of classical central space, the new one was developed in Manufaktura. Moreover, some new urban project of so called New City Centre of Łódź on post-industrial and post-rail areas is being developed nowadays as principal central area. It is expected to be finished in 2030. There are planned: four public squares (crucial are: Katarzyna Kobro Square and Władysław Strzmieński Square) of total space of 50397 m^2 (it will give 65% of all new public squares and 40% of all public squares in central space of Łódź in 2030) and public precinct of 55145 m^2 that integrate them with public squares in old central space (fig. 3) that will give 49% of all pedestrian area (excluding public squares) in central space in 2030. The biggest public square in current new central space of 21300 m^2 is located in post-industrial site of Manufaktura (fig. 3). Just one public square in current old central space of Łódź was modernized, but it wans't connected with any revitalization projects (fig. 3). Crucial feature of public space organization in central space of Łódź, even after revitalization projects is desintegration and malformation in comparison to the scale of the city in Polish settlement net. It is also weakly equiped with institutions typical for central area as theatres, cinemas, museums, art galleries, opera house, offices, retail, restaurants, night clubs and so others that are limited in a large extent to the Piotrkowska Street and Manufactura.

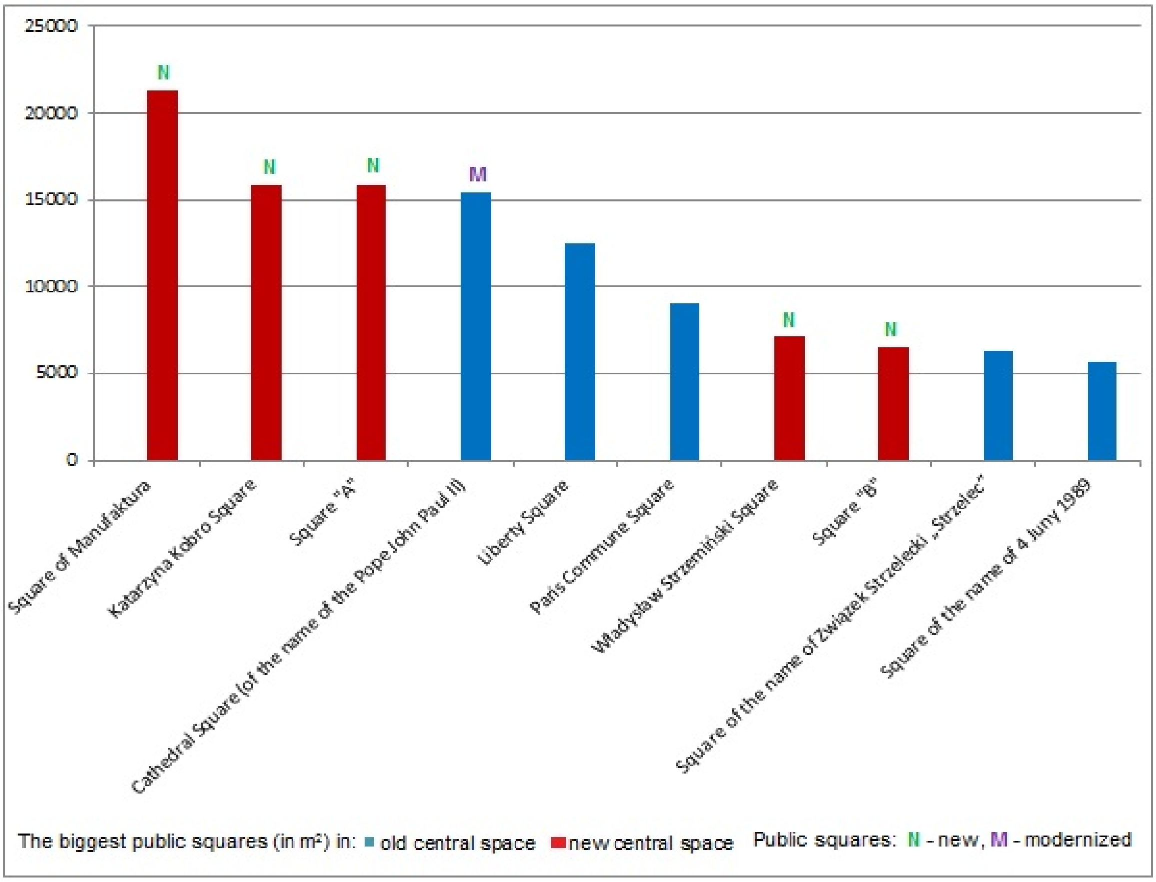

Fig. 3 The biggest public squares in central space of Łódź

3.4 COMPARISON OF PUBLIC SPACE ORGANIZATION OF ANALYZED POST-INDUSTRIAL CITIES

Case studies of Manchester, Lyon and Łódź showed that the impact of revitalization of post-industrial urban areas and new central space creation on public space organization can be distinct due to various objectives of the projects and historical central space development (its morhgenesis) as a cucial factor. Before re-development process of post-industrial sites had been initiated, the best developed central space (in fact the old one) was in Lyon, where was the biggest total surface of public squares (fig. 4). The difference between new and old central space is much more significant in this case than in Manchester and Łódź (fig. 4). Thus, it is possible to say that the impact of revitalization has the least impact on public space reorganization in the case of Lyon. Moreover, one can idicate that this influence is the most significant in Łódź, according to increase of the role of public space of new central space in whole central area (figg. 4, 5).

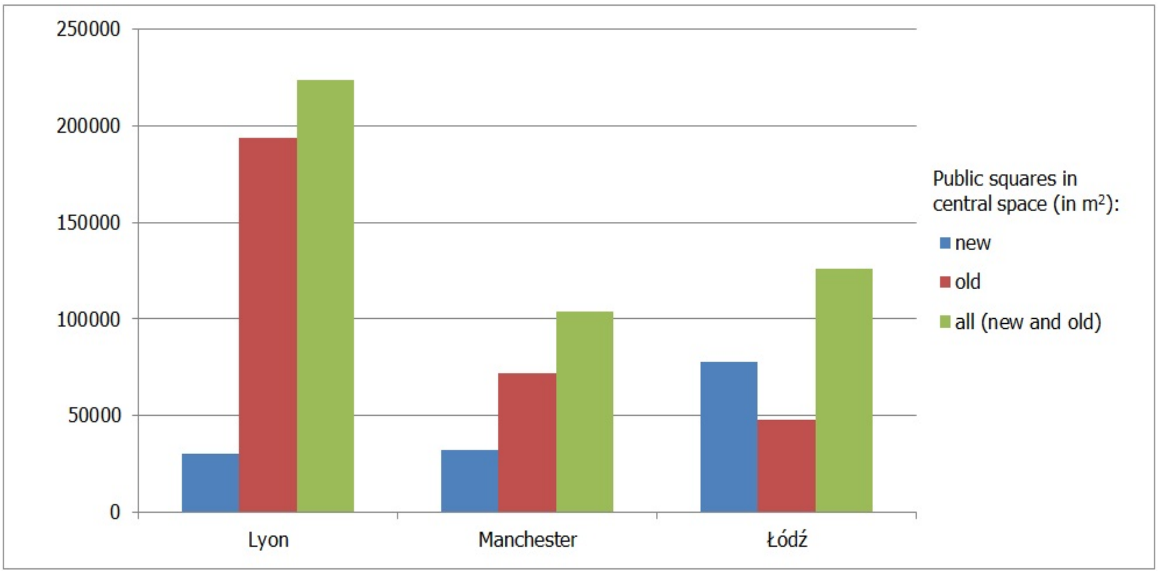

Fig. 4 Comparison of total surface of public squares in central space of Lyon, Manchester and Łódź

Regarding public space organization of central space and its different types, it is meaningful that the increase of total surface of new pedestrian precinct linking public squares is essential task for revitalization projects in all anazyed cities. The biggest surface of all pedestrian areas characterize Lyon, due to the most significant number of 72 public squares in central space (64 in old and 8 in new central space). The smallest surface of pedestrian precinct is identyfied in Łódź where only 11 public squares are situated in central space (6 of them are in new central space). In the case of Manchester the average surface of pedestrian area correspond to the number of 18 public squares in central space, included 7 of them in new central space. In the case of Manchester the average surface of pedestrian area correspond to the number of 18 public squares in central space, included 7 of them in new central space. According to the research the most fundamental increase of total surface of pedestrian areas is connected with waterfronts and riverside boulevards. As a result of their significant growth in new central space in Lyon and Manchester they become a key element of public space syetem. Only in Łódź, where there is no huge river in the central area, this type of pedestrian areas have not been created (figg. 6, 7, 8).

4 CONCLUSION

The results of the research showed revitalization of post-industrial urban areas is essential in current European cities' morphological transmutation, despite its various origins and mode of spatial and functional development.

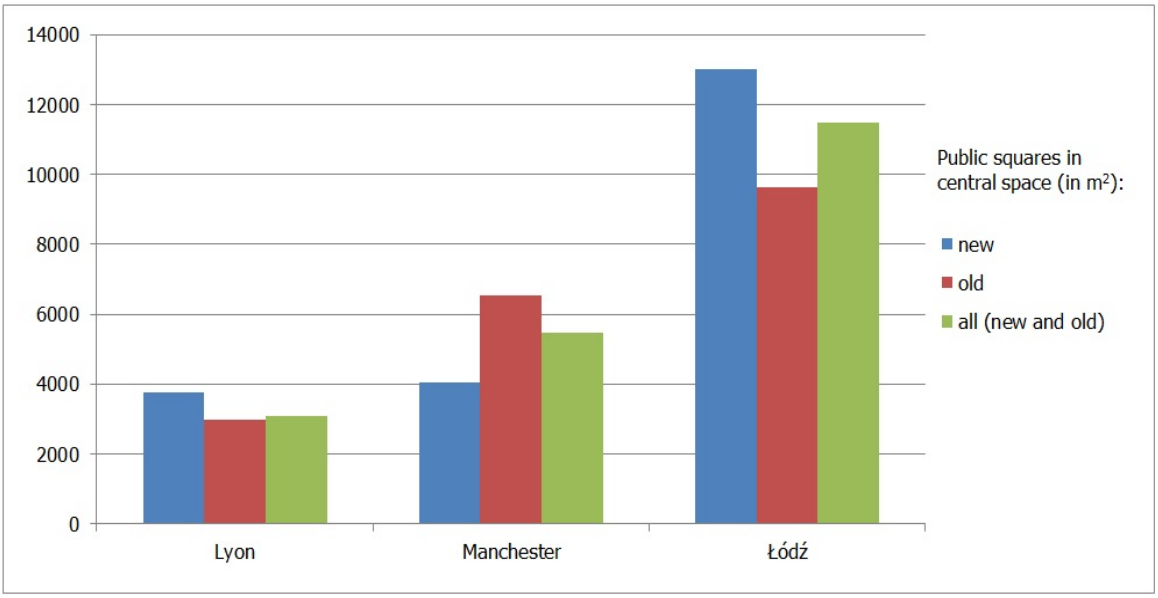

Fig. 5 Comparison of average surface of public squares in central space of Lyon, Manchester and Łódź

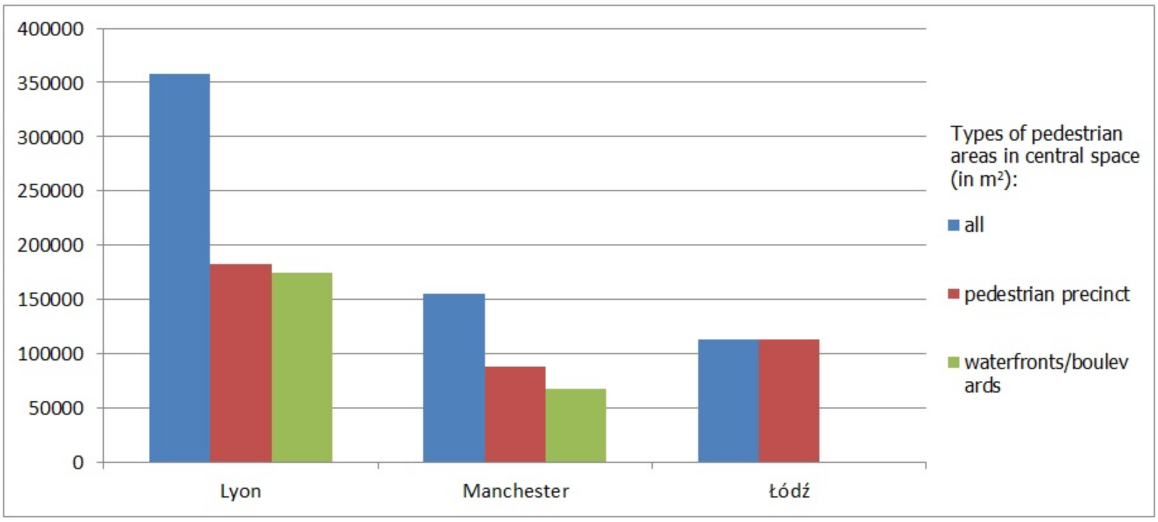

Fig. 6 Comparison of various types of pedestrian areas (excluding public squares) in central space of Lyon, Manchester and Łódź

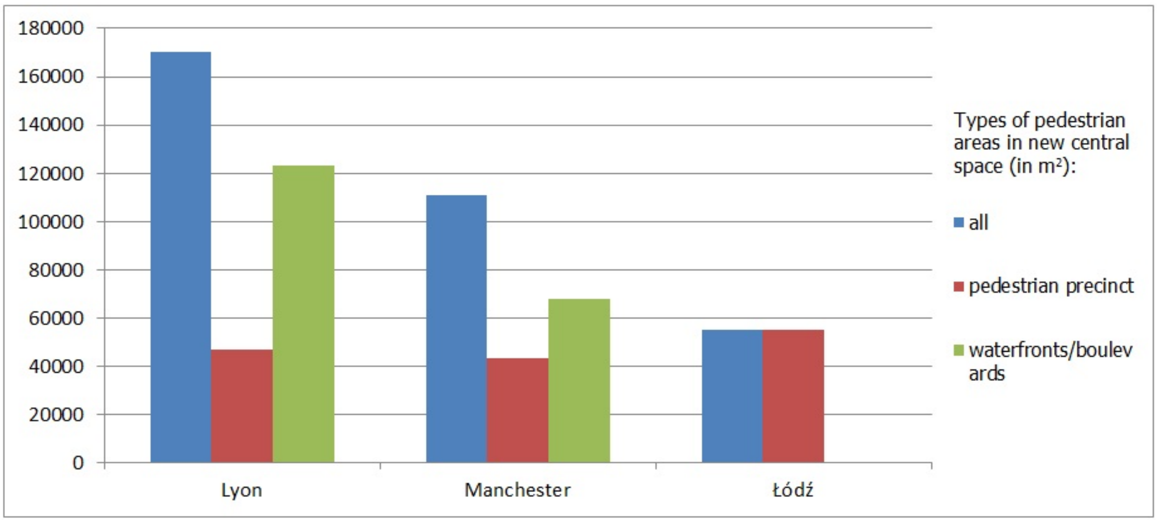

Fig. 7 Comparison of various types of pedestrian areas (excluding public squares) in new central space of Lyon, Manchester and Łódź

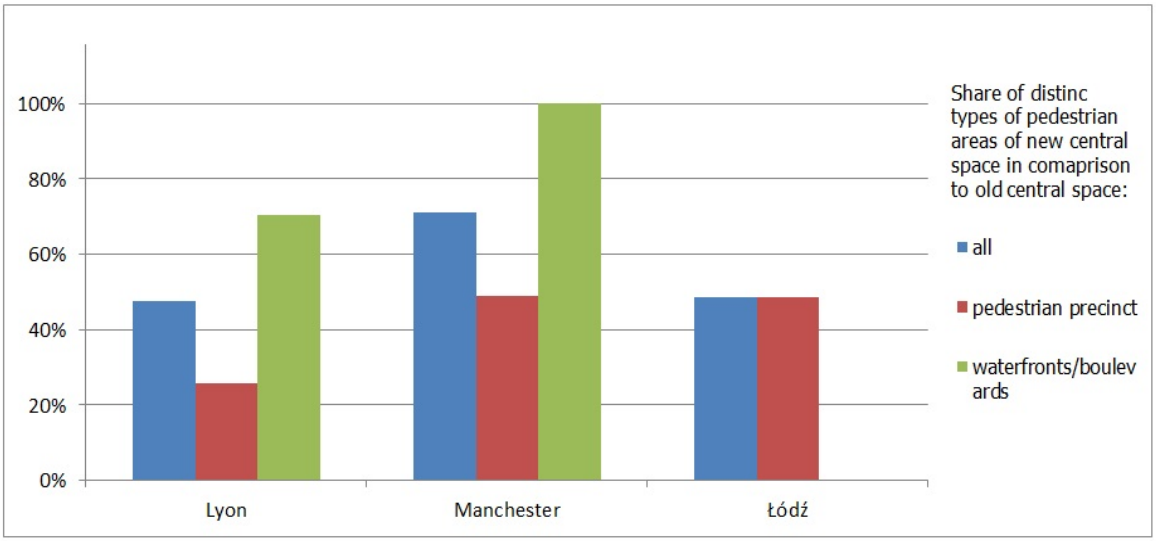

Fig. 8 Comparison of share of distinct types of pedestrian areas (excluding public squares) in central space of Lyon, Manchester and Łódź

However, it is also possible to indicate distinct impact of public space reorganization of central space. This is to say, that one can distinguish sustainable and unsustainable changes in public space system, mainly due to different morphogenesis of central space and various levels of public space development. Crucial in this context was also second half of 20th century when Western European and Central-Eastern European cities has developed in different economic and political conditions, that have considerable influence of its central space modification.

According to the research, Lyon and Manchester represent sustainable type of public space reorganization as a result of revitalization of post-industrial urban areas and new central space development, while in Łódź unsustainable changes were identified. New public space in Manchester and Lyon have supplemented old public space and initiated its modernization process. The structure of public squares and pedestrian precinct in both of Western European cities had been well-developed before revitalization of post-industrial urban areas where new elements of public space system have been created as a significant part of spatio-functional changes. In the case of Łódź, new public squares are planned as principal elements of public space structure. In consequence it can disturb historically shaped hierarchy of central space where Piotrkowska Street with public squares along it is essential. New central space enclaves as Manufaktura and especially New City Centre of Łódź are gaining the highest rank in the area of future Łódź's downtown. These transitions of current central space can contribute to far reaching marginalization and potential degradation of Piotrkowska Street as an old central space weakly integrated with new central space by pedestrian precinct. However, the results of revitalization projects undertaken in all of analyzed cities have some common features connecting with implementing the idea of "smart living" as essential part of smart city concept. First of all, this process is combined with sustainable growth by purifying polluted brownfields in the downtown area, restricting urban sprawl as well as protecting green belts inside and outside urban structure. Furthermore, reorganization of public space as a part of comprehensive downtown revitalization including post-industrial sites, comprises also development of environmentally friendly means of public transportations as tramways (Lyon and Manchester) or touristic lines of water trams (Lyon). Significant are also new cycle paths growth (Lyon and Łódź). Secondly, the increase of total surface of pedestrian areas encourages inhabitants and other urban space users to spend more time in city centre, especially in modernized public squares and new ones created on post-industrial sites. They are usually equipped with modern urban furniture and green areas enabling resting in central area. In fact, developing of coherent structure of pedestrian precinct with rising numbers of small restaurants, galleries and shops along the streets give a possibility for limit car use during the day path of inhabitant's life. Finally, as a result of revitalization of post-industrial sites new housing areas are developed that entices new people to reside in the city centre. Well-developed structure of public space raises the standard of living in downtowns, especially in post-industrial cities. Important elements of attractive public space creation in all of analyzed cities are river banks (Lyon and Manchester), waterfronts (Manchester) and fountains (Lyon, Manchester and Łódź). To conclude, enlargement of public space in central space as a part of brownfields revitalization projects can be considered as essential task in creating "smart live" in post-industrial smart city.

NOTES

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IMAGES SOURCES

Figg. 1, 2, 3, 4, 5, 6, 7, 8: Author, based on *in situ* research.

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GEODESIGN FOR URBAN ECOSYSTEM SERVICES

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ABSTRACT

This paper argues about the use of Geodesign tools in planning for enhance the Ecosystem Services provision in a urban context. Recently evolved from GIScience, Geodesign is an emerging field dealing with 2D and 3D representation tools developed for environmental design. On the other hand, the ES concept has become a central issue in environmental planning and research, dealing with the services provided by ecosystems to sustain and fulfill human life and well being. However, both Geodesign and ES still lack of a real integration in planning practices. While Geodesign tools appear to be stuck in rendering realistic 3D urban environments, the use of the ES concept in planning processes is still largely missing. For these reasons this paper will take advantage of concepts and tools from Geodesign and Ecosystem Services disciplines and will explore how they can be integrated in a methodological framework to generate Geodesign solution aimed at increasing the provision of urban ecosystem services.

KEYWORDS

Geodesign, Urban Ecosystem Services, Urban Planning

1 INTRODUCTION

Geodesign is an emerging, interdisciplinary field that has evolved from Geographic Information Systems (GIS) and encompasses digital, 2 and 3 dimensional representation tools developed for environmental design (Goodchild 2010). Over a relatively short span of time, Geodesign has moved from a neologism to the focus of contemporary researches on urban design integrated with modern IT tools (Miller 2013), thanks to the swift development of IT world and computational capability of personal computers. The advantage of Geodesign tools is that they can handle a wide spectrum of spatial complexity. This tools show a promising role in involving many stakeholders in planning processes by ensuring a feedback between future visions of changes and present actions and offering a learning process also known as "higher order learning" (Brown, Vergrat, Green and Berchicicci 2003). Yet, despite this central role in urban planning and design, Geodesign isn't currently integrated in land-use processes and still remains the domain of IT applications, mainly because it is non-intuitive and relatively difficult to use. Contemporary Geodesign approaches are mainly focused on single rendering of 3D urban landscapes, but they are often disconnected from general objectives of sustainability planning.

Ecosystem Services (ES) are the conditions and processes through which natural ecosystems and the species that compose them sustain and fulfil human life (Daily 1997). These services include, among others, purification of air and water, mitigation of floods and droughts, detoxification and decomposition of waste, generation and renewal of soil fertility, regulation of climate, moderation of temperature extremes, provision of aesthetic beauty and intellectual stimulation (Bolund and Hunhammar 1999; MEA 2005). The concept of ES represents a consolidated theoretical reference for a number of different disciplines, such as ecology, forestry, agricultural science, environmental economics and urban/landscape planning. However, the inclusion of ecosystem services in planning processes is still very limited, especially in Italian urban planning, where there is a general lack of knowledge by decision makers about these issues.

The field of urban and landscape planning appears to be to most straightforward destinations for the outcomes of Geodesign and Ecosystem Services disciplines. Geodesign tools are naturally and closely intertwined with urban planning and have very recently emerged as a specific opportunity, to better accommodate landscape architects, urban and regional planners, and architects with geospatial technologies (Wilson 2014). They can act as a mean to make complex urban planning problems more readily understandable, in order to broaden public participation, and to improve decision making (Steinitz 2008).

On the other hand, the fast and widespread evolution of the ES concept is seen by a number of scholars and scientists as a not-to-be-missed opportunity to inform planning authorities in finding solutions that respond to competing social and environmental needs.

For these reasons, the integration of concepts and tools from Geodesign and Ecosystem Services disciplines is a promising way for urban planning to achieve significant results of long term sustainability in the urban environment.

2 GEODESIGN TOOLS FOR URBAN ECOSYSTEM SERVICES

There is very limited research ongoing about the relation between Geodesign and Ecosystem Services: querying these two words in academic databases (Scopus, ISI Web of Knowledge) returns only a couple of occurrences.

Current literature have clearly underlined the importance of ES. To prevent a decrease of the quality of ecosystems, the ES concept has become a central issue in environmental planning (Fisher and Turner 2008), allowing the assessment and mapping of services provided by different ecosystems. The concept is also view

as useful for communicating the multiple ways in which natural systems contribute to human well-being and highlighting the (monetary) value of provided ecosystem services (MEA 2005; Pavola and Hubacek 2013).
Despite the growing body of literature on ES, still many challenges remain to structurally integrate ES in planning (de Groot et al., 2010) and rhe use of the ES concept in planning is still largely missing.
Even more limited is the application of ES concept to urban planning field (Gómez-baggethun and Barton 2013), where the ways of including ES into planning choices about future land-use assets are still fairly unexplored (La Rosa and Privitera 2013). Moreover, general approaches of ES assessment do not consider information about detailed land cover composition in urban contexts: having a look at land cover compositions at finer scale reveals significant differences in terms of provision of ES (Lakes and Kim 2012). 3D dimension (height of tree or buildings and building and consequent volume of leaves and built structures) has been never considered in current ES assessment.
In this direction, the use of Geodesign solutions can overcome the limited applications of ES concept in urban planning. Testing and assessing designed spatial configurations of land-use and land cover at detailed scale would be a crucial information to decision makers especially at the municipal level, where the most relevant choices about land-use are taken and the pressure from different stakeholders is higher. In synthesis, the use of Geodesign for planning ES in urban context would allow to:

- increase the credibility of decision on land-use with a detailed design of land-use and land cover;
- improve the communication of key messages, such as the right choice of design element might maximize the provision urban ES;
- explore and communicate alternative decisions about land-use according to available financial resources.

Despite the link between of Geodesign and urban planning is claimed to be central (McElvaney 2012), current applications of Geodesign are mainly focused on producing complex, appealing 3D virtual urban landscapes, but often show no sound objectives or policies of urban sustainability as their bases. For this reason, the integration within urban planning of ES concept and Geodesign techniques appear to be of great importance to achieve relevant results for a sustainable the urban environment. A proposal for using Geodesign tools for integrating Urban Ecosystem Services into planning follows below.

2.1 A METHODOLOGICAL PROPOSAL

The main assumption of the methodological proposal here presented is that physical features such as land-use/land cover and socio-ecological variables are identified as the main components of urban ecosystems, thus influencing the production of ES (Bolund and Hunhammar 1999). These features can act as the main information sources for ES assessments, as they are able to provide information about environmental, physical and social characteristics of the urban environment. They can be represented by the following variables:

- land-use classes (according to the 4 level of the legend of Corine Land Cover data set);
- land-cover classes (trees, shrubs, grass, herbaceous vegetation, buildings, streets, other impermeable surfaces);
- census data (total population, children, elderly people, …).

These variables can be used for the calculation of a set of spatial indicators for the assessment of ES, as explained below.
A first set of ecosystem services can be derived from literature (Burkhard *et al.* 2009; de Groot *et al.* 2010; MEA 2005), trying to encompass the most relevant categories of service. The set includes: (1) provision of

food and fodder, (2) provision of wood/timber, (3) clean air provision, (4) local climate regulation, (5) global climate regulation, (6) water balance regulation, (7) clean water provision, (8) soil erosion protection, (9) recreation and ecotourism, (10) aesthetic value, and (11) biodiversity.
The criteria for the choice of the ES are: to be among the most used assessed ES in current literature, to span all categories of ES according to MEA (2005). Each of the previously identified ES can be assessed by one or more indicators. An initial set of indicators available in literature is reported in reported table 1. This set should be always subject to a check aimed at verifying the possible use of indicators according to data availability.

ECOSYSTEM SERVICES CATEGORIES	SERVICES	INDICATORS
Regulating	Water balance regulation	Water balance regulation: water retention capacity [m^3 * ha-1], run-off coefficient [Ψ], soil sealing [%]
	Climate regulation	Local climate regulation: albedo [%]
		C-Sequestration - storage of C in soil and biomass [kg C ha-1]
	Soil erosion protection	C-factor (USLE model)
	Capacity for biological regulation	Number of habitats for pest control species
Provisioning Ecological integrity	Biological diversity	Composition of flora and fauna communities
	Ecological Connectivity	Connectivity index
	Water cycles	Ground water recharge [m3 * ha-1]
	Evapotranspiration	Evapotranspiration [area of evapotranspiring land covers/ total area]
	Production of plant biomass	Food and fodder from plants [t * ha-1 *a-1]
		Biomass for industrial use / processing [t * ha-^{1} *a^{-1}]
	Bio-resource production	Biomass for energy production [t * ha-^{1} *a^{-1}]
		Food from livestock [t * ha-^{1} *a^{-1}]
	Cool air production	Clean air production [m^3 * ha^{-1} * h^{-1}]
Human health and well-being	Recreation and social values	Number/area of green spaces
		Number of visitors of green space
		Aesthetical value (expert opinion)

Tab.1 A possible set of indicators for urban Ecosystem Services

The second step of the method assesses the ES using spatial indicators selected in the previous phases. First indicators are calculated in a GIS environment on the base of available land-use, land cover and census data. Since indicators are expressed with different units and scales of values/scores, they need be transformed to a relative scale from 0 – 100 by mathematical normalization. Moreover, some ES, i.e. regulating and cultural services and to a minor extent some provisioning and supporting services, depend strongly on the geographic location of urban ecosystems or land-use/land cover classes. For example, cultural services provided by urban green spaces can be dramatically increased when these areas are well distributed in the urban context. These aspects are always excluded from ES assessments and require the inclusion of urban ecosystem mosaic (or mosaic of land uses) in the assessment models. Thus the spatial configurations of land-use/land cover must be expressed in terms of specific spatial features (heterogeneity, density, contiguity) and used to assess some of the indicators.

The third step is the definition of a set of Geodesign solutions (2D and 3D) according to literature review and environmental features of the study areas. Each Geodesign solution include a combination of base elements of land-use and land-cover (Fig. 1). Examples of design solutions encompass different combinations of buildings and/or streets/public space layout with different area covered by trees, shrubs, lawns and water and thus presenting different permeability/evapotranspiring ratio. All Geodesign solutions are sketched and mapped with 3D GIS software (for example, ESRI City Engine) and will be based on vector base GIS information (shapefile) containing the 2D spatial composition of land-use and land cover. This would allow to include the designed solutions in a geodatabase that comprehend all attributes and features related to each solution (land-use, land-covers, covered area, height, permeability ratio, cost of implementation per area unit) as well as the relative geographic vector information.

Fig. 1 Example of green corridor and bike/pedestrian pathway

Figure 1 and Figure 2 show a couple of examples of Geodesign solutions for two green urban corridors integrate with bike and pedestrian pathways. They have a width varying from 20 m to 14 m, with a total percentage of green cover varying from 75% to 70% and permeable surface at 92% and 100% respectively. They can composed by a bed of arboreal species with a width between 7.8 m and 6.8 m. Trees have their maximum height between 5 m and 12 m and canopy width between 3 m and 6 m. Species of Ligustrum japonicum, Phillyrea Agustifolia, Magnolia grandiflora, Celtis Australis can be used. One way cycle (1.5 m wide) and pedestrian are paths (from 2.1 m to 2.5 m) included in this solution. Corridors can be paved with bituminous layer. Cycle and pedestrian paths are always paved with natural permeable materials. Zoysia Japonica specie can be used for lawns, as it is a very resistant specie for Mediterranean climate. The result of this Geodesign solution is a configuration of public green spaces where usability (cultural services), thermal comfort (regulating services) and safe mobility can be achieved. The shade along cycle and pedestrian paths is a key element considering the climate condition of the city, characterized by long and hot summers (regulating services).

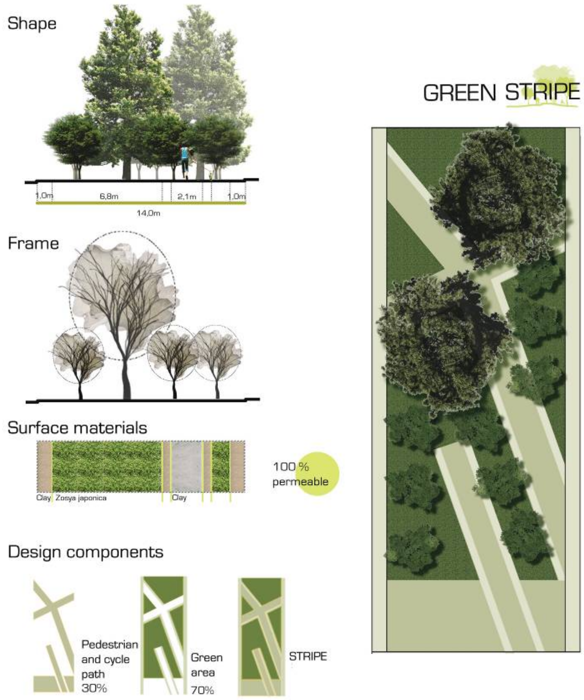

Fig. 2 Example of green corridor

Particular importance should be attributed to the vertical dimension of proposed design solutions, since the provision of ES can be very different when, for example, being equal the area covered by a land-use, there are different heights of buildings and trees or different permeability ratios. Of course, the costs for each solutions need to be evaluated, based on appropriate literature and urban design projects' reviews. This represents a crucial information that will allow to quantify the effectiveness of proposed solution in terms of benefits/cost ratio.

The last step of the method quantifies the changes in ES provision according to Geodesign solutions identified in the previous phase. To achieve this, Geodesign solutions can be structured into two groups of planning scenarios, that represent the spatial modification of current land-use pattern in the study area and are aimed at understating which ES and to what extent it may change according to these modifications. For example, planning Scenarios can be grouped in urban development and green spaces provision scenarios and each group of scenarios can be further divided in 3 sub-scenarios, according to the intensity (low, medium, high) of proposed urban transformations and thus considering an increasing cost for their implementation. This would allow to explore the changes on ES provision by Geodesign solutions in a more continuous way, moving from low intensity to high intensity transformations.

Each scenario results in a change of provided ES ad different scales, such as neighbourhood and the entire municipality scales. Within each scenario, different combinations of Geodesign solutions are tested, so to find an optimal set of solutions in terms of ES enhancement and relative costs. This means that the a single planning scenario can be constituted by different combination of Geodesign solutions. For example, a scenario of low urban development with a 30% of covered floor area can be obtained by several combination of single high rise buildings, lawn and trees or, as an alternative, semi-detached houses, ornamental orchards and shrubs. To find an optimal set of GeoDesign solutions, a Multi Criteria Model can be used, by defining an objective (the maximization of the ratio between provided ES and relative costs) and weighting each ES according to Analytical Hierarchy Process (Saaty 1980).

Figure 3 presents an example of the generation of a 2d design solution for an Non Urbanized area within the dense urban fabric of the city of Catania (Italy). The detailed layout include a proposal for an optimal localization of buildings, public facilities and greenspaces in the area in terms of provided Ecosystem Services (Martinico *et al.* 2014). This area is characterized by different function and land covers. For example, within the two designated Development Zones, multi-storey apartments, buildings for offices and retails up to five storeys can be allocated and a required minimum percentage of permeability of 30% is fixed in order to allow the natural infiltration of rain waters and decrease the urban surface run-off. In the new public greenspaces (representing about 50% of the area), the tree coverage is set to be higher than 25%. Moreover, new land uses such as allotment gardens and Community Supported Agriculture farms can be included allowing the increasing of provisioning services.

Fig. 3 A planning scenario to optimize Ecosystem Services provision

3 CONCLUSIONS

This paper proposes to understand how modern Geodesign spatial tools for urban planning can be used to provide design solutions aimed at the maximization of urban Ecosystem Services. Recently evolved from GIScience, Geodesign is an emerging field dealing with 2D and 3D representation tools developed for environmental design. The ES concept has become a central issue in environmental planning and research, dealing with the services provided by ecosystems to sustain and fulfill human life and well being. However, both Geodesign and ES still lack of a real integration in planning practices. While Geodesign tools appear to be stuck in rendering realistic 3D urban environments, the use of the ES concept in planning processes is still largely missing. For these reasons the integration of the two concepts and relative tools can be used by urban planning to achieve results of long term sustainability for the urban environment.

The proposed method can be considered as an initial framework to use Geodesign tools in urban planning aimed at the optimization/increasing of urban Ecosystem Services. In this method, different GeoDesign solutions can be defined as combination of land-use/land cover elements of the urban environment such as building, paved areas, roads, trees, shrubs and grass. They are based on 3D GIS software modelling, able to sketch, render and map both at 2D and 3D scale. Different GeoDesign solutions are and their spatial configurations can included in planning scenarios to test and quantify the achieved change in provided Ecosystem Services. A set of planning scenarios involving different Geodesign solutions (in terms of number and types) can thus be tested and assessed in terms of costs for its implementation and enhancement of Ecosystem Services.

Through these Scenarios, planners of municipalities and decision makers will be able to understand precisely the effects of decisions on land-use on the provision of ES and to quantify the related cost for such decisions. Implementation of urban policies aimed at enhancing ES can be rather expensive and several Italian public administrations are suffering by a strong lack of resources. For this reason an accurate choice of Geodesign solutions that optimize the cost-effectiveness in increase ES can be of the utmost importance. Finally, the proposed methodological framework might be able to provide some significant scientific and socio-economical advancements:

- by obtaining a quantitative and documented assessment of the impacts of Geodesign solutions on ES provision at different urban scale;
- by quantifying the role of spatial configurations of land uses and land covers in the provision of ES;
- by making ES concept more appealing, actionable and useful by public administrations with the modern tools of Geodesign;
- by providing some practical tools (planning scenarios of Geodesign solutions) to public administrations, allowing them to make more efficient and sustainable decisions on future land-use assets of their urban contexts.

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AN ONTOLOGY OF IMPLEMENTATION PLANS OF HISTORIC CENTERS

A CASE STUDY CONCERNING SARDINIA, ITALY

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ABSTRACT

This paper discusses some key points related to the ontology of implementation plans of historic centers (IPHCs). We study this ontology by discussing its implementation in the context of the provisions of the Sardinian Regional Landscape Plan (RLP), and put in evidence some important general observations, coming from the case study, concerning the utility and effectiveness of the ontological conceptual framework in order to help planners and decision makers understand and structure the assessment process of implementation plans.

KEYWORDS

Implementation plans of historic centers, Ontologies, Urban renewal

1 INTRODUCTION

In the framework of regional and urban planning processes of Sardinia, in the context of the RLP, established by the Decision of the Sardinian Regional Government (DSRG) no. 36/7 of 5 September 2006[1], the IPHCs are planning tools which implement the Planning implementation code (PIC) of the RLP into the "Areas characterized by historic settlements". For these areas, the PIC defines a set of prescriptive rules and planning criteria (articles nn. 51-53 of the part of the PIC related to "Cultural and historic spatial framework", which is defined by articles nn. 47-59). More precisely, article no. 52 identifies the IPHC as a plan which has to be necessarily approved through the cooperation of the Sardinian regional administration and a municipality as a necessary precondition for a municipality to exert its ruling power over the local transformation processes related to the municipal spatial jurisdiction, which implies a considerable pressure on the local administrators in order to implement valuable and effective planning processes concerning the municipal historic centers.

Following the RLP's approval, the Sardinian regional administration provided municipalities and practitioners with a wide range of technical guidelines and documentation which are significantly influencing the implementation of the planning processes of IPHCs[2].

As a consequence, in the planning processes of the IPHCs, heavily influenced by the control of the technical staff of the regional offices, a strong consistency and implied uniformity do show up as: i. a strong attention to historical, typological and morphological characteristics in terms of the territorial analysis of historic urban settlement systems, which are identified by the RLP as "Centers of antique and primary development"; ii. A strong prescriptive ruling framework characterized by a markedly-conservative attitude.

With its approximately 24,000 square kilometers, Sardinia is the second-largest island in the Mediterranean Sea; its population density is rather low, as it counts less than 1.7 million inhabitants according to the 2011 National Census. The vast majority of Sardinians live close to the sea, and especially in the two densely urbanized areas around the two major cities (Cagliari and Sassari), while the inner areas of the island, hilly and mostly badly connected to the rest of the island, are sparsely populated. This uneven concentration of population parallels the island's unbalanced economic development, as in coastal areas the majority of economic activities takes place.

It is therefore not surprising, given this context, that the Regional Landscape Plan of Sardinia (RLP), the first statutory landscape plan with regional dimensions produced in Italy under the new legislation, focused on the coastal zone because of the complexity of development conflicts arising from tourism (on which a large part of the economy of the island relies) and other development, and owing to the fact that thirteen out of the fourteen previous landscape plans covering coastal areas, which contained some restrictions on coastal development, had been quashed between 1998 and 2003.

1 An updated and revised version of the RLP was preliminarily approved by the Regional Government of Sardinia by the DSRG no. 45/2 of 25 October 2013. According to this DSRG, only a subset of the "Centers of antique and primary development" of the Sardinian municipalities are classed as "landscape goods", as it occurs in the case of the RLP, while the majority are classed as "Identitarian systems: areas characterized by historic settlements" (art. 52 of the Planning implementation code of the updated and revised RLP; documents are available online at http://www.sardegnaterritorio.it/j/v/1293?s=242464&v=2&c=11437&t=1 (accessed April 2014). If and when the new version of the RLP is established, this will imply some (minor) changes in the IPHCs' planning processes, which will make the approval processes of projects faster, since landscape authorization will be not required any longer.

2 Guidelines and documentation are available online in the institutional Internet site of the Sardinian regional administration "Sardegna Territorio" [Sardinia Territory] at http://www.sardegnaterritorio.it/j/v/1123?&s=6&v=9&c=9560&na=1&n=10 (accessed April 2014).

Following approval of the plan in 2006, restrictions and prohibitions (on development of land and on certain changes in land uses) stemming from the plan are currently in force, in order to protect a part of the island considered economically strategic and environmentally sensitive. Restrictions and prohibitions are set out by the plan by means of a system of rules.

The planning activity of the regional administration of Sardinia has undergone a deep change after the approval of the RLP, which establishes the directions for nearly any future planning activity in Sardinia, and requires that actual sectoral and local plans, as well as plans for protected areas, be changed to comply with its directions.

Within the framework of the provisions of the RLP, and after providing the reader with a thorough presentation of some important technical issues related to IPHCs and a discussion on the semantics of the term “ontology” (second section), this paper discusses some key points concerning the ontology of the IPHCs procedure, that is the spatial analysis of the IPHCs and implied planning measures (third section). This discussion regards the IPHCs’ definition procedure in the context of the municipal planning processes stated by the provisions of the PIC of the RLP, with the objective of proposing the ontology as an important contribution to the definition and implementation of this procedure (fourth section).

We develop the ontology on the basis of these normative standpoints, and implement its construction through Protégé, a software program developed by the Stanford Center for Biomedical Informatics Research of Stanford University and freely available at: http://protege.stanford.edu.

2 BACKGROUND

2.1 IMPLEMENTATION PLANS OF HISTORIC CENTERS

The qualitative enhancement of historic centers represents a significant question in the national, regional and local planning contexts. In particular, the Sardinian regional administration, which identified in the historic centers’ renewal, improvement and promotion, a very important opportunity to support local, economic and social development, established the Regional Law no. 1998/29 titled “Protection and enhancement of the historic centers of Sardinia”, and, in 2006, approved the RLP, which recognizes the strategic role of the “Centers of antique and primary development”, which are defined through a cooperative planning activity by the regional administration and the municipalities, and are classified as landscape goods, and, as such, are subject to a special protection regime under the provisions of the National Law enacted by decree no. 2004/42 on cultural and landscape goods.

A critical analysis of the IPHCs of Sardinian municipalities, which reflect properly and precisely the planning guidelines of the regional administration, shows a lack of an explicit strategic vision which should characterize the planning processes, which instead are mostly concerned with the analysis of the historic urban settlement system and of the typologies of the buildings, which eventually found projects which mainly consist of limited and conservative interventions. So, there is no evidence of a strategic vision of IPHCs, which puts in evidence the lack of a strong link between planning processes related to historic centers and local economic and social development.

Under this perspective, we propose a system of objectives which aims at identifying the strategic potential of the IPHCs, on the basis of a detailed analysis which could eventually increase substantially the strategic effectiveness of these plans.

Effective strategic approaches to historic centers’ strategic planning can be recognized in some recent experiences implemented by the municipalities of Reggio Emilia (Strategic plan for the qualitative enhancement of the historic center; Comune di Reggio Emilia, 2005, 2011) and of Vicenza (Masterplan of the historic center of Vicenza; Fantin, 2013). In both cases, a strategic approach is explicitly mentioned and implemented into the plans, in order to study the futures of the historic centers, on the basis of a system of objectives which comes from the overcoming of a system of problems (negative actual situations: a problem solving-based goal-oriented approach). A very similar logical framework can also be identified in the debate proposed in a monographic issue of *Urbanistica Dossier* related to LUDA (Large urban distressed areas)[3]. In particular, Mueller *et al.* (2005) propose a GOPP methodology, the so-called CoSGOP (Collaborative strategic goal-oriented programming), to define strategies and programs to address urban requalification programs towards cooperation between pubic and private stakeholders, based on the analysis of case studies related to the urban contexts of Bratislava, Dresda, Edinburgh, Florence, Lisbon and Valenciennes.

The analysis of the strategic approaches to the definition and implementation of plans for the historic centers provide the municipalities with sets of objectives which could be very useful to assess the strategic effectiveness of their IPHCs, and to identify suitable planning paths to improve the quality of life and to catalyze economic and social local development. These sets may eventually make more comprehensive and multifaceted the almost-monotonically conservative and philological character of the actual IPHCs.

In our view, a tentative general set of objectives to define and implement IPHCs could be the following:

first general objective: improving the quality of municipal life in the short run, which includes the following specific objectives:

1.1. promoting the urban system of the historic center and its relationships with the rest of the municipal area;
1.2. improving the quality of the historic centers' built environment, which contributes substantially to the historic centers' perceived features, which implies a particular attention to urban maintenance and renewal;
1.3. increasing the quality and potential of the historic center's public spaces in terms of aesthetic attractiveness, urban fabric and functionality;
1.4. organizing and increasing the quality of commercial and retail sale activities;
1.5. promoting the image of the historic center through marketing campaigns related to the local, regional, national and international tourist markets;

second general objective: promoting local development in the medium and long run, which includes the following specific objectives:

2.1. making housing in the historic center more interesting and attractive;
2.2. implementing cooperative actions between the public and private sectors to generate a system of urban services qualitatively valuable and competitive in terms of capacity of responding to social demand, also by means of innovative tertiary activities;
2.3. improving accessibility, mobility efficiency and the situation of thru-traffic flows in the historic center, by encouraging the use of public transport, pedestrian and cycling paths, and discouraging the use of private transport;
2.4. implementing participatory practices to support planning processes.

Our discussion is related to the IPHCs of four Sardinian municipalities, Assemini (Comune di Assemini, 2012), Cagliari (Comune di Cagliari, 2011), Elmas (Comune di Elmas, 2012) and Villacidro (Comune di Villacidro,

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[3] The issue describes the experience of "LUDA Project - Improving the quality of life in large urban distressed areas", funded by the European Commission through the Fifth Framework Program - Energy, Environment and Sustainable Development, Key-action 4 - City of Tomorrow and Cultural Heritage (Bentivegna, 2005).

2010), which are the only municipalities that studied an IPHC and a strategic plan as well[4]. We consider the strategic operations concerning their historic centers, which are identified in their IPHCs, in the logical framework of the set of objectives indicated above.

However, Elmas and Assemini do not show any evidence of strategic operations specifically related to the historic centers, since they have a general spatial scope. In any case, these strategic operations can possibly have important impacts on the historic centers' situation of the two municipalities. The municipalities of Cagliari and Villacidro identify site-specific policies related to their historic centers, regarded as peculiar parts of the municipal areas in the strategic visions of the plans.

With reference to the first general objective, "improving the quality of municipal life in the short run", which is taken into account much more than the second one, the four IPHCs address in particular specific objective no. 1.2 above. The four IPHCs, starting from context analyses which put in evidence a significant decay of their historic centers, project interventions aimed at protecting the comprehensive characteristics of their centers of antique and primary development, paying particular attention to conservation of the historic identity of the built environment. On the other hand, these operations not only focus on urban decay, but also aim at revitalizing the urban historic contexts characterized by insufficient endowment of public services. The municipalities also address this issue through projects which pursue specific objective 1.4 above. Moreover, even though all the IPHCs give provisions concerning enhancement and strengthening of public spaces in terms of aesthetic attractiveness, urban fabric and functionality (specific objective no. 1.3), only the municipality of Cagliari emphasizes the strategic importance of this objective in terms of enhancing their attractiveness and functionality.

Finally, it is certainly emblematic that specific objective no. 1.5 is almost totally neglected by the IPHCs. From this point of view, it has to be noticed that, in operational terms, the issue of the centers of antique and primary development is dealt with as an almost-exclusively local question, and, as such, as an issue that deserves only limited consideration. Only the municipality of Assemini underlines the importance of increased awareness of the local communities, even though no planning policy is explicitly defined. Specific objective no. 1.1 is addressed, even though in general terms, only by the IPHC of Cagliari, which proposes an analysis of the synergic relationships between the historic center and the rest of the city.

As regards the second general objective, "promoting local development in the medium and long run", the analyzed IPHCs do not show interest in strategic visions which go beyond a short run horizon, with the exception of Cagliari, since they identify, as their only focal point, what indicated by specific objective 2.1, that is "making housing in the historic center more interesting and attractive".

On the other hand, the municipality of Cagliari promotes interventions and operations aimed at improving the quality of housing in the historic center by boosting not only the stability of the present resident population, but also the demand for houses of new inhabitants, such as students. The other three specific objectives (2.2, 2.3 and 2.4 above) are almost completely ignored, with the exception of Cagliari. The municipality of Cagliari plans to strengthen and redevelop the historic center endowment of public services, and pedestrian and cycling mobility. Finally, the IPHC of Cagliari is built on a participatory process, based upon a set of public debates, and shows a strategic vision related to the local economic and social development in the medium and long run, and, by doing so, this plan goes far beyond the provisions of the regional guidelines.

[4] Only Elmas and Villacidro have concluded the approval procedure of their IPHCs, under the provisions of art. 9 of Regional Law no. 1998/28, as stated by the Decisions of the Office for Urban Planning of the Sardinian Regional Government (called "Determinazioni") nos. 2012/4283 and 2010/2407.

2.2 ONTOLOGY AND ONTOLOGIES

A generally-accepted meaning of the term “ontology” in contemporary theoretical debates of urban and regional planning is “discussion of the substance of an object,” that is a discussion of the most important characteristics of its essence, especially in epistemological debates. For instance, Hillier (2010) points out that, according to some contemporary scholars, “ontology” indicates the paradigm of “relational ontology,” that is a discussion of the substance of the relations between agents and structures (capital, social classes, agreed-upon semantics, etc.) which do not possess their own essence, formed only through their being in relation. Moreover, Hillier stresses, with reference to DeLanda (2006), that the reference point of planning practice should be the observation and analysis of the relations between the elements which constitute the empirical reality (e.g., agents and structures), whose existence does not depend on the fact that human beings perceive it.

These relations generate emergences, that is unexpected phenomena, for those who are familiar with the single elements but who are not aware of their mutual relations as well: the ontology of agents, structures and relations is a “realistic ontology” of the scientific paradigm of the (planning) disciplinary paradigm, which is based on the empirical analysis of the relation. These emergences have an autonomous existence with respect to agents and structures. The realistic ontology (the ontology of relations) is an ontology of the reality (Hillier, 2010), and a scholar’s disciplinary role is to be aware of and to describe this reality, by identifying and analyzing its relational substance.

The “substantial” attribute of the term “ontology” leads to an effective comprehensive view of the contemporary debate concerning ontology and ontologies. In this context, ontology is not referred to, according to the meaning described so far, as one or a set of conditions which define the substance of a concept (reality–agents, structures, relations) as much as the substance of its agreed-upon representation, that is its formal definition.

Ontology is the identification of a concept, of a domain—in other words, the cognitive contents that a set of agents identify as the particular characteristics of a domain.

Therefore, ontology is not connected to substance, that is the essence of an object, as much as to the agreed-upon available knowledge (scientific, technical, based on traditions and on common sense, etc.) concerning an object.

Formal ontologies are not connected to substance or to essence, but to the essence of representations, or definitions; that is, they propose an agreement on cognitive contents, rather than the substance analysis of an object. According to Smith (2003), ontologies are descriptions of domains of objects as closed data models whose nodes define concepts. These concepts are strategically identified and make sense only in the context of the universe they try to model. Moreover, Smith illustrates that, historically, the use of formal ontologies comes from the fact that several disciplines are experiencing a dramatic Tower of Babel syndrome which needs to be addressed somehow.

Those who deal with complex systems of data and knowledge have peculiar and often idiosyncratic frameworks for representing information. The semantics used for the same term may vary, or the semantics for different terms could take the same meanings.

Formal ontologies could make it easier to deal with this syndrome. Also according to Guarino (1998), as quoted by Pretorius (2004), a formal ontology is a projected representation which consists of a specific agreed-upon set of words which describe concepts belonging to a knowledge domain and a set of agreed-upon propositions concerning the meanings of these word as well. Pretorius agrees with Smith since, in his view, the concept of ontology originated in the field of artificial intelligence.

3 THE SPATIAL ANALYSIS OF HISTORIC CENTERS AND IMPLIED PLANNING MEASURES

The starting point for describing the PIC-based technical approach to the definition and implementation of an ontology of the spatial analysis and implied planning measures of IPHCs is represented by the provisions of art. 52 of the RLP, titled “Areas characterized by historic settlements. Prescriptive rules.”

The article is articulated into four parts. First, it deals with the question of spatial analysis, which has to be carried out through: i. a description of comprehensive urban characteristics of the municipal area, such as orography, water resources and hydrography, natural resources, settlement system(s), municipal walls and ramparts and urban landmarks; ii. an analytic description of the historic centers’ built environment and open spaces, which is implemented through detailed and accurate records related to each public and private block, buildings and built structures, private yards and public spaces (squares, parks, gardens, widening-road areas, etc.), with particular reference to the built environment’s degradation and obsolescence state.

Second, a classification of the allowed interventions is proposed, which makes reference to the category definitions of art. 3, paragraph 1, of Law enacted by decree of the President of the Italian Republic no. 2001/380. The allowed interventions are limited to ordinary and extraordinary maintenance and conservative restoration and refurbishment. In this way, the RLP states, on the one hand, that the spatial analysis should result in prescriptive statements which constitute the normative core of IPHCs, and, on the other hand, that these statements should comply with a general conservative approach, which is implemented through very restrictive rules related to allowed operations on the built and unbuilt environment.

Third, the most invasive and transformative interventions, that is radical restructuring of the existing buildings and change of parts of the urban historic morphology (block shapes, streets, squares, etc.[5]), are limited to the parts of the historic centers where spatial analysis puts in evidence that the original characteristics of buildings and urban morphology are dramatically and irreversibly altered.

Even in the case of radical interventions, art. 52 states that restructuring projects have to focus on the general objective of defining transformations which will eventually generate conditions consistent with the not-irreversibly altered or well preserved parts of the historic urban settlements and morphology.

Fourth, the IPHCs should rule over the functional uses of the buildings belonging to the historic centers, by assuming, as a general normative point of reference, that the residential uses should be the most preferred, and, as a consequence, that houses should maintain their residential use status and the number of the existing residential units should possibly increase as a consequence of the IPCHs’ operations. Moreover, municipalities are encouraged by the provisions of art. 52 to strengthen the availability of public services for residents so that historic centers may become more attractive for people and families who are deciding about the location of their houses. Alternatives to residential uses are identified as accommodation activities for tourists, such as hotels, residences and multi-building hotels, private and public service activities, medical services, craftmanship workshops and retail shops. Finally, art. 52 indicates that a careful consideration of the opportunity of maintaining unbuilt the areas which result from the demolition of ruins should be taken into account in the rules of IPHCs. So, the provisions of article 52 of the PIC of the RLP state that the IPHCs should be based on spatial analysis, whose interpretation of the urban settlements and morphology of historic centers is the point of reference for the conservative and transformative operations established by IPHCs. This is the conceptual framework of the ontology we propose in the following section.

[5] For the normative category definitions of these interventions see points “d”, “e” and “f” of art. 3, paragraph 1, of Law enacted by decree of the President of the Italian Republic no. 2001/380.

4 AN ONTOLOGY OF THE SPATIAL ANALYSIS

As stated in the previous section, the spatial analysis for an IPHC comprises, among other, an analytic description of the historic centers' built environment and open spaces, to be implemented through detailed and accurate records concerning each spatial unit[6] and detailing both conditions and provisions for each element in that unit. In this section, we describe how an ontological approach can support this task.

The ontology of the domain "Description of the historic centers' built environment for an IPHCs" was developed according to the phases suggested by guidance documents and methodological reports produced by the Ordnance Survey, according to which the process whereby an ontology is built can be broken down into a series of steps, the first being the identification of the purpose of the ontology and of its scope. These two aspects are crucial for ensuring both that the ontology is correctly formalized and that it is useful, meaning that it contains only those concepts, relationships and constraints that are judged to be relevant, with regard to the possible ways in which the ontology can be used. With reference to the first point (purpose), the ontology here proposed aims to represent and describe the built environment of a given historic center in order to support the making of IPHCs. With reference to the second point (scope), this ontology aims at providing plan makers with a robust descriptive framework on which they can ground the selection of allowed building activities. Once purpose and scope have been established, the following step consists of the construction of a glossary ("knowledge glossary"), comprising two tables. The first table ("table of concepts") contains a list of core and secondary concepts together with their definition in natural language, and of the source of the definition. The second table ("table of relations") lists and defines, again in terms of natural language only, relationships between concepts pertaining to the domain. The definition of concepts and relationships was based on documentary sources only, which comprise national and regional pieces of legislation and technical documents. The use of such sources was an attempt to ensure that definitions are agreed upon by, and shared among, domain experts. Through a series of checks at internal level of definitions and relations, the two tables were enhanced and modified recursively.

The knowledge glossary, in spite of its being an explicit and shared (at least, potentially) specification of the entities that constitute the abstract and simplified model of the domain, is not a formal specification of the domain itself, up to this point. For the computational aspects, the software program Protégé was next used; concepts were arranged in a hierarchical manner, that is they were organized and grouped into classes and subclasses on the basis of the relationship "is a." To state that a given element belongs to a subclass of a class is in fact tantamount to affirming that this element belongs to the class and therefore that it inherits its properties. In this way, key concepts identified in the previous phase were first organized in a taxonomy according to the following classes: "Activity," "Assessment," "Building," "Obsolescence," "Material," Minimum Unit", "Part," "Use" and then the corresponding definitions were inserted for each class and subclass.

Next, for each class and subclass, appropriate slots were defined and created. Slots can be used either to characterize the elements of a class by means of attributes of different types (for instance, string, integer, float, enumerated), or to describe the relationships between instances, which are defined as the elements belonging to a given class; in other words, features represent the finest level of granularity and form the basis of the hierarchy. Figure 1 illustrates, as an example, the slots assigned to the class "Building."

[6] Spatial units are identified through the first step of the required spatial analysis, that is upon analysis and description of the urban morphology, of typological, architectural and landscape features of the built environment in the historic district, also taking into account aspects such as blocks layout, streets' and paths' hierarchies, cadastral subdivisions and properties. The identification of spatial units (which can comprise more than only a single building) is of outmost importance because each spatial unit is treated as the minimum unit for projects and interventions, meaning that building activities should concern the spatial unit as a whole. For this reason, we refer to it as "minimum unit."

"Cadastral code," "Code", "Construction year," "Area sqm," "Height," "Volume cubm," "Storeys no." and "Zone" are all descriptive attributes, all required and having single cardinality (meaning that only one value for each attribute is allowed); the type of the first, second and third is "string" (meaning that any alphanumeric string is allowed), while that of the fourth, fifth and sixth is "float"; the type of the seventh, accounting for the number of storeys, is integer, and finally the type of the eighth is enumerated, since an IPHC should concern only areas classed in the zoning scheme of the Masterplan as "A" (historic center zone) or "B" (residential completion zone) or "S" (essential services for a residential zone, such as for instance open-space leisure areas or parking spaces). As far as the other five ("Has assessment," "Has obsolescence," "Has part," "Has use," "Is contained in") are concerned, they make the relations between the class "Building" on the one hand and, respectively, the classes "Assessment," "Obsolescence," "Part," "Use" and "Minimum Unit" (or subclasses thereof) on the other hand explicit. Two of these five slots have single cardinality, that is, an instance of the class "Building" can have only one assessment value[7] and it can belong only to a given minimum unit, while the remaining three have multiple cardinality, since a building can serve more than one purpose (for instance, a part of it could be residential and a part commercial), it can be broken down into several components or parts (for instance, roof, walls, porch) and it can have (in our framework) three different values of obsolescence (a structural/physical obsolescence, a functional obsolescence, and an image obsolescence). Some inverse relations are also defined, as shown in Figure 1.

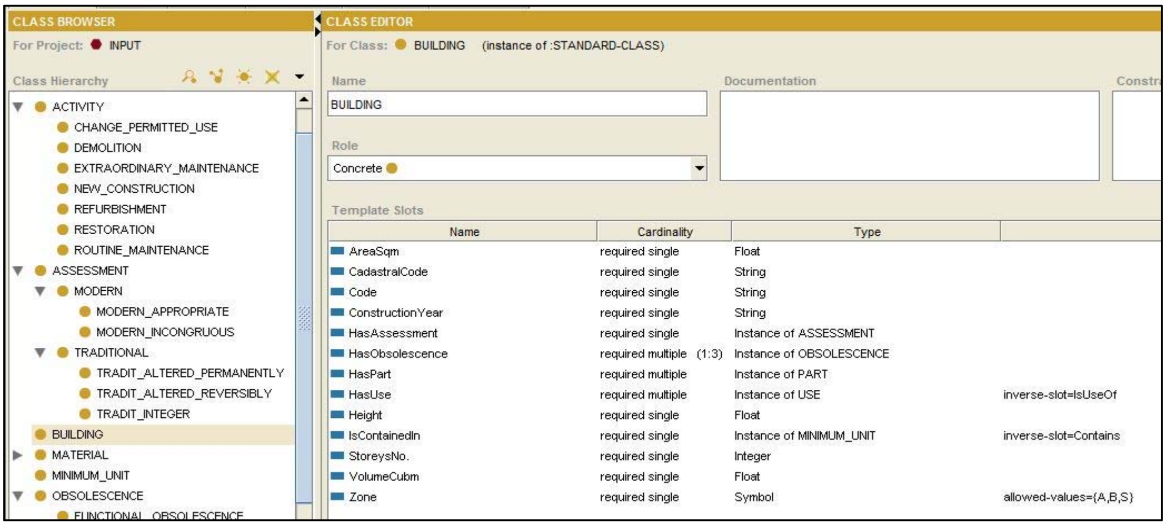

Fig. 1 Hierarchical arrangement of classes and subclasses (left) and descriptive and relational slots assigned to the class "Building" (right).

The construction of the ontology continues with the creation of instances and the filling-in of the values of the slots, and this is done by entering these values in appropriate forms that prevent users from including values which are inconsistent with the ontological hierarchy previously defined. Figure 2 shows one example of this phase, namely the characterization of a single building (coded "A.E.2.A").

Once the instances have been created and their slots have been filled in, the ontology is fully and formally defined, even though it can be continually adjusted and integrated; moreover, the ontology can be represented graphically as a graph tree in which classes, subclasses and instances are represented as nodes, and relations as arches, allowing users to navigate the whole hierarchy, or only a part (Figure 3).

7 By "assessment" we mean the final judgment on whether a single building in the historic fabric has retained traditional characters, which have to be preserved, or it has been altered either reversibly or permanently. For modern buildings, this judgment states whether they are consistent whit the historic fabric or not. The assessment is important because it entails strong directions towards allowed building activities and operations.

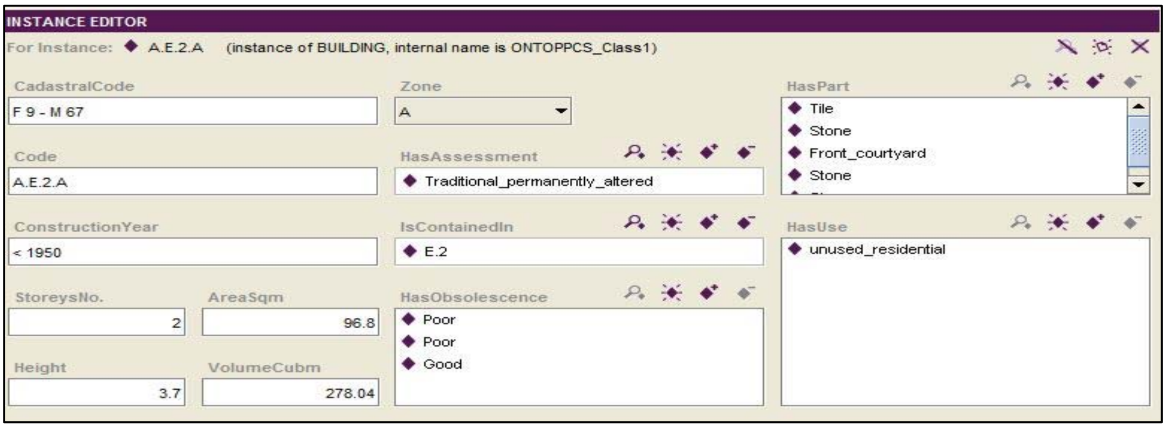

Fig. 2 Representation of an instance of the class "Building"

Graphs can be tailored to the user's needs, meaning that the user can choose whether to display all of the ontology, or only a part of it, by selecting the nodes to be represented or by filtering the relationships to be shown, which allows for a more effective and more understandable representation and exploration in case of complex ontologies.

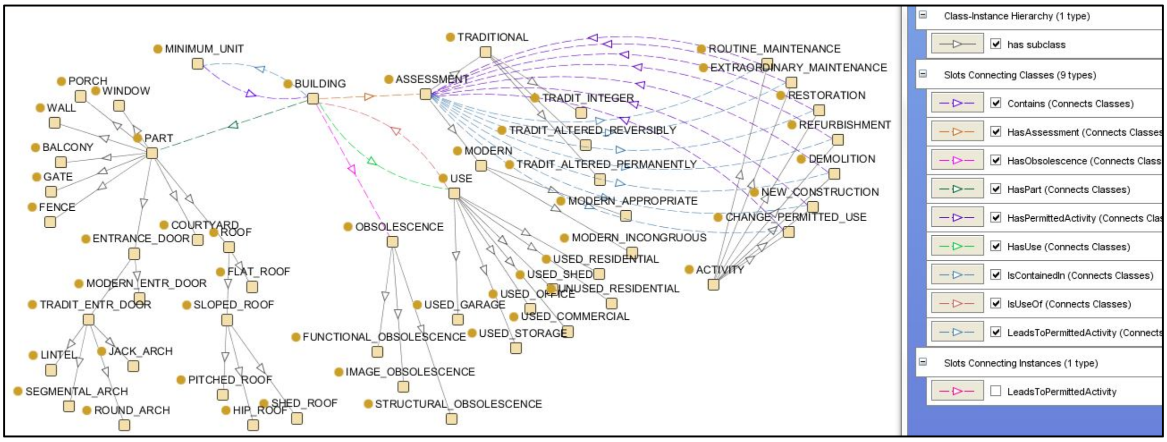

Fig. 3 Graph tree showing relations between the class "Building" and other classes and subclasses

5 CONCLUSION

This paper has attempted to build an ontological representation of the analysis of the built environment of historic centers as a means to support an IPHC, based on the interpretation of normative acts and documents. The ontology can be useful for at least two reasons.

First, this approach provides all the participants involved in the making and implementation of the plan (be they private citizens, planners, public officers and decision makers) with a better understanding of the domain of interest, through an iterative learning process that can continually be refined; this learning process is, in principle, inclusive, because the construction of the glossary can be improved by integrating the definition of concepts, relations, and descriptive attributes, here carried out solely on the basis of documentary sources in a participative way.

Such a collective conceptualization of the domain would also greatly improve the chances of sharing and reusing the ontology in the domain field.

Second, since the ontology here proposed is a domain ontology, therefore aimed at structuring, representing and communicating knowledge on a specific area of interest, the ontology can be updated, refined and reused in the given domain, and it can lay the bases for the development of task-dependent or application-oriented ontologies in the same domain, for instance focusing on administrative and procedural tasks.

Third, the ontology effectively supports, as desired, the analytic description of the historic centers' built environment and open spaces; Figure 4 shows, as an example, part of the record sheet prepared for an IPHC currently under preparation and concerning one single building belonging to a spatial unit which parallels the ontological representation shown in Figure 1.

Fourth, a strong point of this paper is that the ontological approach here utilized can be readily exported; although the domain ontology here developed is grounded on the normative framework that regulates IPCHs in Italy, and more precisely in Sardinia, this ontology could be easily reused to describe in detail features and characteristics of historical settlements.

Finally, an important limitation to exportability of the ontology in other contexts lies in the fact that the definitions of concepts are based, at least to some extent, on Italian laws and regulations, technical documents and vocabularies; for this reason, the table of concepts was built in Italian in the first place, and afterwards translated into English, which can cause some issues of semantic precision in English.

BUILDING "A.E.2.A"

MINIMUM UNIT "A.E.2"

Building	Building code	Area (m²)	Height (m)	Volume (m³)	Construction year
A	A.E.2.A	96,80	3,70	278,04	pre 1950

Basement		Basement use	
Ground floor	☑	Ground floor use	residential
Upper floor(s)	1	Upper floor(s) use	residential

Car entrance	gate	Walls: materials	stone	Walls: finishes	none
Doors: materials		Windows: materials		Blinds	
Roof: geometry	pitched roof	Roof: structure	wood	Roof: finishes	traditional tiles
Roof orientation	North-East South-West	Annotations about the building			

Structural obsolescence	Functional obsolescence	Image obsolescence	Global assessment
poor	poor	good	Traditional – permanently altered

Allowed construction activities		
Routine maintenance	☑	**Characterization:** Front courtyard – side entry
Extraordinary maintenance	☑	
Restoration work	☑	**Prescriptions**
Refurbishment		
New construction		
Demolition		
Change of permitted use		

Fig. 4 A record sheet designed for an IPHC building upon the ontological representation here presented

NOTES

Sabrina Lai and Corrado Zoppi have made substantial contributions to the paper's conception and design, background and concluding remarks. Corrado Zoppi defined the normative framework of the spatial analysis of the implementation plans of historic centers (IPHCs). Sabrina Lai designed the formal ontology related to the spatial analysis of IPHCs.

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OPEN DATA FOR TERRITORIAL SPECIALIZATION ASSESSMENT

TERRITORIAL SPECIALIZATION IN ATTRACTING LOCAL DEVELOPMENT FUNDS: AN ASSESSMENT PROCEDURE BASED ON OPEN DATA AND OPEN TOOLS

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ABSTRACT

The New Cohesion Policy opens to an integrated place-based approach for the improvement of territorial and social cohesion. The issue of territorial impact assessment of regional development policies highlight that data availability, open access to datasets in “near real-time”, participation, knowledge sharing, assumed importance within the development planning process.

The contribution of ‘open data’ appears to be mature and in this paper we present an application of spatial analysis techniques for the evaluation of spatial effects of EU funds starting form open data by open-coesione.

The application regards an internal areas of Basilicata Region: the Agri Valley. A complex contests in which an environmental and agricultural traditional vocation conflicts with a recent development of oil extraction industries.

Conclusions regard further applications and perspectives for improving and supporting regional development planning considering the exploitation of open data sources and spatial analysis.

KEYWORDS

Territorial specialization, New Cohesion Policy, Regional Development, Impact assessment, Open Data, Open-Cohesion

1 INTRODUCTION

The New Cohesion Policy, developed in the context of Europe 2020 agenda, opens to an integrated place-based approach for the improvement of territorial and social cohesion. Smart growth, sustainable growth and inclusive growth for EU 2020 represent overall goals to be achieved under the comprehensive approach defined by Barca (2009) as 'place based approach'. As the authors already discussed (Las Casas and Scorza 2009) concerning the issue of territorial impact assessment of regional development policies, the relevant instance comes from knowledge management in regional programming practice. It means data availability, open access to datasets in "near real-time" [1], participation, knowledge sharing, key actors effective involvement in planning process.

The "concentration" issue coming from EU 2020 Cohesion Policy still reflects ambiguity in interpretation (cfr. Capello 2014) and not structured implementation in Regional Programs. From a "thematic concentration" to a "spatial concentration", several attempt are going to be developed in an uncertainty framework.

If a "thematic concentration" reflects more a traditional approach considering a panel of main objectives and goal, it could represents an affective procedure if a proper context analysis identified ex-ante specific needs and priorities coming from local specializations and local communities needs (in other words "place based"). A "spatial-concentration" should produce a map of cohesion programming based on clear and informed decisions expressing the awareness of 'where' to invest in order to maximize the effects of cohesion policies. There is not a ex-ante solution in order to ensure the achievement of regional development results but a balance between a thematic generalization of objectives and a concrete spatial awareness of development precondition should be investigated,

A relevant information should come from lesson learned in previous programming experiences.

The contribution of 'open data' to the impact assessment of EU Operative Programs appears to be mature in concept but still week in accuracy of available data bases. We used for the research data from the project 'opencoesione' by Italian Ministry for Territorial Cohesion. The Italian Ministry engaged with this unstoppable process of collecting and sharing data for improving citizens commitment on public policies. It developed a web service distributing data on investments policies developed by National and Regional Operative Programs 2007/2013 matching together data from regional and national administrations. The results are analysed in the paragraph number four of the paper with the application of spatial analysis techniques for the evaluation of spatial effects.

In this paper, after a short framework review of New Cohesion Policy issues, we describe a process of territorial impact assessment of Regional Operative Programs investments oriented to the analysis of territorial specialization in attracting funds. The process in completely based on Open Data analysis through Open Tools (software and web services) in order to demonstrate that the integration of such resources overcomes the dependence from proprietary data formats and proprietary software towards interoperability and open information.

The application regards an internal areas of Basilicata Region: the Agri Valley. A complex contests in which an environmental and agricultural traditional vocation conflicts with a recent development of oil extraction industries.

Conclusions regards possible application and perspectives for improving and supporting regional development planning considering the exploitation of open data sources and spatial analysis.

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[1] We refer to the effectiveness of a 'policy monitoring system' providing data concerning regional programs implementation according to the current status. Today, in the information explosion era it is more useful an ongoing datasets tuned with the actual implementation status of a program, instead of a final and checked dataset provided years after the closure of a program.

2 NEW COHESION POLICY: A SYNTHETIC FRAMEWORK

EU cohesion policies include different areas of intervention and generally are carried out in order to promote the principle of redistributing opportunities among European regions and territories. It is the largest area of expenditure for European Union and it is possible to affirm that policy analysis tends to overlook the evaluation stage of such complex strategies while a proper assessment practice (Hoerner *et al.* 2012).

The EU Cohesion Policy is actually interpreted as the main tool in order to achieve the Europe 2020 target addressing a wide range of EU economic, environmental and social objectives. It represents a driven tool toward a new concept of Europe with smart, sustainable and inclusive growth. It currently offers both examples of significant economic and environmental “win-wins” and of “tradeoffs” that fail to offer net added value.

The reform of cohesion approach can be highlighted in two main concept areas including a wide spread of arguments and objectives:

- Investment choices: “where to spend more, where to spend less”
- Investment better - via improved Cohesion Policy governance and tools

The two key EU reference strategies for the next decades are defined by ‘Europe 2020’ & the Territorial Agenda (TA) 2020.

Europe 2020‘ is aimed at providing more jobs and better lives ‘by stimulating smart, sustainable and inclusive growth’ over the coming decade. It involves EU Member States to integrate efforts related to socio-economic development through greater coordination of national and European policies. This strategy was approved by the European Council in June 2010 after three months of elaboration and consultation.

The TA 2020 also puts forward an ambitious strategy, though applying specifically here to EU territorial development. Although this document is also designed for a very wide audience, it has received a lower level of public recognition than Europe 2020‘ strategy. This probably stems from its elaboration process, which was essentially intergovernmental in nature, i.e. a collaboration between the national authorities responsible for spatial planning and territorial development in the EU. The TA 2020 has not been formally adopted by any EU body. TA 2020 was adopted in May 2011 at the informal ministerial meeting.

Europe 2020 and the TA 2020 thus originate from different political processes, and have a different political status, but the aim is to reinforce each other integrating territorial development and inclusion.

The Europe 2020 strategy is mainly focussed on economic development, in particular the recovery from the 2008 financial crisis and the strengthening of the development opportunities in the EU. Europe 2020 has replaced the Lisbon strategy. It puts forward three mutually reinforcing priorities:

1. Smart growth: developing an economy based on knowledge and innovation.
2. Sustainable growth: promoting a more resource efficient, greener and more competitive economy.
3. Inclusive growth: fostering a high-employment economy delivering social and territorial cohesion.

The TA 2020 is the action-oriented policy framework of the ministers responsible for spatial planning and territorial development in support of territorial cohesion in Europe. It aims to provide strategic orientations for territorial development, fostering integration of the territorial dimension within different policies across all governance levels while overseeing implementation of the Europe 2020 strategy in accordance with the principles of territorial cohesion.

Six main territorial priorities for the development of the EU have been set out in the TA 2020:

1. Promoting polycentric and balanced territorial development as an important precondition of territorial cohesion and a strong factor in territorial competitiveness.

2. Encouraging integrated development in cities, rural and specific regions to foster synergies and better exploit local territorial assets.
3. Territorial integration in cross-border and transnational functional regions as a key factor in global competition facilitating better utilisation of development potentials and the protection of the natural environment
4. Ensuring global competitiveness of the regions based on strong local economies as a key factor in global competition preventing the drain of human capital and reducing vulnerability to external development shocks
5. Improving territorial connectivity for individuals, communities and enterprises as an important precondition of territorial cohesion (e.g. services of general interest); a strong factor for territorial competitiveness and an essential condition for sustainable development
6. Managing and connecting ecological, landscape and cultural values of regions, including joint risk management as an essential condition for long term sustainable development

In the figure below IEEP (2011) summarized the relationships between economic and environmental outcomes from policy interventions and investments in a win-loss diagram.

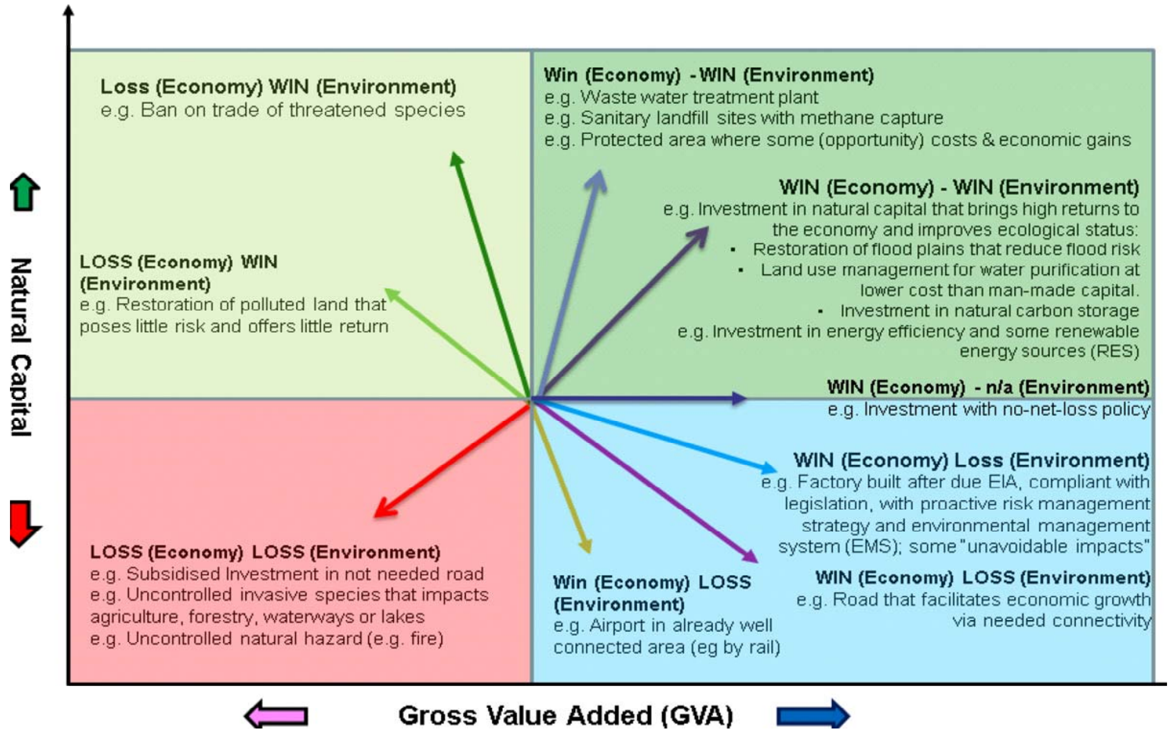

Fig. 1 Relationships between economic and environmental outcomes from policy interventions and investments (IEEP 2011)

This complex policy framework is based on the key objective of "achieving greater economic and social cohesion in the European regions". Anyway some critical consequences could be derived from the point of view of convergence process for lagged regions: the imbalance between regional objectives and financial resources; the existence of serious difficulties for complying with earmarking; and the unknown effects of other policies on regional convergence (Mancha-Navarro 2008).

3 STRATEGIC 'PLACE' CONCENTRATION

The principle of concentration is widely stressed within New Cohesion Policy framework.

The concentration of EU efforts is contra-posed to the indiscriminate distribution of funding (‘raining models’). This interpretation could intend that investment promoted by Regional Operative Programs (ROPs) should be focused on specific and circumscribed instances generating effective local development processes. We are in the case of redistributing investment effectiveness and positive outcomes on local communities, instead of realizing a well balanced €/citizen rate within a region.

This synthetic and not exhaustive remark allows us to highlight two relevant aspects of concentration principle: the concentration on objectives and the territorial concentration of investments. If the first appears to be not so far from traditional behavior of managing EU cohesion policies, the second level looks more at the ‘place based’ approach and expresses the importance of selecting territorial specification.

Where agriculture and farmers can generate cohesion by the means of investments and funding from ROPs? Where SMEs can generate a competitive cluster in EU production framework?

These questions change the interpretation pattern on the evaluation of ROPs effects and objectives.

We consider program evaluation as a cyclic process including techniques, judgments and contribution to forming program decisions. This view leads to the integration of program/project cycle to the evaluation cycle.

To the procedural concept through which decisions are taken binds, as a consequence, the concept of evaluation as a process closely linked to the project cycle (Las Casas 1984). It is reductive to solve the problems of evaluation by the application of a techniques set related to limited issues.

In the "evaluation cycle" (Lombardo 1995) it is possible to identify three types of evaluation each connected to one or another phase of the project cycle.

These types are:

- the evaluation of the state of the art;
- the benchmarking evaluation of strategies, plans or alternative projects;
- the achieved results evaluation.

The evaluation cycle is entitled to respond to the questions that arise at each stage of the project cycle and in particular:

- the assessment of the state of the art is closely related to the formulation of the “raison d'etre” and purpose of the project;
- the assessment of the pre-feasibility of the project highlights the need to put an assumption on the occurrence of conditions not dependent on the project so that the expected benefits can be achieved;
- the feasibility assessments leads to the definition of costs and expected benefits from the project, it identifies the sources of greatest concern dependent on various components of the work and it limits the field of choices;
- the benchmarking evaluation, between different intervention alternatives, leads to the choice to intervene and what changes have to be made to the project;
- the evaluation of the state of the art of the project defines whether to continue the project and what corrective should be provided;
- the final evaluation (and the ex-post evaluation) determines whether the assumptions made ex-ante were reliable and permits do decide if the experience can be repeated.

Connected to the interpretation depending on evaluation approach to local development processes, appeared the thesis of “renationalization” of cohesion policies (Las Casas and Scorza 2008). This approach reinforced the role of national administration in driving the implementation of ROPs at regional ad local level. While the negotiation of Member States at the top level of Cohesion Policy hierarchy was previously considered the primary role of National Authorities, now the importance is mainly focussed on the implementation phase. This idea fits more with the 'place based' approach in terms of local specific needs interpretation. We intend that managing authorities and public administrations generate a progressive perception of territorial capacity and/or territorial needs under the program structure of ROPs. This process of reinforcing territorial knowledge includes tools and procedure of analysis in order to define the spatial specification of ROPs.

Data availability is at the base of such process and data sources comes from different organizations entitled of ROPs management.

In following section we describe the use of an open data service provided by Italian Ministry for Territorial Cohesion. The project 'opencoesione'[2] collected and distributed data on Operative Programs implementation in Italy for the programming period 2007/2013.

4 OPEN DATA FOR EFFECTIVE SPATIAL EVALUATION OF COHESION POLICIES

Today data availability is not the main problem in territorial investigation but new instances emerged in terms of data management, certification and standard exchange protocols (Scorza 2013). Many people and organizations collect a wide range of different data in order to perform their own tasks.

The Open data, and in particular 'open government data', are an huge resource still largely untapped. The Government role is particularly important in this sense, not only for the quantity and the centrality of the data collected, but also because most of the government data are public by law, and therefore should be made open and available for anyone to use.

According to the Open Knowledge Foundation Italia (OKFI 2013) there are many circumstances in which we can expect that the open data have significant value. There are also several categories of individuals and organizations that can benefit from the availability of open data, including public administration. At the same time it is not possible to predict how and where value is created.

We can identify a large number of areas where public open data contribute to create value for user knowledge building and participation, among them:

- Transparency and democratic control
- Participation and increasing influence in the public discussion
- Improvement or creation of products and services for private sector
- Innovation and R&D
- Improving the efficiency of public services
- Improving the effectiveness of public services
- Measuring the impact of public policies

We are interested in the last point of application as the extraction of new knowledge by combining different sources of data and the identification of regularities that emerge from the analysis of large masses of data represent the core of the application we propose for the evaluation of ROPs impact at local scale.

In Italy there are many initiatives opening of information assets undertaken by public central and local administrations. The portal dati.gov.it, (available since 2011) is a milestone in the process of opening a new era for innovation and transparency in the public administration.

Other most famous experienced in this route are: American Data.gov was launched by the Obama administration as a result of the Directive on Open Government in December 2009; Data.gov.uk strongly

[2] http://www.opencoesione.gov.it/.

backed and sponsored by Tim Berners-Lee "the inventor of the World Wide Web"; Australia Data.gov.au; Canada Data.gc.ca; Norway Data.norge.no; France Data.gouv.fr; European portal beta open-data.europa.eu. Actually we can affirm that the practice of open data has been extended, but a lot of work and efforts should still be pay in order to get affective services for data integration.

The project Open Cohesion provides an open data service concerning cohesion policies effects with a orientation toward planning processes. The initiative was strongly supported by the Minister for Territorial Cohesion, which warns the urgency of a more active participation of citizens in decision-making relating to planning decisions and in the process of social vigilance on the use of collective resources.

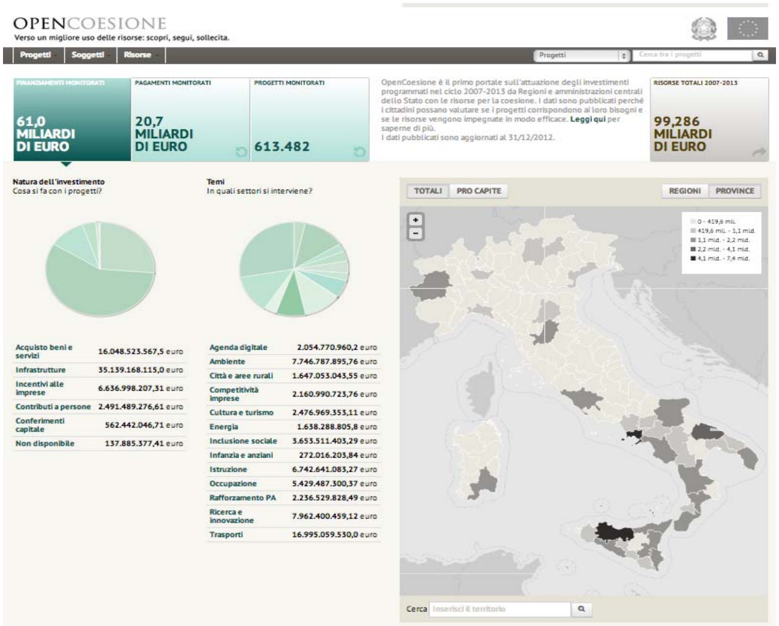

Fig. 2 Opencoesione screen shots

The publication of the data in an accessible format and reusable on their corporate websites shows the willingness of the government to move in a systematic way towards a structure of transparency that encourages the active participation of citizens and the re-use of data. The service pursues the objective of improving Citizen Engagement on investments policies, and offers a data set with specific information concerning project funded by the current programming period 2007-2013 matching implementation data from regional and national administrations entitled of Ops management.

Open-Government and Open-Data represent the two faces of the same coin.

But, to ensure that data are really "open", they has to be provided in an open and non-proprietary format, without particular restrictions of licenses, reusable and integrable, easily searchable on the web through databases, catalogs and search engines, directly accessible via Internet protocols, network-accessible in network quickly, immediately and at any time, and transmitted directly interchangeable between all users on the network. The data must also be supported by metadata and should allow the export in order to use on-line and off-line, integration, manipulation and share.

The next figure represents a classification of data "open" according to stars scoring by Tim Berners-Lee (2009). The single star is assigned to the data in "portable document format", consisting of a cast format that does not allow any manipulation without a considerable work. Two stars are assigned to data in property format, but the owner, allowed a total utilization with some interoperability problems if you are not using the specific software. The three stars are assigned to the product in non-proprietary format ("open

format”). The data are in four-star format if they follow international standards for interoperability, while the five-star data contains also link to other data provided in other contexts (“open linked data”).
Concerning territorial purpose five stars open linked data includes the adoption of OCG standards.

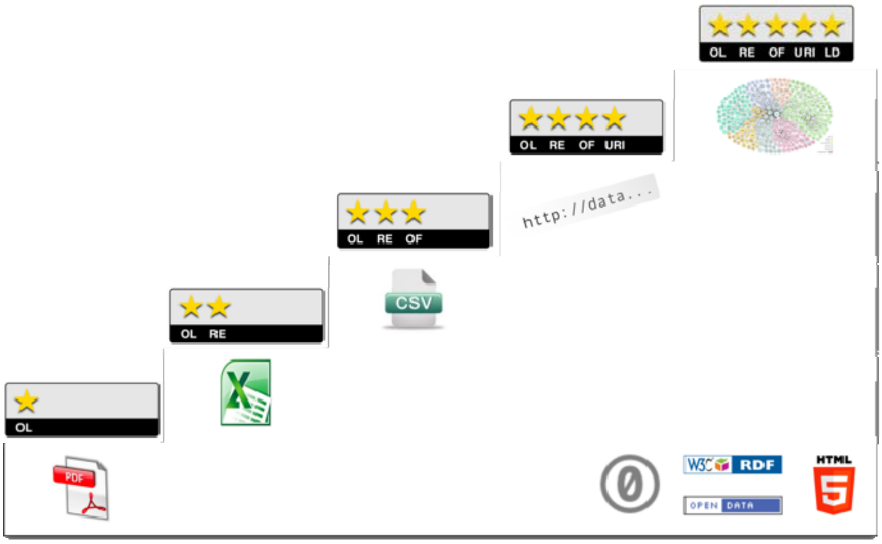

Fig. 3 Five Stars OPEN DATA from: http://5stardata.info/

Open Coesione appears to be a result of Open Governement Approach and concerning the Tim Berners-Lee we can affirm that it provides only three stars open data with the opportunity to get spatial dimension information through external elaboration. In this direction, previous researches demonstrated the added value of providing open spatial information concerning development programs. We refer to the experience developed by PIT Marmo Platano Melandro (Basilicata – IT) during the EU programming period 2000-2006 with a web gis service for the spatialization of development policies (Murgante *et al.* 2011).
While in that experience the main effort was in territorial data production we have to affirm that today it is possible to develop accurate spatial analysis concerning the distribution of EU funded investments with public open data. In the next section we describe the adopted methodology.

5 TOWARD THE ELABORATION OF INVESTMENTS SPATIAL DIMENSION

The innovative element in the assessment approach we proposed depends on the punctual territorialisation of projects and interventions. It is beyond the traditional representation of the information for aggregate items and pre-defined geographical areas (administrative boundaries, areas PIT, PIOT, program areas, etc..) according to the aim of characterizing the "places of implementation."
This approach changes the perspective of the assessment because it reinforces the selection criteria on the basis of the request for territorial "specialization" in programming New Cohesion Policy.
Our approach is based on open dataset distributed according to interoperable formats, managed by open-sources software and application, with a strong relationship with web-based services.
The issue of territorial impact assessment of development policies is a domain in which different approaches produce different results that often represent solutions for a specific purpose, serving a specific process of socio-economic and territorial planning without a framework methodology validated under a scientific or technical point of view.

The developed proposal aims to provide answers to the demand for territorial specializations analysis oriented to the construction of policy choices to be developed within the EU's 2014-2020 operational planning tools. The proposed approach, based on information concerning the implementation of the instruments 2007-2013, develops a interpretation model that allows a progressive monitoring of on-going processes. A territorial monitoring system that allows at a detailed scale punctual information.

In fact, it has been developed a procedure that identifies the punctual interventions (public and private projects in different thematic areas of intervention) through a dataset of geo-referenced points on which you can develop spatial statistics, overlaying, compatibility assessments, etc..

The territorial context of the implementation is the Agri Valley. An inland area of the Basilicata Region in which coexists structural problems for the socio-economic development related to the low level of infrastructures, to a fragmented distribution of settlement and services, to a backward and uncompetitive production system. In contrast to this condition of lagging area, since the 90s a settlement in the oil extraction, relevant also at national level, has been settled (ENI 2012). These industrial activities characterized by an high environmental impact generated conflicts, including at local development programming level, compared to a traditional view of development related to the enhancement of the environmental and agricultural domains, and social expectations, in terms of the positive impact on employment and income for the local communities, not yet completely satisfied.

5.1 OPEN SOURCE AND WEB-BASED TOOLS: AN INNOVATIVE PROCEDURE

In relation to the structure of the information sources we used, it has been implemented a procedure 'ad hoc' that exclusively refers to open-source tools. In this section of the paper we describe the operational steps and tools used with appropriate references to encourage the replicability of the process and results. The flow chart presented in the following figure exemplifies the process in terms of operational components.

The first stage of the process includes the operation of extraction, analysis and preparation of data for the territorialisation. The datasets provided by the project Open Cohesion contain fields relating to the 'localization' of each records, it means addresses of each individual interventions funded by different programs/funds. These are attributes that can have different levels of specialization in relation to the nature of the intervention, the type of expense, with the characteristics of the proposer or the beneficiary of resources.

Generally the objective of intervention territorialisation is to get precise location of each initiatives. Therefore, we considered the field "address" in addition to "name of the City" and the "Postal Code" to generate a string "LOCATION" on which to perform an operation of geo-coding supported by the free tools by Google.

Data tables, pre-processed appropriately, were uploaded within 'Google Fusion Table' . It is a web experimental application distributed within the Google applications 'Google Drive', for viewing and sharing large data tables.

The application tool allows you to:

- Show online large tables of data.
- Filter and synthesize information.
- Develop online graphs, maps, graphs or layouts.
- Management of multi-user and collaborative production date.
- Merge and cross more databases.
- Export of geographic data format (.kml) and other interoperable formats (.csv).

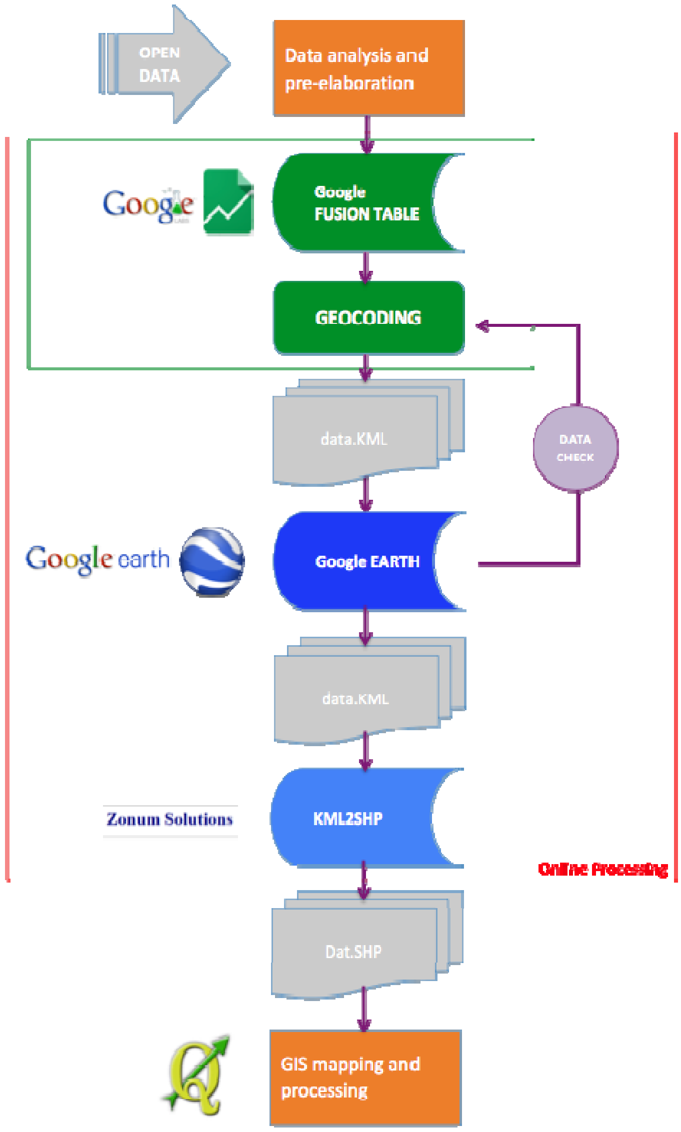

Fig. 4 Territorialization procedure flow chart

Therefore Google Fusion Table, working online, allows to perform a geo-coding on the field "location" of the table returning a map of points exported in KML format.

These files, as verified by the operator recursively in order to reduce the uncertainty in localization, after processing in Google Earth[3], are exported in local .kml format and subsequently converted in .shp through an online tool distributed by Zonum Solutions[4].

In this way you get data with a proper format interoperable widely in GIS application software and web-GIS.

The picture below shows the investments supported by the Operational Programmes 2007/2013 falling within the Val d'Agri area. The GIS processing were carried out using the open-source sowtfare Q-GIS[5].

The the figures we shows the total of 551 projects localized in the study context.

[3] http://www.google.it/intl/it/earth/index.html.
[4] http://www.zonums.com/online/kml2shp.php.
[5] http://www.qgis.org/it/site/.

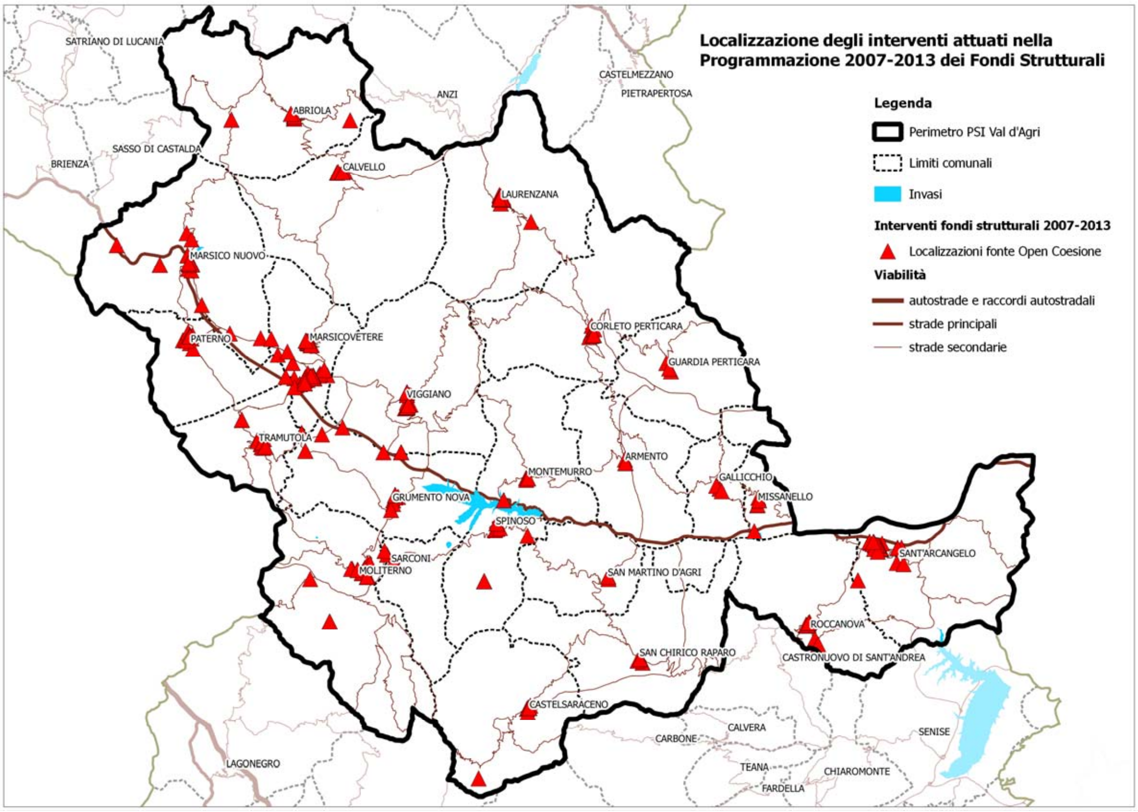

Fig. 5 Investments point pattern

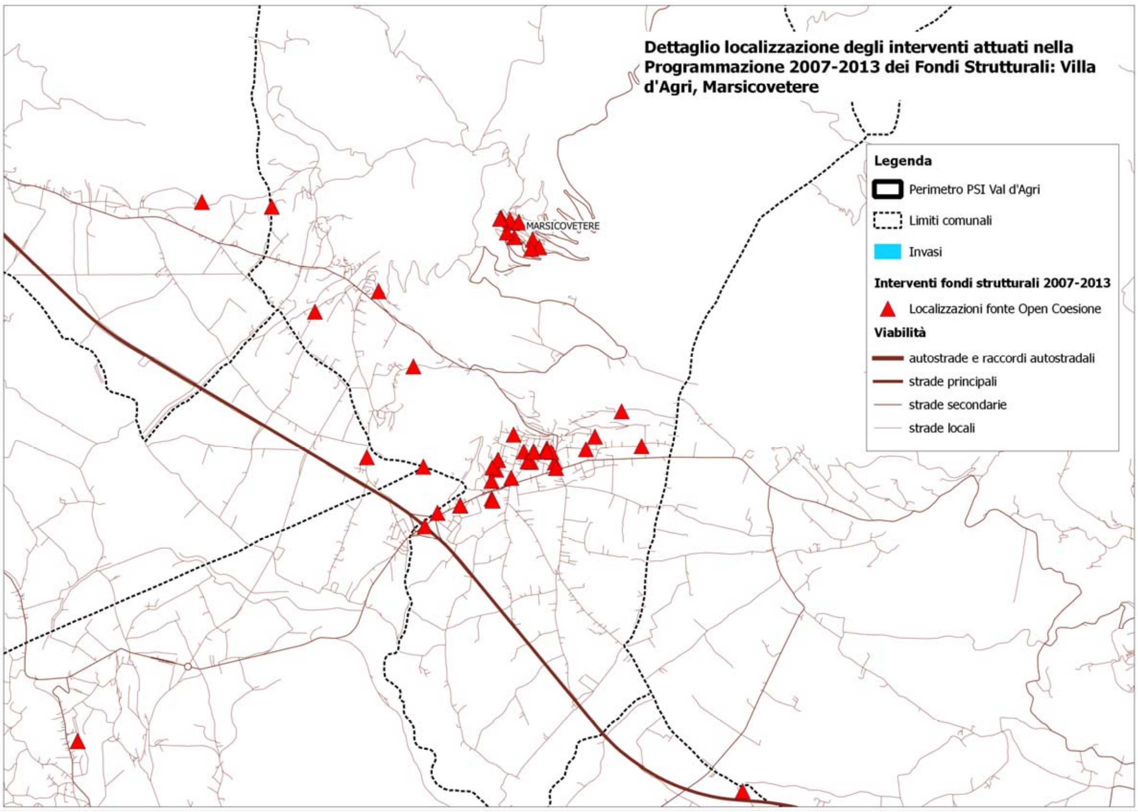

Fig. 6 Detail of investments point pattern

The proposed procedure allows to achieve high accuracy in punctual localization of interventions and projects. The table describes the accuracy level and specific uncertainty causes in percentage .

ORIGINAL DATA (N° RECORDS)	DATA REFERRED TO WIDER ADMINISTRATIVE AREA THAN MUNICIPALITY	LOCALIZED BY THE PROJECT ADDRESS	LOCALIZED BY THE NAME OF MUNICIPALITY OF THE PROJECT (MAIN URBAN CENTRE)	NOT LOCALIZABLE AS ERRORS AFFECT ORIGINAL DATA
100	**8**	**76**	**9**	**7**
	These data were excluded from representation as they relate to operations for which it is not possible to express a point impact	The geocoding in Google Fusion Table and the subsequent verification in Google Earth allow the unique identification of the investment point	In the case where the address was not recognizable by Google the location of the investment has been fixed on the main urban centre of the municipality	In the operational phase have been reported cases in which, on the basis of the information contained in the attributes of projects location, it was not possible to make an unambiguous choice of location. For example, it has been found several times that in the address field of a project was presented an information (also very detailed) referring to a location belonging to a municipality that did not correspond with project municipality.

Tab. 1 Accuracy of territorialisation process

5.2 PRELIMINARY TERRITORIAL ASSESSMENT

This spatial data infrastructure allows to develop several territorial elaboration. In the following figure we included some relevant maps showing the concentration assessment of investments adopting traditional data charting and geo-statistical techniques.

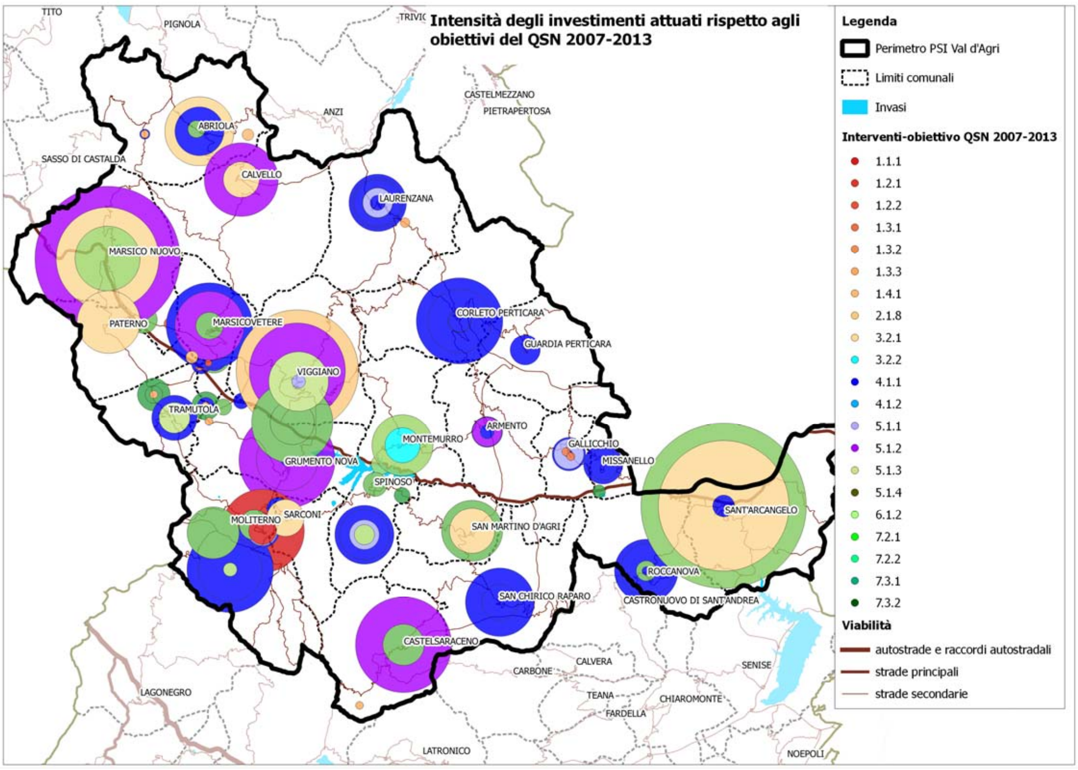

Fig. 7 Classification of investments intensity according to Strategic National Framework 207/2013 priorities

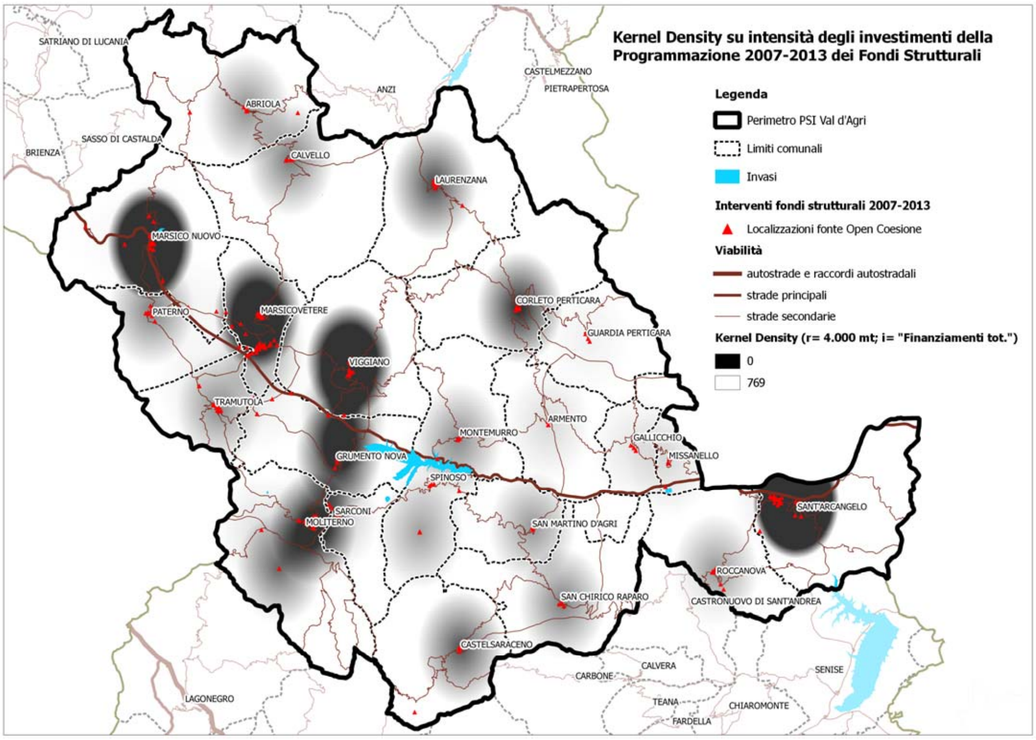

Fig. 8 Kernel density estimation of investments intensity in the study context

6 CONCLUSIONS AND PERSPECTIVES

Place based approach will bring to innovations in EU cohesion management. Where outcomes indicators measure the implementation of cohesion operative program (Barca *et al.* 2011) other efforts should be addressed to the identification of local specialization. It could generate not a fix picture of a context, places and communities evolve continuously especially as a reaction to the huge changes brought by economic crisis.

Main issues connected with the instances of the New Cohesion Policies are:

1. The need of a clear identification of the combined place-specific characteristics in each region;
2. a clear identification of the appropriate territorial context in order to implement effectively “smart specializations”.

Open data phenomena represent an useful process that already driven the research from data production to exploitation of the informative value of several data sources available for everybody. But data and data analysis technique cannot bring to useful information. Regional science has the task to produce effective ‘places’ interpretation in order to support public decision in incoming generation of EU ROPs. We are in the case in which it is relevant to use numerous data sources and indicators assuming a variable rate of approximation in the accuracy of the datasets.

The information management and exchange implies problem in interoperability between sources, procedures and technologies. In the field of Regional development the ontological approach provided alternative interpretation models of the interaction between the context, the program and the beneficiaries (cfr. Scorza *et al.* 2012; Las Casas 2011; Scorza *et al.* 2010).

Specialization analysis should be developed through an integrated set of technique oriented to generate descriptive geographies of the EU region at a variable scale.

The preliminary elaborations proposed in section 5.2 of the paper just highlight the potentialities of managing such structured datasets. The perspective regards the application of such processes in the framework of managing Regional Operative Programs and generally development programs in order to involve beneficiaries and citizens in the process and mainly in order to inform the technical level on the success or failure of a policy in order to improve the plan in term of effectiveness. It is possible to affirm that a real time monitoring system of development investments is actually feasible with current open resources.

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SUSTAINABILITY AND PLANNING

THINKING AND ACTING ACCORDING TO THERMODINAMICS LAWS

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ABSTRACT
The paper deals with environmental sustainability, in terms of intrinsic vulnerability and thermodynamics laws concepts, applied to urban green infrastructures. This approach gives also the track to build more resilient and complex landscapes. Integrating intrinsic vulnerability and thermodynamics laws concepts, an effective strategy could be conceived to face best management practices in planning more sustainable and healthy cities.

KEYWORDS
Landscape sustainability, Urban planning , Ecosystem Services, Second Law of Thermodynamics, Resilience

1 INTRODUCTION

Environment is a fundamental pillar of sustainability science (Ahern 2012), usually handled by planners with different point of view and sectoral approaches that could lead to an heterogeneity of assessments and, sometimes, to the lack of a holistic vision required by an effective sustainable development. For instance, residence buildings with high energy saving performances are usually defined sustainable even if any attention is not paid to other environmental, landscape and social characteristics. Indeed, the LEED certification (the U.S. national standard for the evaluation of buildings' sustainability) primarily deals with the architectural objects and not with the larger scale of the processes (landscape/territory scale) involving towns and cities.

To pursue a more holistic approach, much more attention should be focused on contexts' specificities, investigating the interaction between Environmental Intrinsic Vulnerability (EIV) and related human actions.

This paper reports some discussions aimed to increase awareness on environmental sustainability concept applied to urban environment, by two synergic strategies related to greening: increasing EIV and thinking (and planning) having thermodynamics laws as a reference.

1.1 SUSTAINABILITY AND PLANNING

EIV is defined as an inherent property of an environmental system which determines its sensitivity to external actions. This definition integrates and, in part, juxtaposes the definition of resilience, which is the property of environmental systems to absorb disturbances or changes, still maintaining its functional and structural characteristics (Ahern 2012).

The combination of EIV degree with human action degree defines the real risk.

This formulation can also be interpreted as an operative contribution to the evaluation of Rees and Wackernagel (1996) ecological footprint, where: human action is the print (load on the environment) and EIV is the environmental stretchiness (print entity) or carrying capacity.

As a consequence, environmental impacts are always specific, due to the different combinations between EIV (that can be «high», «medium» or «low») and anthropic load that, independently by EIV, can be «high», «medium» or «low». Not necessarily a high load generates relevant environmental impacts, if EIV is «low» (high carrying capacity); vice versa, a «medium» or «low» load can generate high impacts if the environment is highly vulnerable.

Considering a typical approach of Building Science, the following symbolic sustainability equation could be formulated:

$$\sigma \leq k \times \sigma_{amm} \qquad (1)$$

where σ is the effective stress, i.e. the load on the environment or the unitary weight that generates the ecological footprint; σ_{amm} is the admissible stress (or intrinsic vulnerability or carrying capacity of the environment), depending on the environment sensitivity to external actions; k is a safety coefficient, always less than 1 and as far minor as lower is the acceptable risk degree.

Stated these definitions, it is clear that σ and σ_{amm} descend from technical and scientific analyses, while k definition involves both technical and political spheres. In this sense, planning and sustainability are the same thing, if we consider the town planning definition by Salzano (2007), as the product of political decisions «technically supported».

1.2 THERMODYNAMICS AND NEW PLANNING PARADIGMS

Sustainability, intrinsic vulnerability and resilience are concepts usually related to complex systems, such as landscape and cities. These concepts are easy to define, but not so easy to put into practice, because it is necessary a radical change of thinking, and a consequent deep change in the society organization. Thermodynamics is probably the more structured science of complex systems and many concepts developed in this discipline found applications in other fields, such as ecology (Naveh 1987), sociology (Mckinney 2012), economy (Georgescu-Roegen 1998), Industrial ecology (Stremke, Van den Dobbelsteen and Koh 2011) and planning (Scandurra 1995; Pelorosso, Gobattoni, Lauriola and Leone 2014).

Thus, a strategy following the ecosystems behavior appears essential. Ecosystems are open systems (in the thermodynamic sense), connected by matter and energy exchanges, where symbiotic mechanisms are established and, above all, the concept of waste is unknown. In this way, it is possible to pursue anti-entropy and to slow the inexorable increase in disorder, i.e. the system's death.

Another sustainability milestone comes from thinking about efficiency, i.e. the ratio between produced work and energy input. Thinking in a Newtonian-linear way, the main aim is to pursue maximum efficiency, with the mirage of reaching values closer to 100%, thanks to technological development. By following this utopia, the second law of thermodynamics (the entropy law) is forgotten, so that the order created in a limited part of the earth system causes a higher disorder in another part of the same system and, in general, to the whole Earth system (climatic change, for example).

Thinking about ecological systems, on the contrary, shows us that efficiency in energy use is not very important, as the whole of Earth evolution, until Homo sapiens, demonstrates. Indeed, the main natural energy supply is photosynthesis, whose efficiency is only 1% (Blankenship *et al.* 2011). In ecological systems, much more relevant than efficiency in energy use, is the capacity to build complex systems, characterized by a large amount of synapses, which are consequently robust and dynamic, able to transform accidents into opportunities.

The first law of thermodynamics is written as follows:

$$\triangle U = Q - W \qquad (2)$$

where $\triangle U$ is the variation of internal system energy, Q the exchanged heat (from a "hot" to a "cold" source), W is the work done by the system. In fig. 1 there is a scheme of the most famous interpretation of this law, which, integrated with the second thermodynamics law, allowed Carnot to formulate his theorem, about the perfect thermal machine working[1].

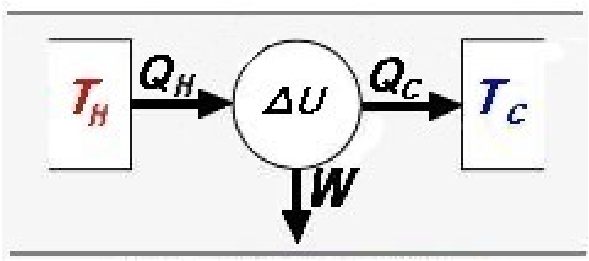


Fig. 1 One of the many expressions of the first thermodynamic law: the Carnot's principle

[1] For a further confirm of the chimera associated to efficiency concept, it can be considered the Carnot's theorem: also an hypothetical perfect machine cannot have a 100% efficiency.

In the Newtonian-simple approach, the focus is on the produced work *W*, that should be as high as possible. It is perfectly logical, because the aim of Carnot's law is to build "simple" and "smart" machines, producing work for human development. They are smart because they provide the opportunity for a cheap, great empowerment and this capacity has been the main milestone of Industrial Revolution. On the other hand, smart empowerment not necessarily means clever development. Clever indicates a problem solving capacity, the ability to elaborate robust solutions, which are the result of a deep thinking and analysis; smart is the quick and competitive intelligence. For example, smartness is the ability to rapidly learn rules, while cleverness is the ability to speculate about the reasons behind the rules (Leone 2013).
Moreover, while Modern Age (and related Industrial Revolution) development has really been smart, this smartness is now limited by a missed awareness of resources limits. After more than two centuries from the Industrial Revolution beginning, the signs of the wrong postulate of unlimited development are evident and it is time to be conscious of environmental and social impacts[2] produced in the mean time.
Carnot's law, schematized in fig. 1, allows to highlight these concepts: for "simple-smart" machines the focus is on *W*: the smarter the machine, the higher is *W*, and the related efficiency in energy transformation in work. But we have seen that this approach became obsolete, due to the high entropy production, i.e. a too high *Qc* dispersion into the environment. The epochal change needed for the immediate future looks at "complex-clever" systems rather than "simple-smart" ones. In this case, the focus is no more on *W*, but on *Qc*, in particular on the system ability to utilize *Qc*, transforming it in a resource, while, for thermal machines, it is only a waste, a factor of efficiency reduction[3].
A practical approach to this concept is reported in fig. 2 (from Rydin *et al.* 2012; modified), where a scheme of the integration of rural and town systems is reported. It shows how the use of wastes and local resources can build a complex landscape.

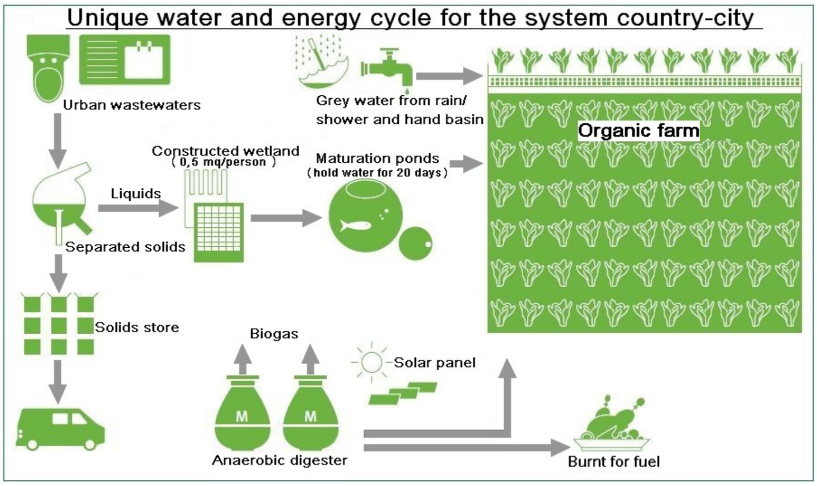


Fig. 2 The creation of a virtuous cycle of connections between urban and agriculture (Rydin *et al.* 2012 modified): an example of care for "Qc" in fig.1.

Generalizing: "smart-simple" is the characteristic of the Modern Age development, represented by technology: physical infrastructures, encompassing also information and communication technologies (ICTs); "clever-complex" is the new paradigm, represented by the strategies that increase social and environmental

2 See in the next section the world's north-west versus south-east dualism in development.
3 It is not casual that Sadi Carnot is the son of Lazare, mathematician, but also politician, member of Directory during French Revolution. French Revolution was one of the Modern Age social milestones.

capital, also thanks to physical infrastructures and ICTs, which are not the aim, but the tools to obtain more resilient systems, fulfilling the sustainability equation.

Some forgotten characteristics of pre-Modern Age should be, therefore, re-discovered (see fig. 3): they were unconsciously sustainable, due to low technology and consequent deep attention and respect for resources: work *W* was modest, but wastes and pollution were absent, thanks to interacting sub-systems, for which there is always a part of the system that can metabolize and/or reuse what is waste for another.

Hence, the challenge for the future consists in "saving the baby and dumping the bath water": maintaining what is good in modernity (high *W*), thanks to smart technology, but considering that it is no longer sufficient for present and future needs, since a more organic (clever) world development is required.

2 HOW THESE CONCEPTS CAN BE USEFUL IN PLANNING PRAXIS

Sustainability is not easy to pursue, because it requires a radical change of thinking, above all for the present western society and its way of life, whose crisis is evident and whose implications have an impact on city's, landscape's and planning's related crisis.

For example, the current necessity to build smart cities derives from the loss of traditional human development which took local resources into consideration; the rediscovery of these forgotten traditions offers the key to a new quality landscape building. This is particularly true in the Mediterranean area, whose great and unique physical diversity generated biological and social diversities and a very high and unique landscape, a way of life and of managing territory that is surely sustainable. On the contrary, all modern age development is increasingly based on allochthonous resources (fig. 3), considered unlimited. Consequently, this development proceeded blind to the laws of thermodynamics for more than two centuries, in particular for the last 70 years generating a diatribe among Mediterranean (and, in general, among the south-east part of the world) way of life and the north-west way of life, the former in modernity retard, waiting to become a "north-west" and, in the mean time, depressed and backward (Cassano 1996). This phenomenon hides an erroneous behavior, since it induces a lethal uniformity, which simplifies the system and reduces its resilience, with the risk of bringing the system to not be able to solve crises. The present north-west crisis could be a signal of this occurrence. A new development paradigm is then required and the south-east part of the world can offer an opportunity.

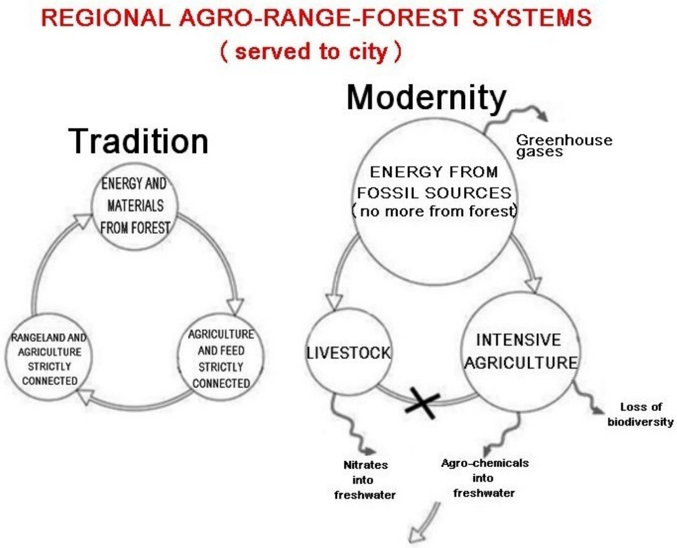


Fig. 3 Schemes of regional systems

The scheme in fig. 3 is useful for clarifying these concepts. Landscape is the consequence of the interactions among production systems (agriculture, livestock and forest) and the consumer system (city). In the tradition scheme, all systems are connected and all interact functionally and their functionality is the insurance of a good equilibrium. Wood is sacred in all pre-modern cultures, above all northern ones, where wood is the main energy supply and, without energy, it is not possible to survive winter. Furthermore, forest is an insurance against famine, reservoir of forage for livestock, but also food for humans, in extreme cases (Licinio 1998).

The scheme of traditional management in fig. 3 is much closer to nature and cleverer rather than smart and, for this reason, can produce beauty and harmonic landscape, intended as equilibrated territorial product of the integration between human activities and nature, as stated in the Florence European Convention (2000) and in the consequent Italian Landscape Code (2004).

Translating these concepts into planning praxis, the paradigm is synthesized by 3-Re: Reuse, Recycle, Renewal of the existent, above all related to built environment. To achieve this objective, landscape should be re-thought according to a holistic vision, retrieving the organic approach of the fig. 3.

A practical approach to this concept is shown in fig. 2, where a scheme of the integration between rural and town systems is reported, in a post-modern lecture. It illustrates how wastes and local resources use can build a complex landscape, following the 3-Re approach and related symbiosis.

3 AN EXAMPLE OF CLEVER URBAN PLANNING

A concrete realization of the above mentioned approach is going to be applied in the case of Bari (Southern Italy). In this city, as well as in other Mediterranean cities, soil sealing, in the entire historic urban fabric and large part of the periphery, has compromised the land permeability and the rainwater drainage network that is no more able to manage the meteorological precipitations in the current climate change context. In turn, the city structure defines therefore a high Environmental Intrinsic Vulnerability that induces damage, risk to the safety of people and threats for water quality in wide stretches of the sea coast.

To control storm water on the urban territory, several Best Management Practices (BMPs) were proposed (Pelorosso, Gobattoni, Lopez and Leone 2013) with the aim to:

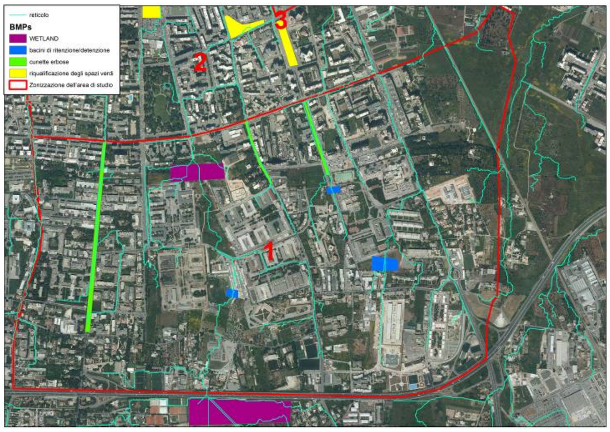
- increase urban soil permeability, through greening and other permeable surfaces in the compact city.
- identify landscape zones where it is possible to store storm water, preventing its runoff, into natural depressions and permeable areas (ponds, constructed wetlands, infiltration and filtering areas)

Fig. 4 presents a scheme of these concepts applications.

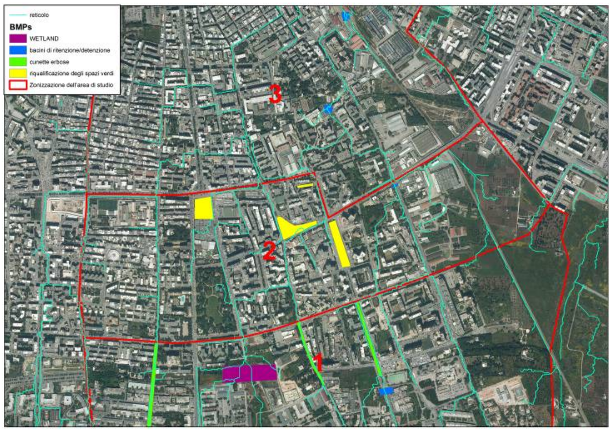
Urban green primary function is hydrological, reducing city impervious areas, whose percentage is an indicator of intrinsic vulnerability of urban environment. In synergy, BMPs can furnish many other functions (related to the so-called Ecosystem Services), in a fully positive feedback:

1) Freshwater preservation from pollution.
2) Urban heat island attenuation with consequent reduction of energy consume for cooling.
3) Possibility to increase urban biomass production, integrating it with humid fraction of solid wastes, with consequent possibility to produce energy from renewable sources.
4) Reduction of greenhouse gases, such as CO_2.
5) Biodiversity increasing and growth of local ecological network.
6) Construction of leisure and socialization spaces.
7) Improvement of aesthetical aspect of the city.

Zone 1: Surroundings, where possibilities for different BMPs are more, thanks to more space.



Zone 2: Peripheral areas, where space for BMPs is lesser.



Zone 3: City centre, where it is necessary to rethink the already built

Fig. 4 Possible BMPs set for different city characteristics. The case of Bari (Pelorosso *et al.* 2012).

These positive functions are able to build new landscapes, with strong identity: this means that their global impact is greater than the sum of each function, which is the Aristotelian quintessence. The consequence is a more complex system, more robust and resilient, characterized by less EIV and higher carrying capacity and able to better sustain human pressure. Finally, the quality of life of citizens is increased because more green areas can satisfy their social needs, as well as enhance the health status of the system.

In this way, theoretical principia of sustainability and thermodynamics laws thinking are satisfied, indeed:

a) The green infrastructure reduces city impervious areas and water storage capacity. In this way, EIV is reduced and it is more probable that eq. 1 could be satisfied, in this first step from hydrological and water quality point of view. Eq. 1 can be developed quantitatively, estimating the return time of urban drainage crisis (and related water quality), with and without planned green. This difference is a quantitative sustainability indicator, i.e. efficiency of the planned infrastructure.

b) Planned greening can be evaluated also in terms of climatic and air quality effects. Even in this case, it is possible to quantitatively evaluate the reduction of urban system intrinsic vulnerability, as urban surface temperature difference, with and without the green infrastructure. The difference is another sustainability indicator, associated with the reduction of CO_2 emissions (Akbari 2003).

c) Planned green infrastructure can be evaluated in terms of biomass production, that, joined to CO_2 saving explained in the previous point b), gives a contribute to urban sustainability in terms of climatic change mitigation.

d) On the other hand, renewable energy production from biomass is also a contribute to urban symbiosis, i.e. the reuse of Qc of eq. 2. Also in this case, a quantitative indicator can be derived.

e) Green infrastructure can be quantitatively evaluated in terms of its ecological and biodiversity values, linked to a landscape connectivity index (see the PANDORA model in Gobattoni *et al.* 2011).

Integrating these five processes, also through a multivariate analysis of them, it is possible to satisfy eq. 1 and 2, building both smart and clever cities.

4 CONCLUSIONS

This paper demonstrates how it is possible to transfer formal concepts of sustainability (eq. 1) and of thermodynamics laws thinking (eq. 2) into quantitative and measurable approaches, useful to give an integrated, holistic perspective to city management aimed to a more comfortable urban environment. Indeed, citing Costanza *et al.* (2014): " It is often said that what you measure is what you get. Building the future we desire requires that we measure what we want, remembering that it is better to be approximately right than precisely wrong".

In the study case of Bari City, it was demonstrated that the thermodynamics principles can be applied recurring to a re-thinking of planning and design of green areas. The minimum green infrastructure was then planned on the basis of hydrologic and water quality aspects while, in the following step, the resulting infrastructure may be evaluated (and eventually increased) on the basis of the other functionalities. Clearly, each case is different and the core criteria defining the starting point in the definition of planning strategies can change. However, ecological functionality of water, soil and air systems should firstly be preserved and the safety and health of citizens should always be kept in mind during the assessment process.

The consequence of the proposed method is a more complex landscape, able to increase city resilience and the delivery of a more diversified and stable range of Ecosystem Services. In this view, the integration of the thermodynamic approach within Ecosystem Services framework could further contribute to a cleverer planning science that effectively supports practitioners in building sustainable city and landscapes.

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STRATEGIC PLANNING OF MUNICIPAL HISTORIC CENTERS

A CASE STUDY CONCERNING SARDINIA, ITALY

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ABSTRACT

The conceptual horizon of this essay is related, on the one hand, to the adjustment process of the implementation plans of the historic centers of the municipalities of the Sardinian region to the Regional Landscape Plan (RLP), and, on the other hand, to strategic planning as an important tool to guide land transformations in order to implement effective local development processes.

We address these issues through a critical analysis of a set of implementation plans of the historic centers (IPHCs) of Sardinian municipalities adjusted to comply with the rules of the RLP, in the frame work of strategic plans (SPs), in order to assess if, and to what extent, IPHCs are consistent with the strategic planning approach.

KEYWORDS

Implementation plans of historic centers, Strategic plans, Landscape plans

1 STRATEGIC PLANS AND IMPLEMENTATION PLANS OF HISTORIC CENTERS: A PROBLEMATIC DUALISM

In the framework of regional and urban planning processes of Sardinia, in the context of the RLP, established by the Decision of the Sardinian Regional Government (DSRG) no. 36/7 of 5 September 2006[1], the IPHCs are planning tools that implement the Planning implementation code (PIC) of the RLP into the "Areas characterized by historic settlements". For these areas, the PIC defines a set of prescriptive rules and planning criteria (articles nn. 51-53 of the part of the PIC related to "Cultural and historic spatial framework", which is defined by articles nn. 47-59). More precisely, article no. 52 identifies the IPHC as a plan which has to be necessarily approved through the cooperation of the Sardinian regional administration and a municipality as a necessary precondition for a municipality to exert its ruling power over the local transformation processes related to the municipal spatial jurisdiction, which implies a considerable pressure on the local administrators in order to implement valuable and effective planning processes concerning the municipal historic centers.

Following the RLP's approval, the Sardinian regional administration provided municipalities and practitioners with a wide range of technical guidelines and documentation that are significantly influencing the implementation of the planning processes of IPHCs[2].

As a consequence, in the planning processes of the IPHCs, heavily influenced by the control of the technical staff of the regional offices, a strong consistency and implied uniformity do show up as: i. a strong attention to historical, typological and morphological characteristics in terms of the territorial analysis of historic urban settlement systems, which are identified by the RLP as "Centers of antique and primary development"; ii. A strong prescriptive ruling framework characterized by a markedly-conservative attitude.

Sardinian SPs are studied and defined either by the municipal councils, or, less frequently, by groups of municipalities or province administrations, by means of financial programs stated by: i. paragraph 1.1 of the Decision of CIPE (The Interministerial Committee for Economic Programming of the Italian government) no. 2004/20, titled "Additional resources, premiality, extraordinary destinations and reserves", and by criteria and procedures established by the Interinstitutional Table for the "Reserve for urban areas" of FAS (the governmental Fund for Underdeveloped Areas) in November 2004, which states that a part of the financial resources of each Italian Region will be utilized to define and study municipal, metropolitan areas' or groups of municipalities' SPs with a resident population of at least 50,000 inhabitants (paragraph B.11, titled "Interventions concerning innovative planning/projecting activity and immaterial investment in urban areas"); ii. Annex 2 of Note no. 125/GAB of 17 March 2005, titled "Modalities to activate resources", where funds for SPs are increased.

[1] An updated and revised version of the RLP was preliminarily approved by the Regional Government of Sardinia by the DSRG n. 45/2 of 25 October 2013, tited: "Regional Law n. 4 of 23 October 2004, article 11. Regional Landscape Plan of Sardinia, first coastal territorial homogeneous region, approved by the DSRG n. 36/7 of 5 September 2006. Updating and Revision. Preliminary approval". According to this DSRG, only a subset of the "Centers of antique and primary development" of the Sardinian municipalities are classified as "landscape goods", as it occurs in the case of the RLP, while the majority are classified ad "Identitarian systems: areas characterized by historic settlements" (art. 52 of the Planning implementation code of the updated and revised RLP; all the documentation concerning is available online at http://www.sardegnaterritorio.it/j/v/1293?s=242464&v=2&c=11437&t=1 (accessed April 2014). If and when the new version of the RLP is established, this will imply some (minor) changes in the IPHCs' planning processes, whose rules will not be related to landscape goods, which will make the approval processes of projects faster, since no landscape authorization will be required anymore.

[2] Guidelines and documentation are available online in the institutional Internet site of the Sardinian regional administration "Sardegna Territorio" [Sardinia Territory] at http://www.sardegnaterritorio.it/j/v/1123?&s=6&v=9&c=9560&na=1&n=10 (accessed April 2014).

Following these measures, about forty SPs were defined, the most part at the municipal level, which delineate the strategic framework of the ongoing projects of the local contexts in the medium and long run.

How these plans integrate and confront with municipal Masterplans and implementation plans of Masterplans is still an issue of debate and discussion, in theoretical and technical terms.

In the vast majority of cases, the SPs identify and prepare the implementation of strategies that consider the historic centers of municipalities fundamental for the definition of the urban development policies, which aim at generating, especially in the medium and long run, an effective improvement of urban life quality. For instance, the SP of Sassari implements a holistic approach and defines a "Direction D9: urban transformation/regeneration " where the interventions related to the historic center are integrated into a system of operations, which addresses several important and interdependent issues, such as: hydraulic reclaim of the subsoil, urban refuse collection, urban retail sale organization, e.g. through natural commercial centers, energy saving and efficient use –oriented through appropriate plants (Comune di Sassari 2007, 153).

The SP of Villacidro is rather different from the Sassari's, since it considers urban renewal of the historic center almost exclusively dependent on buildings' reuse and requalification instead of an issue that should involve city planning in general and systemic terms. Some punctual interventions are planned as "catalyzing operations" implemented through hierarchically-ordered projects named "flag projects", "carrying projects" and "supporting projects". The catalyzing action mainly related to interventions concerning the historic center is named "socially-oriented building sites", which implies the implementation of projects based on the functional rehabilitation of historic buildings located either inside or outside the historic center. In this case, the rehabilitation of the historic center has not a strategic character, but an ancillary role with respect to higher-order strategic goals (Comune di Villacidro 2008). Between the two extremes represented by the SPs of Sassari and Villacidro lay a range of intermediate situations, among which the SP of Settimo San Pietro, Sorso and Stintino.

A comparison between SPs and IPHCs shows, rather surprisingly, a general lack of coordination and integration among the processes of definition of these municipal planning instruments, and a sort of a communicative short circuit since, on the one hand, SPs tend to neglect the importance and the intrinsic value of historic and cultural resources of the *centers of antique and primary development*, and, consequently, to undervalue the systemic and general potential of interventions in the historic centers that are often limited to punctual and fragmented restoration of buildings; and, on the other hand, IPHCs propose analyses of municipal historic settlement systems characterized by excessive philological and self-referential attitudes, which do not take into account planning frameworks that may possibly found, in the medium and long run, realistic plan implementation processes, in terms of the logical framework of the objectives and financial feasibility.

This essay proposes a discussion on the definition and implementation of IPHCs with the general goal of orienting their conservative character, mainly based on the urban settlement system's requalification and restoration, in order to generate conditions favorable to local economic and social development, following the strategic planning conceptual framework.

In the next section, we tentatively define a system of foundational elements for a "Strategic plan of a historic center" (SPHC), by considering as reference points some recent experiences. In the following section, we critically analyze some approved or adopted municipal IPHCs, with reference to these foundational elements. In the concluding section, we discuss some possible theoretical and technical-practical paths to go beyond the dualism of the SPs' and IPHCs' planning approaches.

2 FOUNDATIONAL ELEMENTS OF A STRATEGIC PLAN OF A HISTORIC CENTER

A critical analysis of the IPHCs of Sardinian municipalities, which reflect properly and precisely the planning guidelines of the regional administration, shows a lack of an explicit strategic vision, which should characterize the planning processes, which instead are mostly concerned with the analysis of the historic urban settlement system and of building typologies, which eventually found projects that mainly consist of limited and conservative interventions. So, there is no evidence of theoretical and practical connections between IPHCs and SPs, even though several SPs, which were established just one year or so before the IPHCs, put in evidence a potential strong link between planning processes related to historic centers and local economic and social development.

Under this perspective, in this section, we propose two parallel analytical grids. The first grid aims at identifying the strategic potential of the IPHCs, on the basis of a detailed analysis that could eventually increase substantially the strategic effectiveness of these plans that is, implementing their transformation into SPHC. The second grid indicates the strategic priorities related to the historic centers of the SPs of four Sardinian municipalities (Assemini, Cagliari, Elmas and Villacidro) in order to detect if, and to what extent, these priorities are recognized in their IPHCs.

As a reference point, we assume the GOPP (Goal-oriented project planning; Bussi, 2004) strategic planning approach, which has recently been used in several planning and programming processes, implemented under the direction of the Sardinian regional administration. The GOPP methodology is based on a logical framework and was adopted in the first place for the definition of the so-called *Integrated development projects* in 2006, which were one of the main technical and financial instruments the Sardinian regional administration used in order to implement the investment policies of the 2000-2006 Regional operational program of the European structural funds. The GOPP approach makes it possible to address, in systemic and structured terms, economic, social and spatial planning and programming issues, and represents a theoretical and technical framework to implement processes of social learning, aimed at developing local development policies, which imply active participation of the local communities[3]. The logical framework consists of a hierarchically-structured objective tree, which should be defined through an incremental and participatory process by the local communities. This process starts with a SWOT[4] analysis, which recognizes and classifies positive and negative current conditions that characterize the spatial, economic and social situation of the local context (e.g., the municipality) where a public policy is going to be projected and implemented. From the SWOT analysis we derive a hierarchically-ordered problem tree, where the lowest-level problems are identified as the causes of the highest-level problems, in a bottom-up causation chain. The problem tree generates the hierarchically-ordered objective tree that is a mirror copy of the problem tree, where objectives are future positive situations, which are represented by the overcoming of the (current) problems. The systemic and structured representation of the analysis of the local context through the SWOT analysis makes it clear and straightforward the definition of the problem and objective trees, which is the logical framework of the public policy at stake. The objective tree and the planning operations, associated to each operational (lowest-level) objectives, is named “matrix of the project” (Bussi, 2004). Through the “Document, which integrates the guidelines concerning strategic planning” (Regione Autonoma della Sardegna, 2005, pp. 6-7) the GOPP was assumed as the methodological reference point for SPs by the

[3] See, for example, the materials available online in the institutional Internet site of the Sardinian regional administration at http://www.regionesardegna.it/ argomenti/ programmazione/ progettazioneintegrata/ comepartecipare/ presentazioneprogetti.html (accessed April 2014).

[4] SWOT is the acronym of strengths, weaknesses, opportunities and threats.

Office of Local public bodies, Financial affairs and Regional and urban planning of the Sardinian regional administration.

Effective strategic approaches to historic centers' strategic planning can be recognized in some recent experiences implemented by the municipalities of Reggio Emilia (Strategic plan for the qualitative enhancement of the historic center; Comune di Reggio Emilia 2005 2011) and of Vicenza (Masterplan of the historic center of Vicenza; Fantin 2013). In both cases, a strategic approach is explicitly mentioned and implemented into the plans in order to study the future scenarios of the historic centers, on the basis of a system of objectives, which comes from the overcoming of a system of problems (negative current situations: a problem solving-based goal-oriented approach). A very similar logical framework can also be identified in the debate proposed in a monographic issue of *Urbanistica Dossier* related to LUDA (Large urban distressed areas)[5]. In particular, Mueller *et al.* (2005) propose a GOPP methodology, the so-called CoSGOP (Collaborative strategic goal-oriented programming), to define strategies and programs to address urban requalification programs towards cooperation between pubic and private stakeholders, based on the analysis of case studies related to the urban contexts of Bratislava, Dresda, Edinburgh, Florence, Lisbon and Valenciennes.

Starting from these methodological and conceptual premises, and in order to clarify the analytical framework of our discussion, it is fundamental to understand how the SPs of the four municipalities we consider in order to analyze their IPHCs deal with the issue of their historic centers' strategic planning. All these municipalities used the GOPP methodology to set up the logical framework of their SPs, and they founded their goal-oriented SPs on a context analysis ordered through a SWOT representation. The participatory issue is fundamental and gives the whole a bottom-up character which the identification of future urban scenarios is based upon. However, not all the analyzed SPs consider the municipal historic center as a primary question. For instance, the SPs of the municipalities of Elmas and Assemini identify the historic center as a marginal urban area, and treat it as such in defining the future municipal scenarios, by giving much more importance to other spatial contexts, such as the productive peripheral areas and the urban parks for open-space recreational activities. From this point of view, the projects related to the historic center are critical, since no strategic future vision concerning the urban historic settlement system can be recognized and integrated into the implementation process of local plans.

The analysis of the GOPP-based strategic approaches to the definition and implementation of plans for the historic centers provides the municipalities with sets of objectives that could be very useful to assess the strategic effectiveness of their IPHCs, and to identify suitable planning paths to improve the quality of life and to catalyze economic and social local development. These sets may eventually make more comprehensive and multifaceted the almost-monotonically conservative and philological character of the current IPHCs.

In our view, a tentative general set of objectives to define and implement SPHC could be the following, based on two general objectives, 1 and 2.

1. General objective: improving the quality of municipal life in the short run, which includes the following specific objectives:

1.1. promoting the urban system of the historic center and its relationships with the rest of the municipal area;

[5] The issue describes the experience of "LUDA Project – Improving the quality of life in large urban distressed areas", funded by the European Commission through the Fifth Framework Program – Energy, Environment and Sustainable Development, Key-action 4 – City of Tomorrow and Cultural Heritage (Bentivegna 2005).

1.2. improving the quality of the historic center's built environment, which contributes substantially to the historic center's perceived features, which implies a particular attention to urban maintenance and renewal;
1.3. increasing the quality and potential of the historic center's public spaces in terms of aesthetic attractiveness, urban fabric and functionality;
1.4. organizing and increasing the quality of commercial and retail sale activities;
1.5. promoting the image of the historic center through marketing campaigns related to the local, regional, national and international tourist markets.
2. General objective: promoting local development in the medium and long run, which includes the following specific objectives:
2.1. making housing in the historic center more interesting and attractive;
2.2. implementing cooperative actions between the public and private sectors to generate a system of urban services qualitatively valuable and competitive in terms of capacity of responding to social demand, also by means of innovative tertiary activities;
2.3. improving accessibility, mobility efficiency and the situation of thru-traffic flows in the historic center, by encouraging the use of public transport, pedestrian and cycling paths, and discouraging the use of private transport;
2.4. implementing participatory practices to support planning processes.

With, reference to the second grid of objectives, our discussion is related to the SPs of four Sardinian municipalities, Assemini, Cagliari, Elmas and Villacidro, whose we consider only the strategic operations concerning their historic centers, which, theoretically, should be identified in their IPHCs as well. However, in the SPs of Elmas and Assemini there is no evidence of strategic operations specifically related to the historic centers, since they have a general spatial scope. In any case, these strategic operations can possibly have important impacts on the historic centers' situation of the two municipalities. The municipalities of Cagliari and Villacidro identify site-specific policies related to their historic centers, which are considered peculiar parts of the municipal areas in the strategic visions of the plans. Table 1 shows the second grid.

MUNICIPALITY	STRATEGIC OPERATION[6]
Assemini	Requalification urban projects: A1. reorganization and enhancement of existing collective services and areas; A2. promotion of functional intermix; A3. promotion of private and public collaboration. Requalification building projects: A4. requalification and restoration of existing fixed heritage in relation to environmentally friendly architecture principles.
Cagliari	Characterization and orientation of historic centers neighborhoods, in terms of requalification, in order to increase their attractiveness and use: C1. definition of infrastructural actions in order to revitalize the historic neighborhoods. Enhancement of all tourist components and rediscovery of commercial and artisan uses in relation to the municipal center and historic neighborhoods, which represent essential parts of a new supply system based on environment, culture, commerce, tourism and the local products, related to Sardinian tradition and cultural identity: C2. Development of natural shopping centers and small artistic centers, in particular in the historic neighborhoods.
Elmas	Requalification of the residential offering: E1. reorganization and enhancement of existing public areas;

6 The strategic operations are extracted by SPs of Municipalities of Assemini, Cagliari, Elmas and Villacidro, available at http://www.sardegnaterritorio.it/cittacentristorici/pianificazionestrategica.html (accessed April 2014). Bibliographic references are available in the section 'reference'.

	E2. requalification of existing fixed heritage; E3. definition of urban planning policies in order to address the current population (inhabitants and workers) needs and to promote the increase of the endowment of public capital. Reorganization of internal mobility: E4. usability improvement for disabled consumers; E5. construction of pedestrian and cycling paths.
Villacidro	Enhancement of the historic center as unique and recognizable system in order to improve usability with particular regard to both development of cultural tourism and increase of urban quality: V1. development of an integrated project concerning the overall relaunch of the historic center; V2. integration of new cultural and social functions within the presently underused fixed heritage; V3. development incentive of high-quality tourist accommodations; V4. development of a total or partial pedestrianization strategy in order to protect a public good and to enhance its peculiarities.

Tab.1 Strategic operations of SPs

As it is possible to recognize in the above-mentioned analyses, in relation to the majority of examined SPs, the objectives and strategic operations implement the two general goals of the first grid that may possibly improve the living quality standard in the short run and promote local development in the medium and long run. As a result, the historic center acquires a strategic value, shared by local communities and administrators.

3 ANALYSIS OF POTENTIALITY AND CRITICAL ASPETCS OF IPHCS IN RELATION TO FOUNDATIONAL ELEMENTS OF A STRATEGIC PLAN OF A HISTORIC CENTER

The qualitative enhancement of historic centers represents a significant question in the national, regional and local planning contexts. In particular, the Sardinian regional administration, which identified in the historic centers' renewal, improvement and promotion, a very important opportunity to support local, economic and social development, established the Regional Law no. 98/29 titled "Protection and enhancement of the historic centers of Sardinia", and, in 2006, approved the RLP, which recognizes the strategic role of the "Centers of antique and primary development", which are defined through a cooperative planning activity by the regional administration and the municipalities, and are classified as landscape goods, and, as such, are subject to a special protection regime under the provisions of the National Law enacted by decree no. 2004/42 on cultural and landscape goods.

On one hand, this section of the paper aims at identifying potentialities and critical elements of the IPHCs of four Sardinian municipalities, such as Assemini, Cagliari, Elmas and Villacidro, in relation to the objectives, defined in the section two. On the other hand, the section proposes a critical analysis in order to understand if the strategic operations, defined in the SPs, have been accepted by IPHCs, lending a strategic value to these plans. From this conceptual viewpoint, it is important to underline an elucidation concerning the choice of these four municipalities and to provide some information on the IPHCs. First of all, we chose these four municipalities because they are the only Sardinian municipalities that developed both a SP and an IPHC in order to make the SPs/IPHCs comparative analysis possible. Secondly, only Elmas and Assemini concluded the approval procedure in relation to the art. 9 of the Regional Law no. 28/98, as stated, respectively, by Decisions of Municipal Government no. 4283 of 28 September 2012 and no. 2407 of 26 October 2010.

With reference to the first general objective "improving the quality of municipal life in the short run", which is taken into account much more than the second one, the four IPHCs address in particular specific objective

n. 1.2 “improving the quality of the historic center’s built environment, which contributes substantially to the historic centers’ perceived features, which implies a particular attention to urban maintenance and renewal”. The four IPHCs, starting from context analyses that put in evidence a significant historic centers’ decay, project interventions aimed at protecting the comprehensive characteristics of their centers of antique and primary development, with a particular attention to conservation of the historic identity of the built environment. On the other hand, these operations not only focus on urban decay, but also they aim at revitalizing the urban historic contexts characterized by insufficient endowment of public services. The municipalities also address this issue through projects that pursue specific objective 1.4 “organizing and increasing the quality of commercial and retail sale activities”. Moreover, even though all IPHCs give provisions concerning enhancement and strengthening of public spaces in terms of aesthetic attractiveness, urban fabric and functionality (specific objective n. 1.3), only the municipality of Cagliari emphasizes the strategic importance of this objective in terms of enhancing their attractiveness and functionality. Finally, it is certainly emblematic that specific objective n. 1.5 “promoting the image of the historic center through marketing campaigns related to the local, regional, national and international tourist markets” is almost totally neglected by the IPHCs. From this point of view, it has to be noticed that, in operational terms, the issue of the centers of antique and primary development is dealt as an almost-exclusively local question, and, as such, as a problematic that does not deserve but a limited consideration. Only the municipality of Assemini underlines the importance of an increased awareness of the local communities, even though no planning policy is explicitly defined. Specific objective n. 1.1 “promoting the urban system of the historic center and its relationships with the rest of the municipal area” is addressed, even though in general terms, only by the IPHC of Cagliari, which proposes an analysis of the synergic relationships between historic center and the rest of the city.

In regard of the second general objective “promoting local development in the medium and long run”, the analyzed IPHCs do not show interest in strategic visions that go beyond a short run horizon, with the exception of Cagliari, since they identify, as their only focal point, what indicated by specific objective 2.1, that is “making housing in the historic center more interesting and attractive”. On the other hand, the municipality of Cagliari promotes interventions and operations aimed at improving the quality of housing in the historic center by boosting not only the stability of the current resident population, but also the demand for houses of new inhabitants, such as students. The other three specific objectives, namely “implementing cooperative actions between the public and private sectors to generate a system of urban services qualitatively valuable and competitive in terms of capacity of responding to social demand, also by means of innovative tertiary activities”, “improving accessibility, mobility efficiency and the situation of thru-traffic flows in the historic center, by encouraging the use of public transport, pedestrian and cycling paths, and discouraging the use of private transport” and “implementing participatory practices to support planning processes”, are almost completely ignored, with the exception of Cagliari. The municipality of Cagliari plans to strengthen and redevelop the historic center endowment of public services, and pedestrian and cycling mobility. Finally, the IPHC of Cagliari is built on a participatory process, based upon a set of public debates, and shows a strategic vision related to the local economic and social development in the medium and long run, and, by doing so, this plan goes far beyond the provisions of the regional guidelines. In relation to the second grid, where strategic operations of the four IPHCs in relation to the SPs of the same municipalities are analyzed, synthetized in the table 3, the study emphasizes how, with exception of Cagliari and Assemini, the IPHCs do not transpose integrally the objectives and strategic operations, defined by SPs, within their IPHCs. Moreover, Assemini, Elmas and Villacidro do not mention the existence of a SP for their territory. On the other hand, the municipality of Cagliari takes strategic operations of its SP into consideration, by analyzing the SP within a particular section of the IPHC's report. In addition, Cagliari defines actions that address the strategic operations, identified by SP, lending a strategic value to IPHC, consistent with the SP.

GOAL[7]	ASSEMINI	CAGLIARI	ELMAS	VILLACIDRO
1.1	Missing	Emphasis on the reciprocal relation between local level, represented by the historic center, and the overall level, represented by the city.	Missing	Missing
1.2	Requalification and restoration of the municipal historic tissue, by protecting the historic identity	Protection, preservation and restoration of the building stock, promoting the reconstruction of altered urban tissues	Reinstatement of the historic center's urban quality through restoration and requalification operations, based on the study of the typology identity of the urban tissue	Restoration of the historic center's urban quality in order to reinstate uniformity across the urban tissue, by reducing non homogeneous conditions
1.3	Adequate detailed prescriptions concerning public spaces in terms of materials, urban fabric and decor by means of graphical examples	Enhancement and protection of attractiveness and functionality of public spaces, through public infrastructural operations	Detailed prescriptions related to public spaces in terms of materials, urban fabric and decor by means of graphical examples	Detailed prescriptions related to public spaces in terms of materials, urban fabric and decor by means of graphical examples
1.4	Individuation of possible uses within the historic tissue, such as artisan shops and tourist facilities in order to reinstate a significant supply of services	Requalification, with the aim of supporting the existing artisan shops, in order to promote high quality operations	Promotion of commercial, artisan and tourist uses, consistent with environmental quality's enhancement	Promotion of commercial, artisan and tourist uses, consistent with environmental quality's enhancement
1.5	Local communities become conscious of the importance of historic centers	Missing	Missing	Missing
2.1	Restoration and reuse of existing buildings in terms of residential and service uses	Restoration and reuse of existing buildings in terms of residential use, in order to promote the stability of the current resident population, but also the demand for houses of new inhabitants, such as students	Urban renewal related to the maintenance of houses, that represents a specific target of planning policies related to the historic center	Missing
2.2	Missing	Requalification and improvement of the historic center in terms of quality and usability of services	Missing	Missing

[7] The objective codes are related to the numeration of the second section that is "Foundational elements of a Strategic plan of a historic center".

2.3	Missing	Improvement of the public transport system and pedestrian mobility at the local level	Missing	Missing
2.4	Missing	Use of participatory approaches, such as public debates involving the local communities	Missing	Missing

Tab.2 Comparison between the objective system, defined in the second section, and strategies identified in the IPHCs[8]

The IPHC of Villacidro represents an emblematic case because only one of the four strategic operations is accepted and adopted in the IPHC. The position of Assemini municipality is intermediate. Indeed, although the IPHC accepted the most part of the SP's strategic objectives, with exception of one, it does not define specific operations related to such objectives.

STRATEGIC OPERATIONS[9]	ASSEMINI
A1.	Definition of recommendations in relation to materials, urban fabric and décor
A2.	Individuation of different possible uses of buildings
A3.	Missing
A4.	Requalification and restoration implemented through conservation of the historic characteristics rather than through environmentally friendly architectural principles
	CAGLIARI
C1.	Restoration operations based on polyvalent uses; Construction of public infrastructure Restoration of the urban waterfront Promotion of urban mobility characterized by limited pedestrian transfers
C2.	Supporting the existing artisan shops Enhancement of uses concerning existing cultural and environmental resources
	ELMAS
E1.	Missing
E2.	Reinstatement of the historic center's urban quality through restoration operations
E3.	Promotion of new commercial, artisan and tourist activities
E4.	Missing
E5.	Missing
	VILLACIDRO
V1.	Missing
V2.	Promotion of cultural activities
V3.	Missing
V4.	Missing

Tab.3 Comparison between the strategic operations of both SPs and IPHCs

In conclusion, the two analyses have underlined two significant problems. The first concerns the difficulty of small municipalities in defining strategic operations in relation to their municipal land. The second regards the current gap between the strategic operations of SPs and the strategies and actions of IPHCs.

8 Bibliographic references are available in the section 'reference'.

9 The objective codes are related to the numeration of the second section that is 'Foundational elements of a Strategic plan of a historic center', in the table 1 'strategic operations of SPs'

5 CONCLUSION

This essay discusses the definition of planning processes concerning the historic centers in terms of sustainable development. There are two parallel analyses proposed in the essay. One identifies the potential strategic values that convert IPHCs into SPHCs. The other concerns the relations between SPs and IPHCs of four Sardinian municipalities.

From this methodological viewpoint, the above-mentioned analyses have emphasized five critical questions. The first issue regards the difficulty of small municipalities in defining strategic operations. Indeed, this situation is clearly traceable through a comparison between Cagliari, the Sardinian regional capital, and the other municipalities. In addition, the issue is particularly critical in relation to the second general objective that concerns the medium and long run time periods. Under this perspective, the increased availability of resources in terms of skills and money could favor the development of a systemic vision that lends strategic value to SPs in the case of small municipalities.

The second issue concerns the conceptual gap between the strategic operations, defined by the four SPs, and strategies and actions, identified by IPHCs. With the exception of Cagliari and, partially, of Assemini, not only do the IPHCs ignore the existence of a SP, but also they neglect the most part of strategic operations, which puts in evidence a missing dialogue among the public departments at different scales of planning. The third issue concerns the lack of strategy of the current IPHCs, which are just aimed at fulfilling some practical questions targeted by various departments of the regional public administration, identified by the repletion of such task as filling in specific forms related to the architectural analysis of buildings, and the detailed description of blocks and parcels. Therefore, technical guidelines and handbooks were issued by the Sardinian regional administration related to IPHCs. Following this conceptual vision, historic centers represent single entities within municipal conurbations, which give rise to the fourth question. Indeed, with exception of Cagliari, all IPHCs neglect the identification of functional relations among the historic center, the rest of the urban tissue and the peripheral and periurban areas of a municipality. This problem originates from the lack of a systemic vision and strategic values that convert IPHCs into SPHCs. In the light of our discussion, a theoretical and practical path that may possibly help overcoming the almost-absolute lack of strategy of the IPHCs, and, at the same time, be a promising future development of our research, could be the radical redefinition of the actual IPHCs through a thorough and analytical implementation of the GOPP methodology, and the identification of the logical frameworks of the IPHCs.

NOTES

Federica Leone and Corrado Zoppi have made substantial contributions to the paper's conception and design, background and concluding remarks. Corrado Zoppi defined the question of the problematic dualism of strategic plans and implementation plans of historic centers (IPHCs). Federica Leone and Corrado Zoppi designed the discussion on the issue of the founding elements of a strategic plan of a historic center. Federica Leone analyzed potentialities and critical points of the IPHCs with respect to these founding elements.

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A GIS APPROACH TO SUPPORTING NIGHTLIFE IMPACT MANAGEMENT

THE CASE OF MILAN

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ABSTRACT

Following the increasing liberalisation of commercial activities, which have taken place in the last few decades, the power of municipal authorities to schedule retail and leisure-based businesses has been reduced in its spatial extent; it now applies only to specific 'Protection Zones' (*Zone da sottoporre a tutela*). In these areas, due to environmental, social and/or traffic sustainability reasons, the freedom of private business is limited by the need to respect the right of residents to normal liveability and mobility standards.

This paper describes a research by Laboratorio URB&COM (Politecnico di Milano), aimed at supporting the City of Milan in detecting those spatial contexts whose conditions suggest the application of a specific regulation, in order to control nightlife leisure's negative externalities. A GIS-based analysis approach has proved fundamental in defining an objective and transparent evaluation path, towards the mapping of critical areas where regulation is needed.

In addition, within the proposal of policy monitoring methods, a particular approach has been suggested, based entirely on the use of Information and Communication Technology (ICT).

KEYWORDS

Retail planning, Protection Zones, GIS, KDE, monitoring, ICT

1 INTRODUCTION

Present-day Italian legislation, which follows an incremental business liberalisation process, which has occurred in the past twenty years (D.Lgs. 59/2010, L. 248/2006, D.Lgs. 114/98), allows municipal authorities to programme the start-up of retail and leisure-based businesses only within specific spatial contexts called 'Protection Zones' (*Zone da sottoporre a tutela*[1]). Such zones are established in order to control the impact of highly attractive activities, ensuring public order, security and calm for residents and granting a basic sustainability level on social, environmental and liveability grounds. Therefore, the release of permits to free business is dependent on the achievement of a minimum level of service quality (Tamini 2011).

Since the possibility of scheduling and regulating retailing activities has become an exception, municipalities and other public authorities engaged in such policies are now asked to support their decisions through an objective and scientifically rigorous acknowledgment process.

Politecnico di Milano's Laboratorio URB&COM has supported the City of Milan in the definition of its Protection Zones, and how to apply and define a municipal guideline aimed at managing the externalities of nightlife leisure activities (which are particularly problematic in the case of Milan). This regulation is intended mainly to introduce some qualitative evaluation criteria for the opening of food and drink supply activities (bars, pubs and restaurants), in order to minimise their impact on the urban context in terms of noise pollution, public decency and mobility.

For the mapping of critical areas needing special regulation we have proposed an approach entirely based on GIS technology, useful in defining an objective and transparent evaluation process, achieving the best possible result sharing.

In particular, the evaluation process was divided into two main phases:

The first identified areas "potentially subject to nightlife phenomenon", by analyzing the geography of bars/pubs/restaurants and detecting areas with a high offer density.

In the second phase the "most sensitive municipal areas" were detected, as a result of demographic, environmental and social variable interaction.

Accessibility features and public transport infrastructure were also studied, in a synthesis of public transport service level in the municipal area (which has to be considered as a further indicator).

2 THE DETECTION OF AREAS SUSCEPTIBLE TO NIGHTLIFE PHENOMENON

2.1 MAPPING FOOD & DRINK SUPPLY ACTIVITIES

In order to identify those areas where nightlife-related food & drink supply activities tend to cluster, it was first necessary to define their geography by processing some basic municipal data[2] through a Geocoding[3] method.

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[1] Literally: 'zones to be subdued to protection schemes'. This protection regime is created within a 2010 national decree (D.lgs n. 59/2010, "Attuazione della direttiva 2006/123/CE relativa ai servizi nel mercato interno". Art. n. 64, c. 3.).

[2] Open Data are directly or indirectly produced by public administration authorities and shared through their websites in a digital format, as 'usable' data. The City of Milan activated its Open Data service in 2012 at the following URL: http://dati.comune.milano.it/.

[3] ESRI ArcGIS' Geocode Addresses was used as a geocoding procedure, which allowed an automatic mapping of database records, finding variably precise matches with the geo-referenced house numbers' layer.

Information about 'opening hours' and 'business type' (as two distinct fields) is provided within the municipal database, which helped to improve the geographical description of the phenomenon, with the possibility of defining both 'by-day' and 'by-night' maps of food & drink supply.

As we can observe, the complete by-day map is made up of 7.192 stores[4], whereas 3.408 businesses keep open after 12 p.m., thus appearing in the general by-night map ('night geography'). This number is further reduced to 1.940, if we include only nightlife leisure-related typologies (bars, pubs, discos, etc.), without catering food service like restaurants (Fig. 1).

Fig. 1 Spatial distribution of food and drink supply activities. Maps refer to: by-day activities, by-night activities (after 12.00 p.m.) and 'nightlife business' specific typologies

2.2 KERNEL DENSITY ESTIMATION FOR THE IDENTIFICATION OF CLUSTERING AREAS

Following the geographical description (first mapping phase), it was necessary to propose a geostatistical interpretation of business spatial distribution, with the aim of identifying the main clustering phenomena (that is, those areas where nightlife entertainment tends to reach a 'critical' level).

The applied geostatistical technique, Kernel Density Estimation (KDE), was widely experimented in the geographic interpretation of social and economic phenomena (Adolphson 2010, Batty *et al.* 2004, Borruso 2004), including the behaviour of retailing businesses (Porta *et al.* 2007).

The choice of this particular spatial interpretation technique for a preliminary selection of critical areas related to nightlife business distribution, was made on the basis of KDE method's specific interpretation approach, which represents a certain density of 'events' (elements being represented in a given space) as a continuous field. In other words, it converts two or more events into a single graphic element, allowing their interpretation and relational analysis. The result corresponds to areas with a variable size and expressing different values, which include the autocorrelated dots and whose value is proportional to the dots' concentration (which means that lower value areas can be found as we move away from the density peak).

Kernel Density Estimation therefore applies on a hypothetical homogeneous plane, setting a given Euclidean distance in order to identify an 'inquiry window'. For this reason it is not yet clear whether this method is really effective in the interpretation of events strongly connected with urban space and its peculiar geometric shapes. Indeed, some published studies showed misleading results when applying KDE to phenomena occurring mainly along streets (Borruso 2005). In previous surveys by Laboratorio URB&COM, some good interpretation results had been obtained in KDE application to retailing by using lines (the linear extension of shop windows) instead of dots (shop entries), as basic analytical elements. The will was that of correlating retail with public space facing it, as well as of introducing variations in window extension as an additional evaluation element (Limonta 2012). This methodological device had proved very effective, although

4 Data are referred to June 2012.

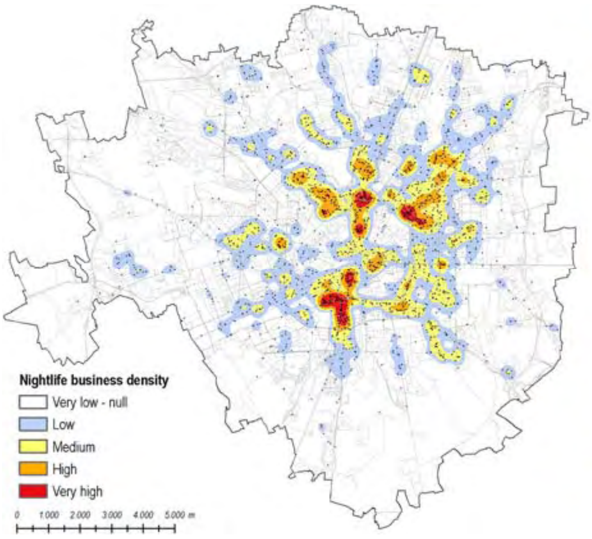
requiring the precise measurement of each shop window extension, which can be rather complicated in the analysis of large and articulated contexts such as Milan.

In line with these premises, we have proposed an analytical approach based on associating the study of retail phenomena to the one dimensional linear space of the street (network), in order to provide a geographic interpretation of food & drink supply activities. This option was suggested by the output of NKDE[5] application, already tested within several inquiries (Dai *et al.* 2010, Okabe *et al.* 2009, Yamada and Thill 2004).

In our case, maps were analysed and interpreted by using a NKDE version implemented in SANET (Spatial Analysis along Networks)[6], a specific analysis tool designed for ESRI ArcGIS software.

A crucial phase of KDE analysis (both in ordinary and Network version) is the choice of bandwidth, that is, the reference search radius for the interpretation of spatial correlation between dots (businesses, in our case). This choice should be made according to the context and to the analysed phenomenon peculiarities, as it emerges from various experiments and applications (Brunsdon 1995).

In the direct application of this methodology to other contexts, bandwidth sizing had been made in relation to people movements across urban space (Limonta 2012). This criterion was once more adopted, by selecting a spatial range of 370 m, which is the distance a pedestrian can cover in 5 minutes at a speed of 1,25 m/s (an intermediate value between 1 and 1,5 m/s, commonly used in walking speed simulations). The result was divided into 5 classes (density levels) after excluding zero values, according to Natural Break classification method (the Jenks algorithm) used for non-normal distributions (once their number is set, data group divisions/classes are made starting from gaps in the distribution of values, before applying Jenks' algorithm[7]).



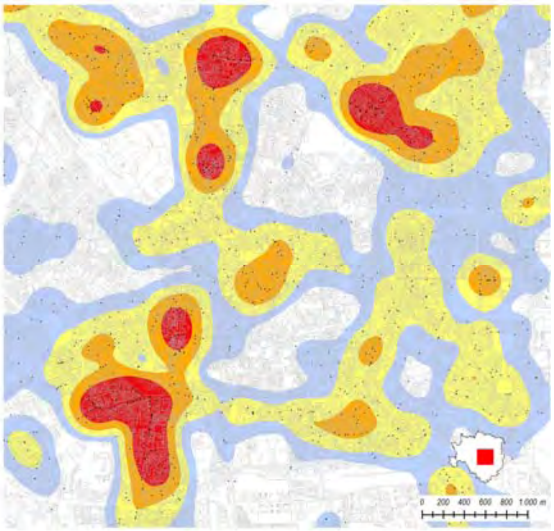


Fig. 2 KDE application: nightlife-related business density levels

5 Network versions of KDE.

6 SANET. A Spatial Analysis along Networks (Ver.4.1). Atsu Okabe, Kei-ichi Okunuki and SANET Team, Tokyo, Japan. SANET software is available at the following URL: *http://sanet.csis.u-tokyo.ac.jp/.*

7 The algorithm aims at determining the best arrangement of values into different classes. It consists in: calculating the sum of squared deviations between each class (SDBC), calculating the sum of squared deviations from the global average (SDAM), then subtracting the SDBC from the SDAM and maximising the result.

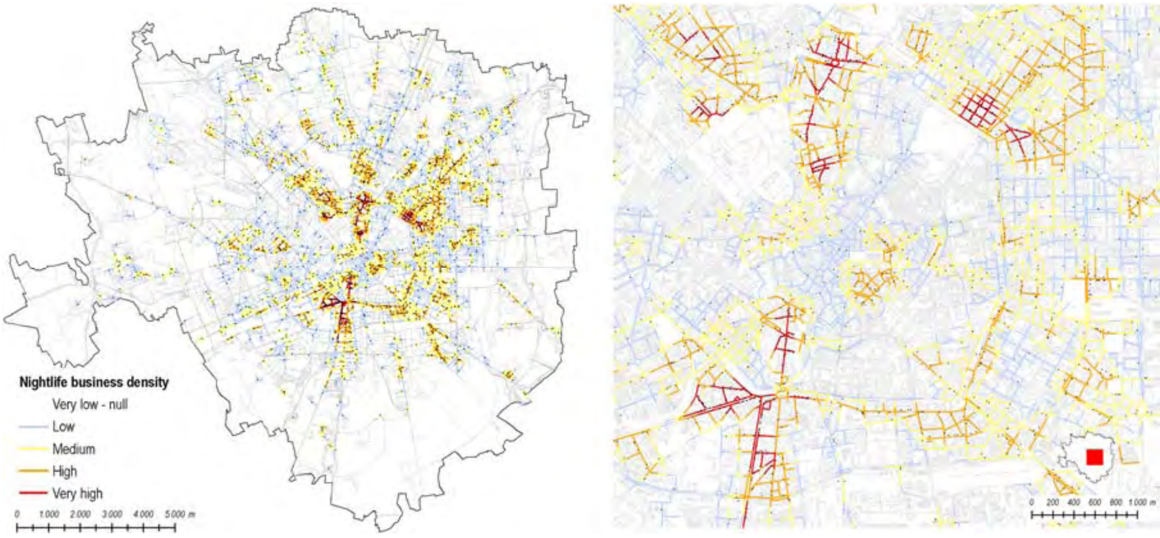


Fig. 3 NKDE application: nightlife-related business density levels

As can be seen from the comparison of the results of the two analytical procedures (Fig. 2 and Fig. 3), NKDE has allowed an improvement in mapping accuracy, since street segments with a very high density of nightlife businesses could be more clearly highlighted. The joint use of the two outputs helped to delimit the Protection Zones.

3 IDENTIFICATION OF MOST SENSITIVE MUNICIPAL AREAS

The second phase identified the "most sensitive municipal areas" (*ambiti comunali maggiormente sensibili*) through certain indicators showing greater or lesser sensitivity to nightlife externalities.
The aim was to identify the most sensitive areas and buildings, as a result of particular environmental and social variable interaction. Variables are the following:

- Distribution and characteristics of resident population;
- Presence of artistic/historical/architectural/environmental heritage;
- Acoustic vulnerability of the municipal area (exposure to noise pollution).

At a later stage, a spatial proximity belt was defined around potentially sensitive areas, according to certain considerations on outdoor sound propagation.

3.1 DEMOGRAPHIC INDICATORS

The study on population distribution started from resident analysis, based on an extract from the Milan civil registry office's database (December 31st 2011). The records were mapped through the same Geocoding procedure previously carried out for mapping food & drink supply businesses (paragraph 2.1). In order to be analysed and represented, the result was aggregated into spatial units corresponding to 2011 census units[8]. It was nevertheless necessary to update and partially change block and parcel perimeters, mainly because of recent urban transformations and, as a consequence, a new residential layout. In some cases, units were re-defined, due to the presence of large open spaces (both public and private), which would have altered the statistical significance of the results.

[8] Census units' grid is freely available on the website of the Italian National Statistical Institute (ISTAT) http://www.istat.it

Once the population had been mapped in connection with revised spatial units, it became possible to identify the following demographic sensitivity indicators:

- Resident population density;
- Population density aged over 60 years;
- Population density aged under 10 years.

For these three demographic indicators was applied different classification methods[9], producing 5 classes (1-very low; 2-low; 3-medium, 4-high; 5-very high).

The interaction of these three demographic indicators identified those areas of Milan potentially susceptible to nightlife externalities. By selecting the highest classes (5) of each indicator, we identified the buildings located in such units as elements to be 'protected'.

3.2 VULNERABILITY TO NOISE POLLUTION AND PLACES OF ARTISTIC, HISTORICAL AND ENVIRONMENTAL INTEREST

Noise pollution is a serious and widespread problem in big cities around the world, affecting human behaviour, welfare, productivity and the long-term health of people. Environmental noise is a major environmental problem at the local level in Europe and the source of an increasing number of complaints from the public. For this reason, we decided to include urban areas defined as "Specially Protected Areas" (*Aree particolarmente protette*) by the Italian legislation[10], besides 'sensitive buildings' detected through demographic indicator analysis. These areas include all the functions whose "assumes quiet as a basic element: hospitals, schools, sites for rest and leisure, rural residential areas, areas of particular interest for planning, public parks , etc".

For the same reason, elements related to the city's artistic, cultural and environmental heritage were also considered as susceptible to potential nightlife externalities. In particular, we included:

- Monuments, buildings and other elements of architectural and historical value;
- Protected historical gardens and parks;
- Protected natural and agricultural areas (namely, Parco Agricolo Sud and Parco Nord Milano).

All architectural elements and areas identified in the previous phases were shown together on a map, as the city's areas "most sensitive to externalities generated by nightlife phenomenon". Many buildings and areas

---

[9] *Residential density (m2 per inhabitant)*. The output values showed an abnormal statistical distribution, due to substantial variations in housing features. For this reason, before classifying values, it was necessary to exclude census units with a zero density value. Subsequently, values were processed through a base-10 logarithmic transformation, in order to reduce their variance and therefore relatively to normalise the statistical distribution. At a later stage, a quantile classification method was applied, producing 5 classes. In this method, each class contains the same number of features.
Concentration of population older than 60 years. A normal statistical distribution permitted the classification of output values without previously transforming them. However, it was necessary to exclude from classification those census units with too low levels of resident population ("very low" density class shown at the previous indicator) and with a zero percentage of over-60 residents. In such cases, poor statistical evidence would have generated a misleading interpretation of results. The highest class (class 5) identifies census units with an over-60 population amounting to 70% or more.
Concentration of population younger than 10 years. As in the previous analysis, the observed statistical distribution here was normal, but some exclusions were nevertheless necessary. In this case, census units with zero percentages of under-12 population were ignored, besides insufficiently populated ones. In this case, class 5 corresponds to units where under-12 residents amount to more than 16%.

[10] Reference to the DPCM (Prime Ministerial Decree) of March 1st, 1991 ("Limiti massimi di esposizione al rumore negli ambienti abitativi e nell'ambiente esterno") and the DPCM of November 14th, 1997 ("Determinazione dei valori limite delle sorgenti sonore").

proved sensitive to more than one indicator, as in the case of religious buildings or hospitals, both classifiable as historical heritage and services.

3.3 DETECTING THE 'INTERACTION BAND'

At a later stage, it was possible to identify an 'interaction band', meaning the space within which noise - a major nightlife externality - comes into contact with objects and areas previously classified as 'sensitive'.
For the sizing of interaction bands, the measurement of noise was made by merely considering customers' outdoor clamour, since the legislation already submits nightlife businesses to specific sound-proofing standards. The aim was to determine the desirable minimum distance from a 'noisy' sound source, in order to reduce the level of sound pressure regardless of the acoustic climate value of the specific urban context (Fig. 4).
To do this we used a calculation procedure considering sound propagation from omnidirectional point sources[11] in free field, according to UNI ISO 9613 *Attenuation of sound during propagation outdoors* (Part Two). The purpose of ISO 9613-2 standard is to provide an engineering method for calculating the equivalent continuous A-weighted sound pressure level under meteorological conditions favourable to sound propagation (for downwind propagation or in moderate ground-based inversion conditions). The basic equation shown in UNI ISO 9613-2 is the following:

$$Lp(f) = Lw(f) + ID(f) – A(f)$$

Where:

- Lp is the equivalent octave-band sound pressure level, in decibels, generated at a given point (p) by a given source (w) at a given frequency (f);
- Lw is the octave-band sound power level produced at the given f frequency (in dB) by the point sound source (w) relative to a reference sound power;
- ID corresponds to the directivity index of the sound source (w), in case of directional sound source (e.g. for car motors, air treatment plants, etc.);
- A is the octave-band attenuation (in dB) at the given f frequency, that occurs during propagation from the sound source (w) to the receiver (p). Attenuation A is formed by the summation of several sound attenuations, due to several factors (geometric divergence, atmospheric absorption, etc.).

For the purposes of our study, we applied certain simplifications in respect of the determination of values indicating environmental conditions and ways of propagation:

- Background noise was not considered, due to variability depending on the urban context;
- The only estimated sound attenuation factor was that of geometric divergence, since at this stage it was not considered either possible or appropriate fully to evaluate other factors impacting on the extent of sound wave propagation;
- The clamour originated from groups of people, as a set of omnidirectional point sources, was regarded as a sound source, ignoring the amplification value due to D index of directivity.

[11] There are two types of sound source: point s. and line s. Point sources are those of small size compared to the receiver's distance (voices of people, machine noise, etc.). A linear source is narrowed in one direction and lengthened in another, in comparison to the receiver's distance. It can be made up by a series of point sources acting simultaneously along a line (for example a flow of motor vehicles).

Adopting these premises, the following equation permitted the calculation of the distance (r) allowing the abatement of the reference sound source value, in free field:

$$Lp = Lw - 20 \log r - 11 \text{ (dB)}$$

The sound source reference value (Lw) was deduced by using standard levels normally used to assess sound pressure in daily life.

LP (in DB)	EXAMPLES	SUBJECTIVE EVALUATION
130	Pain threshold	PAIN
125	Aircraft take-off 50 metres away	INTOLERABLE
120	Siren at short distance	INTOLERABLE
110	Jackhammer	VERY NOISY
100	Transiting train, disco,	VERY NOISY
90	Heavy truck, scream	VERY NOISY
80	Heavy truck 1 metre away	NOISY
70	Loud radio, whistle	NOISY
60	Noisy office, conversation	NOISY
50	Normal conversation 1 m away	QUIET
40	Inhabited neighborhood at night	QUIET
30	Whispers 1 m away	VERY QUIET
20	Rustle of leaves, human breath	VERY QUIET
0	Absolute threshold of hearing	NON-AUDIBLE

Tab. 1 Sound pressure levels in daily life

The considered sound pressure (produced by two or more persons) was amplified in respect of a hypothetical group of fifty customers positioned outdoors. Supposing that each customers in pairs can produce a borderline-level of 60 dB sound pressure (Tab. 1), we calculated a reference value of 77 dB[12].
The estimation of a buffer-distance of 20 metres, abating sound pressure down to 40 dB, was made only according to this reference value, without considering background noise (though this is typical in real urban environments).

3.4 IDENTIFICATION OF DIFFERENT ACCESSIBILITIES BY PUBLIC TRANSPORT

A further insight into contextual criticalities looks at varying accessibility levels in relation to the public transport network serving the City of Milan. The study of this issue entailed a certain degree of simplification, given its undeniable complexity. In fact, the only accessibility indicator considered was proximity to a station/stop of the rail transport network (underground, ordinary train and suburban rail bypass), either of a major ATM[13] line.

[12] Multiple-source sound pressure level derives from an addition which cannot correspond to a simple arithmetic sum of decibels, due to their logarithmic nature. In this case, decibels were converted into the line value of each individual source, thence summed and converted again.
[13] Azienda Trasporti Milanesi.

'Proximity' attribute was assigned within a given time/distance range (starting from the stop) walkable at a speed of 1,25 m/s[14], which was calculated through a GIS approach in reference to the overall municipal road network. For underground and railway stations a maximum distance of 5 minutes was assigned, falling to 3 minutes for other major ATM network stops. It was subsequently possible to subdivide the overall municipal area into a number of accessibility classes, through a superimposition of stops and station gravitation zones. The higher accessibility score was conferred to underground stations, the intermediate one to train stations and the lowest to remaining ATM stops.
The synthesis map divides the city area into five classes, from low/null accessibility (ordinary ATM stops) up to spots near to both underground and train or to all three analyzed types (Fig. 4).

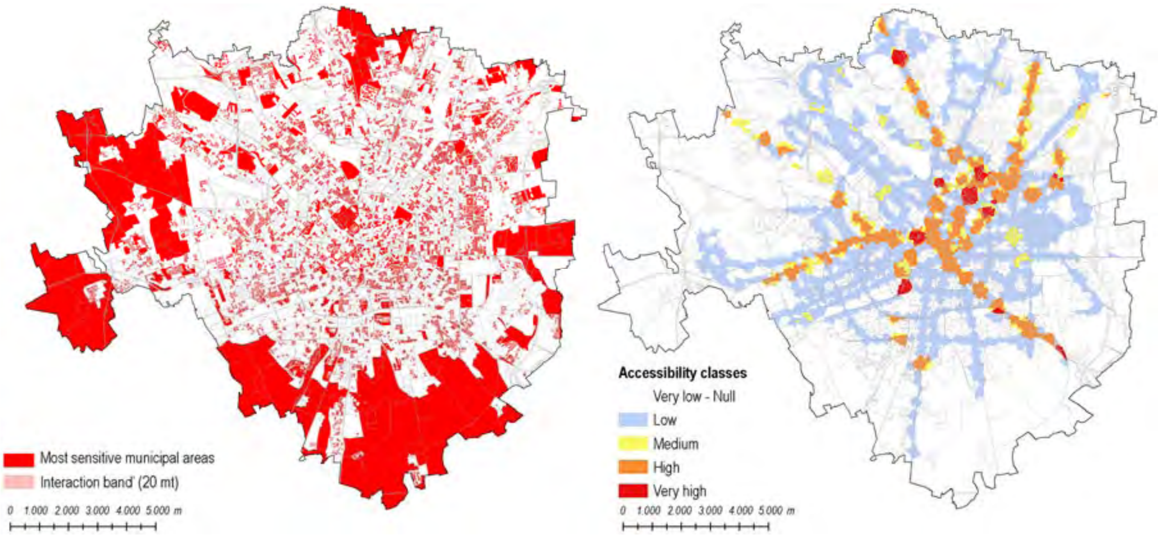


Fig. 4 Most sensitive municipal areas and pertaining interaction band (left figure) and classification of the municipal area according to public transport accessibility (right figure)

4 IDENTIFYING PROTECTION ZONES

Finally, it was possible to identify the Protection Zones within the municipal boundary, an outcome deriving from the synthetic superimposition of maps created at the end of each analysis phase.
Protection Zones emerged from the overlapping of potential criticalities (Fig. 5). The red perimeters (that is, areas with a "very high" businesses' density) are to be considered as the starting geometric elements for their definition. Progressively, the perimeters were broadened, including the "high" density along with the "most sensitive" municipal areas, and possibly considering a scarce or zero accessibility by public transport. "Most sensitive" areas were excluded from the perimeter, in case the density level was less than "high". The perimeter itself was always approximated, and it coincided with a varying spatial element – the street border or centre line, a park or a neighbourhood boundary, etc. - according to the situation.
At last, two distinct Protection Zones (one of which with a higher protection level) were identified, depending on the actual nightlife criticality. These were defined after a measurement campaign carried out by the Regional Environmental Protection Agency (ARPA)[15].

[14] In specialist literature, the average speed for pedestrians is typically comprised between 1 and 1.5 m/s.
[15] ARPA made a Noise measurement campaign within the Protection Zones between September 2011 and August 2012, in order to verify the amount of noise and its seasonal variability.

It is inside these perimeters that the City of Milan provides a 'qualitative' programming, meaning a regulation of permits aimed at limiting the negative impacts of existing night leisure businesses.

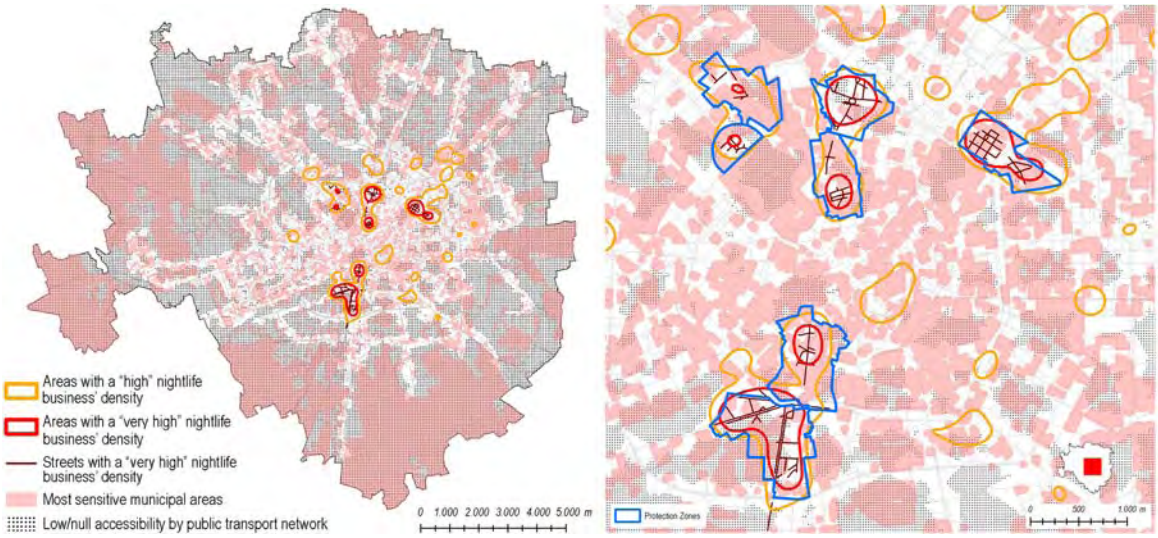


Fig.5 Synthesis map: overall and detail views with the Identified Protection Zones

5 ICT AS A TOOL FOR MONITORING THE EFFECTS OF REGULATORY POLICIES

In proposing a qualitative approach to regulatory policies addressed at nighttime leisure activities[16], it is strongly recommended to consider innovative procedures for both evaluation and monitoring of the proposed solutions. In particular, the use of Information and Communication Technologies is suggested in order to monitor noise pollution, undoubtedly the most critical externalities of nightlife and at the same time the most suitable indicator for assessing the effect of implemented policies, or the respect of municipal criteria. Currently, two main approaches are employed in the detection and monitoring of noise pollution in a given spatial range: through *sensor networks*, and through *direct measurement campaigns*.

5.1 SENSOR NETWORKS

The installation of sound sensors in a given urban context and the setup of sensor network allows for real-time monitoring of environmental phenomena such as noise, weather conditions, air quality, etc.. Installations can take advantage of existing fixed networks, such as public lighting. In this way it is possible constantly to monitor the effects of noise pollution regulation and to detect possible violations.

Among the advantages of this system there is the possibility of a rigorous and precise monitoring, guaranteed by the presence of specifically assigned personnel, plus the option of periodic reports and timely violation warning. High costs are definitely the main disadvantage (although the exploitation if existing lighting network allows fair economies). In addition, the outdoor location of sensors does not help to assess the real impact of noise in home environments.

5.2 MEASUREMENT CAMPAIGNS

This investigation method involves qualified personnel equipped with appropriate instruments, with which to measure noise pollution in specific areas and time periods. The procedure does not allow a constant noise

16 This category clearly includes daytime businesses that keep open during the night or part of it.

monitoring if not through the direct involvement of the resident population, as was the case in the UK with some interesting "community mapping" experiences[17]. One of the main efforts required is people's training to the use of technical equipment such as sound level meters and GPS for the geolocation of outcomes. This can prove a strong constraining factor, due to unaffordable costs of equipping and training a large number of participants. Furthermore, the probing of measurements requires continuous support by technical personnel.

5.3 MOBILE NOISE MONITORING AND NOISETUBE PROJECT

Besides these two approaches, there is also a third mode, definable as 'mobile tracking', which proposes a particular way of monitoring of noise mitigation policies that can prove very useful in the containment of nightlife negative externalities.

This approach is based on the direct involvement of 'ordinary' people through Web 2.0 tools and practices. Web 2.0. implies new ways of active participation and expression of citizens allowed by today's web platforms, which transform the role of the public from passive information consumers into active users of social connection tools (e.g. social networks) and authoring tools (e.g. wikis, blogs, etc.).

In many European countries there is wondering about the possibility to use these instruments to improve the citizens' quality of life, and particularly whether it is possible to employ digital world's User-Generated Content (UGC) in the monitoring and evaluation of real world's phenomena and practices (Maisonneuve et al, 2009). In recent years there have been interesting experiences of measurement and monitoring of urban problems through the use of Smartphone applications[18].

Taking the cue from one of these experiences, aimed at monitoring noise pollution, we propose a practical and low-cost procedure for assessing and monitoring the impacts of nightlife.

NoiseTube[19] project consists in an application for Smartphones that converts mobile phones into sound sensors, thus making their owners contribute to the mapping of noise pollution in specific parts of the city (Fig. 6). A pilot experiment was conducted in Antwerp (Belgium), bringing to a mapping of local noise pollution dynamics (D'Hondt et al., 2012).

Fig. 6 Example of acoustic mapping by NoiseTube app (Milan, "Lazzaretto" neighbourhood)

[17] http://www.mappingforchange.org.uk/.

[18] An interesting example is given by Italian WeDU! Decoro Urbano, an application used by citizens to publicly denounce damages or dysfunctions of urban furniture and urban fabric. http://www.decorourbano.org/.

[19] http://noisetube.net.

6 CONCLUSIONS

We decided to provide a detailed report of this research path in order to propose a possible methodology for the analysis of complex urban contexts, not only to identify critical areas where to apply regulations and programming, but also to identify the excellences and strengths of specific retailing systems. Retail can be considered to all effects as a service to the city, both on a local and on a regional scale. Actually, high concentrations of shops and stores may qualify the city itself, by supplying it with attractive environments and equipments. For this reason, urban development plans or local regulations (regardless of their specific goals) are highly recommended to acknowledge and endorse the role of retail in the organization of city centres and in the enhancement of public spaces.

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DEALING WITH RESILIENCE CONCEPTUALISATION

FORMAL ONTOLOGIES AS A TOOL FOR IMPLEMENTATION OF INTELLIGENT GEOGRAPHIC INFORMATION SYSTEMS

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ABSTRACT

The paper addresses the issue of the representation of the concept of resilience (urban, environmental and landscape resilience) in the context of geographic information systems. In the current technical and scientific debate, resilience is configured as an intrinsic property of a system to switch from one equilibrium state to another without losing its basic internal structure, also definable in terms of "identity." The paths to success or stable growth as well as those of continuing and recursive crisis, although already explained in macroeconomic terms through the mechanisms of accumulation and multiplication (cumulative advantage), are also interpreted in terms of resilience. So, in the field of studies on spatial planning, the concept of resilience became particularly significant in an era characterized by great instability of social systems, deep economic and environmental crisis. In the process of urban and regional planning, conceive the development of an urban region in terms of resilience means using the logic of complex systems and then adapt in this way their methods of knowledge representation. The concept of resilience is multi-dimensional and vague, so its conceptualization is complex. The formal ontologies can be a useful tool to orient geographic information systems towards more complex forms of knowledge representation and to adapt them to the requirements of logic and formal complex systems, such as today's urban regions.

KEYWORDS

Resilience, Formal ontology, Geographic information systems, Knowledge representation

1 INTRODUCTION

In ecological and socio-ecological studies, resilience can be understood as the ability of a system to acquire multiple equilibria: the resilience is presented as an intrinsic property of a system that allows itself to switch from one equilibrium state to another without losing its internal critical structure, otherwise definable also in terms of "identity" (Berkes *et al.* 2003). The paths of success and / or stable growth of a region or a city as well as those of continuing crisis, although already explained in macroeconomic terms through the mechanisms of multiplication (cumulative advantage), can also be interpreted in terms of resilience capability of a system, demonstrating at the same time the link between economic vulnerability, resilience and development trajectories.

Speaking of that particular type of complex systems that are urban regions, it looks like they confront with two main categories of disturbances: sudden shocks and slow processes of change. The first were much more studied (Carpenter *et al.* 2001). Most of the literature on disasters suggests that, in cases of disturbance even intense but rapid, urban regions tend to recover with relative speed the pre-shock status, without remain structurally transformed. By this way, the analysis of resilience may be restored in the field of studies on systems with stable or evolutionary equilibrium. What is interesting in these cases is whether the population and economic growth, for example, have resumed their growth rates within a few years after the event. On the contrary, a system is considered as not resilient when it is unable to resume its original trajectory.

The slow changes, on the contrary, are observed in systems in gradual but steady transformation, systems that can considered out of equilibrium condition. Under these conditions (which include cases of protracted crisis), the institutions have to do with continuous changes in periods of shortage of resources. In such situations, the focus is not on equilibrium condition and stability, but on the ability of the system (included institutions) to adapt to change and to preservation the local identity. This approach in the study of regional resilience (recently in: Berkes *et al.* 2003; Folke *et al.* 2010) which can be defined “evolutionary”, resumed conceptual models developed in the framework of studies on socio-ecological systems.

The concept of resilience seems to be particularly useful in the context of (spatial) planning, also when it is applied to territories and coastal regions. These in fact are areas that are particularly vulnerable, subject to continual mutations (generated both by natural forces to strong pressure from human activities, which often tend to be concentrated in these regions), traumatic and often leading to a spatial framework in constantly improvement. The study of the resilience of coastal zones and regions involves the need to build formal models of analysis and interpretation of the territorial changes that are consistent with a complex and evolving conceptualization.

These models can be implemented within geographic information systems. The fact that the concept of resilience is inherently multidimensional (within the territorial model must find their place natural components, socio -economic ones, symbolic ones), involves the need to equip the information systems of models for knowledge representation both evolutionary and complex. In order to convert these systems in information models for decision support systems, it is essential that the process of conceptualization of resilience is incorporated into the knowledge bases, starting from the metadata and ending with complex systems of indicators. With a complete set of indicators it is possible to build global scenarios of change by which to assess the impact of different actions (or inactions) and policies in the urban and environmental context.

2 RESILIENCE AND ITS CONCEPTUALISATION

2.1 DEFINITIONS

It is now widely recognized as the most complete development of the concept of resilience is derived from studies of ecology, subsequently extended to the integration of the ecological component with the social component. However, upstream of the definitions given in the environmental field lie, the definitions of physical and engineering fields, according to which resilience is the property of a system to maintain its stability with respect to a stationary state of equilibrium initial presumed. In these cases, the focus is on the ability of resistance to a disturbance, and on the capacity of return to the point of initial equilibrium. In this field of study, the interest and the attention are on systems with a single equilibrium. This concept of "resistance" (rather than "resilience") tends to dominate still currently in the field of psychology and studies of disaster. The studies of the responses to disasters tend to understand the engineering version of resilience, linking resilience to the concept of vulnerability. The analysis (directed to the formation of policies) focuses on the likelihood that a catastrophic event could cause a systematic set of physical consequences (errors and damage), loss of lives, property and social support networks to neighborhoods, cities or regions. Orienting studies on the medium-long term, studies of disaster try to measure the resistance as a form of learning that allows an urban system of "catch up" in terms of population, economy, or built forms (Vale and Campanella 2005) after a traumatic occurrence. The resilient city, in this view, would be able to resume its previous growth trajectory after an event that has caused a delay.

Further studies have also investigated the ability of a system to acquire multiple equilibria: in these cases, the resilience is presented as an intrinsic property of a system that allows it to switch from one equilibrium state to another without losing its basic internal structure, otherwise defined also in terms of the "identity" (Berkes and Folke 1998). Recent work in institutional economics and macroeconomics are focused on trying to explain the behavior under stress of multi- equilibrium systems. The paths of success and / or stable growth as well as those of continuing and recursive crisis, although already explained in macroeconomic terms through the mechanisms of accumulation and multiplication (cumulative advantage), can also be interpreted in terms of the resilience of a system. In these cases the size of the systemic phenomenon allow give an interpretation of how the links between the economic system and institutions can affect strongly on a trajectory of development (cases of recursive accumulation in which tend to reproduce consistently the factors of success or failure that became self -sustaining).

In the economic field is therefore clear the link between vulnerability, resilience and developmental trajectories. Within the vulnerability concept, in particular, we can identify two characters determinants: in one hand a kind of "structural" vulnerability, which derives from the characteristics of the organization and the structure of space infrastructures and in other hand a "systemic" vulnerability, instead attributable to the characteristics of relationships between the components of the system. The common element among the studies in ecology and those in the economic field is the size of a systemic analysis. No less interesting is the vision to which these studies are leading: an evolutionary interpretation of change (economic in this case, but this concept can be extended easily to the general field of urban studies).

In general terms, the urban regions (understood at this point as "complex systems"), have to face two major categories of disorders: the sudden and deep shocks on one side and slow and incremental processes of change, which usually are interpreted as discrete event or series of events. The first (shock) have been far more studied, especially natural disasters (Carpenter *et al.* 2001).

Most of the literature on disasters suggests that, in cases of disorders intense but still rapid, urban regions tend to recover relatively quickly in pre-shock state, without great signs of structural transformation. This recovery mechanism to a state of pre-shock lead back the analysis of resilience in the field of studies on systems to stable equilibrium. What is interesting in these cases is whether the population and economic growth, for example, have resumed their growth rates within a few years after the event. A not resilient system (vulnerable system), in these cases, is the one that is unable to resume its trajectory.

2.2 RESILIENCE: THE EVOLUTIONARY APPROACH

The slow changes, on the contrary, are observed in systems in gradual but steady processing, systems such these are probably long out of equilibrium. Under these conditions (which may conditions of gradual improvement, but much more easily deterioration), the institutions have to confront with continuous changes in periods of scarcity of resources. In such situations, the focus is not on equilibrium state but rather on the ability of the system to adapt itself to change and preservation of identity. This approach (recently in: Berkes *et al.* 2003; Folke *et al.* 2010). In this field of study are relevant and are then analyzed those internal processes to a system that allow it to undertake adaptive strategies with respect to the disturbances coming from the extern context, even though these will constantly bring in "danger" the internal structure, inducing a continue process of modification. Already ecologist Holling (1973, 2002) defined ecosystem resilience as the ability of the system to generate and regenerate internal reorganization by way of change management and institutional capacity in order to maintain the same identity, structure and functions. Focusing on identity and structure of the systems, this new idea of resilience explain better the evolutionary trajectory of a system: not only the stability characteristics of the components of the system are decisive (e.g., population , economic activities, fixed social capital), but rather the ability to remain "vital", passing from a state of equilibrium (unstable) to another (more stable). In this perspective, studies on resilience intercept similar experiences in the so called "science of complexity", with interesting analogies with concepts such as self- organization, co-evolution and non-linear behavior (Levin 1999). Along this line of thinking, adaptability and transformability are the two main characteristics that a system (especially if pre-existing conditions of crisis) have to confront with external events: through these two features resilience manifests itself as a form of learning, structural renewal and reorganization.

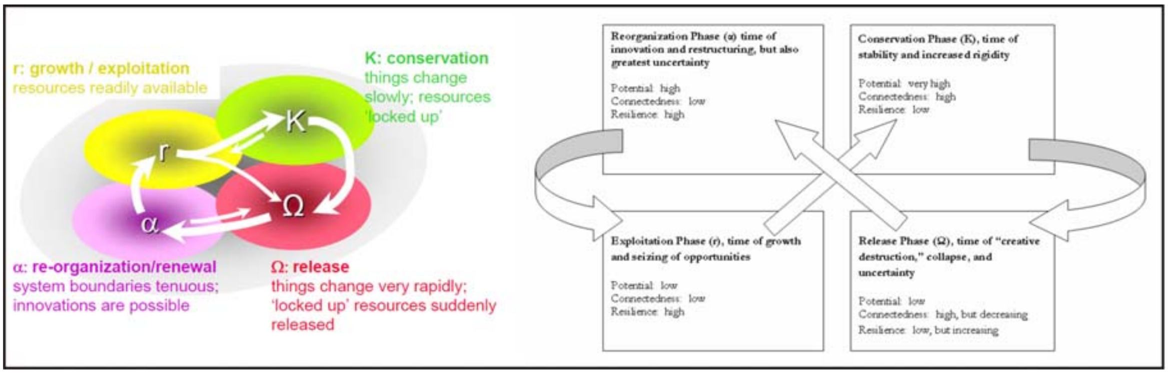

Fig. 1 Resilience phases in a cyclic vision

The potential of resilience is different in the different phases: it is lower during periods of conservation or collapse (due to the specialization and consequent loss of the system in terms of response capacity: in these cases the system in "locked-in"), while it is higher in the early stages of growth and reorganization.

According to this model, the disturbance or the shock are a necessary part of the development as they produce change through learning and self-organization. It should be emphasized that in this model the level of connectivity of the system takes different measures with respect to the reverse potential of resilience, being highest in the early stages of growth and preservation and minimum during the collapse and reorganization phases.

In recent years many cases study (Tidball *et al.* 2010) have demonstrated that as well as in cases of traumatic events that have affected physical settlement (e.g.: Hurricane Katrina in New Orleans), social and institutional learning has been crucial in the recovery urban structure. In some cases social learning is coming first (or even in contrast, initially) engineering intervention (excluding the operations of first responders: Peling 2003).

The new conceptual models of ecological and systemic resilience provide an important contribution in the study of regional trajectories, defining a new determinant: redundancy. In fact, in resilient ecosystems, redundancy is represented by the abundance of different function, preferably spatially distributed. This model seems to describe a new model of ideal city (that in fact, maybe it is already partly in reality (and which still represents a possible scenario): a porous city, with many functions distributed in space and with different levels and gradients of intensity (of uses) and density. Thus, the decentralization of many functions such as the provision of distributed services, it can express a high potential for resilience (Vale and Campanella 2005). From this perspective, moreover, the resilience expresses a strong relationship with the ecological vision represented in the patterns of connectivity, as well as some recent achievements in the field of urban economics and regional (Hassink 2009).

2.3 RESILIENCE ASSESSMENT

The resilience of an urban region can be interpreted as an evolution of the concept of sustainability. Resilience encompasses the way in which we face change. As explained above, the more substantial definition of resilience descend from ecology. Ecological definitions of resilience include “the magnitude of disturbance that can be absorbed before the system changes its structure by changing the variables and processes that control behavior” (Gunderson and Holling 2002) and “the capacity of a system to experience shocks while retaining essentially the same function, structure, feedbacks, and therefore identity” (Walker et al., 2006). So, sustainability includes the capacity to create, test and maintain adaptive capability, whereas development is the process of creating, testing and maintaining opportunity (Holling 2001). Sustainable development can thus be defined as development which fosters adaptive capabilities and creates opportunities to maintain a desirable social, economic and ecological systems (Holling 2001; Folke *et al.* 2002a; Folke *et al.* 2002b). Put another way, resilience can be seen as a necessary approach to meet the challenge of sustainable development.

Resilience can be interpreted as a cycle process, subdivided in four phases (conservation, exploitation, collapse, reorganization). To explain systems evolution in terms of cyclic growth, conservation, collapse, and reorganization we can use a heuristic similar to that of Gunderson and Holling (2002). In a regional system we can note patterns of growth (development of each phase), persistence (of each phase due to recovery capacities), collapse and renewal (in terms of strategic technical innovation and adaptations that allow progression from one phase to another). Persistence is the capacity (within each phase) to protect the system (using preventive adaptations), respond to any unexpected hazard, recovering and avoiding changes in order to keep functions and structures. Re-organisation is recognisable when innovations in subsystems structure or functioning are used to adapt changes stepping from one configuration (phase) to a different one when thresholds come closer and the existing structure can no longer afford to keep systems functional. Learning process represents the increasing capacity of managing systems that move between persistence and re-organisation strategies, conferring sustainability to the system.

The evaluation of the degree of resiliency (or, conversely, of vulnerability) of an urban region can be conducted through formal models that express the fundamental characteristics of that region and consider their temporal trends, under the influence and impact of factors of change or crisis. In a similar way to what happens in models of sustainability assessment, a practical method of approach to this issue is the construction of frameworks of indicators. Through the indicators it is possible not only to measure the time course of the resilience and adaptability of an urban region, but also provide an overview of the strengths and weaknesses on which act to increase the degree of resilience.

Humans have influenced most of the Earth's ecosystems and shaped or created landscapes through activities that profoundly affect biodiversity and ecological processes. In many landscapes, people and nature have co-evolved over centuries or millennia, creating unique bio-cultural systems. As human societies have often led a process of co-evolution with nature, changing and adapting landscapes around them, the concept of resilience (and indicators associated with it) is to assume the characteristics of a holistic assessment of the man-environment relationship and its evolution over time.

3 FORMAL ONTOLOGIES AS A TOOL FOR KNOWLEDGE REPRESENTATION

3.1 FORMAL ONTOLOGIES

Ontologies are logical-semantic schemes that represent the complex structure of the world. Formal ontologies have been originally elaborated in order to build thesauri and dictionaries. To this purpose they can linked to semantic networks and usefully employed to build logical models of restricted domains (Gruber 1993). Basic elements of a formal ontology are the classes (taxonomies), the axioms, the instances and the relationships (Guarino 1998). Every class or category in a formal ontology is defined by a set of features and labels with possible restrictions useful to restrict the heredity relationships. By means of tassonomies we can express heredity relationships among different categories. Axioms are statements that define concepts more precisely. Instances represent occurrences of the different elements of a particular category.

In information systems (and in particular in expert systems and decision support systems) a formal ontology can be used to different aims such as reasoning, categorization and problem solving. In these cases the formal ontology is particularly useful to organize a delimited knowledge domain, because it permits to order concepts and the relationships among them (Frixione 2013).

In this sense formal ontologies make it is possible to represent that fundamental function of reasoning consisting in categorization (classification). In the field of knowledge representation another important possibility deriving from the formal ontology application is its capability of solving ambiguity cases in human language (Evans, 2008). In an ontological model of data the classes are sets, collections, or types of objects with the same characteristics or belonging to the same "species". The classification can proceed according to top-down models (requires expert knowledge and methods to share) or second bottom-up modeling (need a "reasoning engine" that brings together objects in a logical manner according to criteria of similarity). Attributes are properties, features or parameters that objects belonging to different classes may have and share; relationships are the ways that objects can be related with each other; the individuals are instances of the model (they are the basic elements of a system). In an ontological model of structured data we can found two fundamental kinds of relationships: logical and topological. The logical-semantic relations are the synonymy (in the case of elements that are equal); antynomy (opposite, but not bidirectional relations); hyponymy / iperonymy (IS-A hierarchy), mereonymy (which corresponds to the “is part of” relation and defines the cases in which we found the corrispondence: components / member / particle). The topological relationships are: disjoint, meet, overlap, inside, contains, covers, coverde by, equal (Baader *et al.* 2010).

3.2 FORMAL ONTOLOGIES AND GEOGRAPHIC CATEGORIZATION

Also in the case of information systems and data base concerning the geographical world, formal ontologies are useful. In geography, building a domain ontology is something different than creating a thesaurus, even if it could include this function. This is also true if we enter the field of geographical ontologies. With regard to geography (and above all in town and country planning or in action oriented to landscape studies), there are two fundamental causes of difference.

- Geographical objects have uncertain and vague boundaries because of their inherent spatial and topological features;
- A lot of objects (or concepts) doesn’t always find a corresponding term in human language, even if they can be recognizable and identifiable.

With regard to the first item, it can be asserted that many (or most) geographical objects have uncertain boundaries. This is true even for common use terms, which in reality avoid precise definitions. Conventions come into play that are the result of common consent among domain experts: in this case the geographers community. Nevertheless, there are many cases where experts have difficulties in finding a linguistic consent in any way (Smith and Varzi 2000).

With regard to the second item we can take the example of landscape. It is very easy to find situations where according to our “perceptions” we classify it, by dividing it in a range of different geographical parts and places, which are all different and qualitatively distinct. In fact not all these parts have a corresponding term that expresses every concept in a common consent language (Guarino 2009).

With regard to geographical concepts (with some fundamental differences from other domains that build knowledge of natural and artificial worlds) ambiguity cases are more uncommon, whereas matters referring to linguistic consent are more substantial. Linguistic consent is the most important question to solve these cases. This means that in the field of information systems and knowledge representation there is an interoperability problem that is a problem of communication among different information systems as well as between every single information system and human operator.

4 RESILIENCE MODELLING AND REPRESENTATION

4.1 A LOGICAL MODEL FOR RESILIENCE REPRESENTATION

In the construction of environmental information systems during the input phase, the use of logical and computational models derived by computer science (defined in artificial intelligence "knowledge representation”) can be very useful. Semantic networks or frames represent examples of this kind of conceptual models. In recent years the logical models based on ontologies spread. In computer science, an ontology is a formal and explicit specification of a shared conceptualization. The "specification of a conceptualization" is a description of the knowledge we have of a certain domain, using classes, relationships between classes and individuals belonging to classes. Ontologies allow to represent semi-structured data. In contrast with structured data that are stored in a rigid format, such as tuples of tables in a "model entity / relationship", the semi-structured data format are represented by a tree graph or structures that have the potentiality to vary with respect to a pattern assigned. For example, they may be missing some attributes, as for example some branches of the tree, because the order of the associated schema allows a high degree of freedom of adherence in terms of completeness and spelling. This scheme can also be an implicit part of the data and ask for a later definition. Finally, because of the requirements to handle the heterogeneity of the data, it is often much more extensive and variable in time when compared with the patterns of relational databases. The basic elements of each logic model based on ontologies are concepts and rules. The first are the classes, the latter are used to specify the properties of classes. Each concept is interpreted as a subset of the domain of interpretation (the set of instances of the concept), and each role can be interpreted as the binary relation on that domain (Levy 2000).

In the present case, the ontological model has allowed to pass from the meta-data elementary, that is primary indicators representing the main thematic field: natural capital, human settlements and cultural heritage, to semantic structures of data that allowed to represent the different components of the model in spatial form, according to a scheme which for each component identified, elements that characterize the specific component (structure), the vulnerability factors (related to the nature of the phenomenon), the possible alterations that may be induced by human activities, the values assigned to a specific environmental, anthropic or cultural state of the phenomenon.

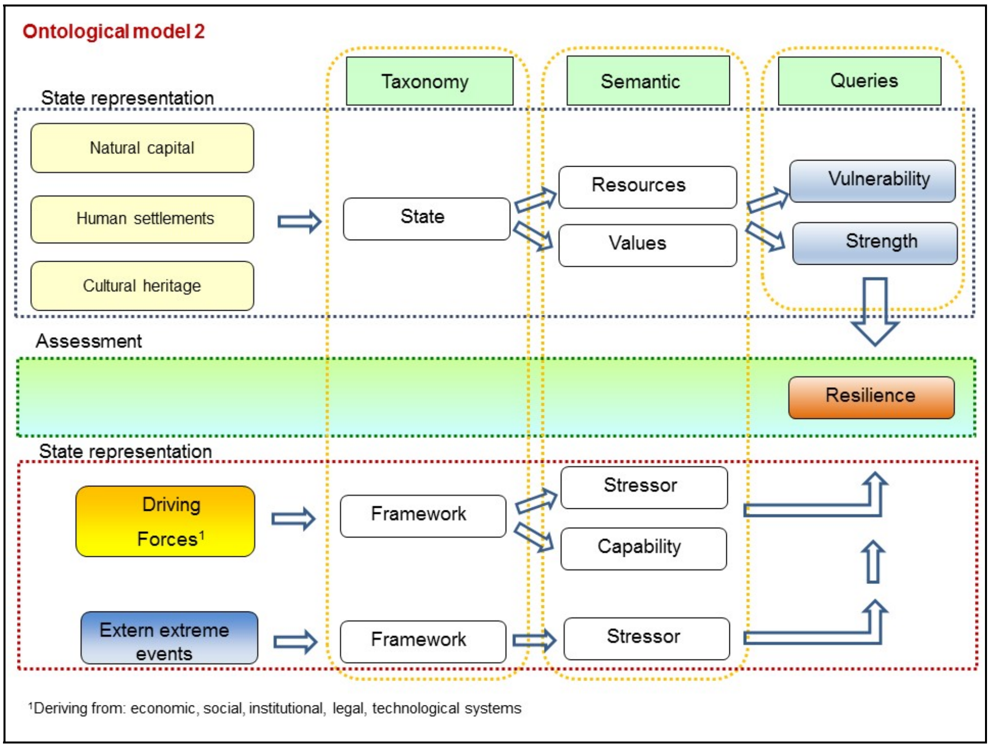

Fig. 2 Ontological model schema to represent the resilience conceptualisation

4.2 THE CASE STUDY: RESILIENCE ASSESSMENT IN A COASTAL ZONE (TIGULLIO – LIGURIA)

The case study concerns the territory of the coastal zone of "Tigullio", a maritime gulf situated in the east part of Liguria (but the methodology could be extended to other cases, because of the problematic of knowledge representation are similar). The territory can be represented in three fundamental systems: the natural capital, the human settlements and cultural heritage, that is the sedimentation of built up signs during the historic process of “territorialisation”. The territorial context is characterized by a specific spatial structure, a set of environmental infrastructures and, in an holistic vision, by an unique identity landscape. Each of these systems are composed by a set of elements (individuals, in an ontology language), and each element in characterized by a set of specific and variable attributes.

The construction of the evaluation model based on ontology has occurred by means of the Protégé software, developed by a research group of Stanford University. This software allows, through its graphical interface and its logic, to process information models and knowledge bases from ontologies originally developed in the OWL language.

In order to assess the resilience of the urban region of Tigullio, in the conceptual model used it has been essential represent the territory in three different states: natural capital (i.e. the set of natural resources), the anthropic settlement and cultural heritage (consists of physical elements of material type, but which are characterized by specific symbolic values). For each "state" then we have proceeded to the construction of an ontology, which took over from time to time typical forms of a tree (Eco 2014) that is the normal knowledge representation model in this kind of model. The software, however, also allows a graphical display of the objects that are being organised in the ontology. To proceed with the construction of the ontology of each "state", prompted by the logic OWL (which is also elaborated by Protege) to split the first domain of knowledge in classes and subclasses (each subclass then inherits the attributes and properties of the upper classes). OWL classes are interpreted as sets that contain individuals. They are described using formal mathematical) descriptions that state precisely the requirements for membership of the class. Classes may be organised into a superclass-subclass hierarchy, which is also known as a taxonomy.

The second step in the elaboration of ontology has been time the construction of property set. These properties, similarly for the classes and subclasses, can be arranged in a hierarchy. OWL Properties represent relationships between two individuals. There are two main types of properties, “Object properties” and “Datatype properties”. Object properties link an individual to an individual. Datatype properties link an individual to an XML Schema Datatype value or an rdf literal. Properties are prefixed with the word ‘has’, or the word ‘is’. Properties may have a domain and a range specified. Properties link individuals from the domain to individuals from the range.

Finally , the last step to build the ontology is constituted by populating the ontology itself with specific individuals. Protégé is a tool to logically organize the concepts and relationships that relate them to each other, but obviously has no analytical functions or spatial representation of the data. For this reason it was necessary to develop a system of communication between the data organized in logical form within the knowledge bases developed in Protege with a geographic information system outside (in the case study it has used an open-source software: QGIS). The connection between the two software has been built by the union of the data tables. In this sense, the construction of the ontology (which is an ontology of spatial type) has allowed a bi-directional flow of data, in the sense that sometimes the queries constructed with GIS, have formed the basic elements to define classes and properties within Protege. This phase of the work, conducted as a final result in the construction of a series of maps, which represent in a structured way the three "states" on which it has been built then the assessment.

In our ontological model of data classes, relations and attributes contribute to formation of the taxonomy of a certain environmental or anthropic phenomenon. Properties instead define the semantic structure of the knowledge base. At this step, new complex concepts emerge: with an organization of knowledge based on taxonomies defined by class hierarchy and properties, the recognition of individuals (by the way of integration of Protegè with geographical information system) brings to the emergence of a new level of knowledge: the semantics of the system. In the case of study, from the built taxonomies emerge a semantic level that define two new concepts: resource and values. The first ones concern the physical state of environment, settlement or heritage the second ones define their value in terms of rarity, dimension, localization and so on. The terms of “resource” and the term of “values” define new maps that are maps of geographical values (and not only maps of distribuited objects).

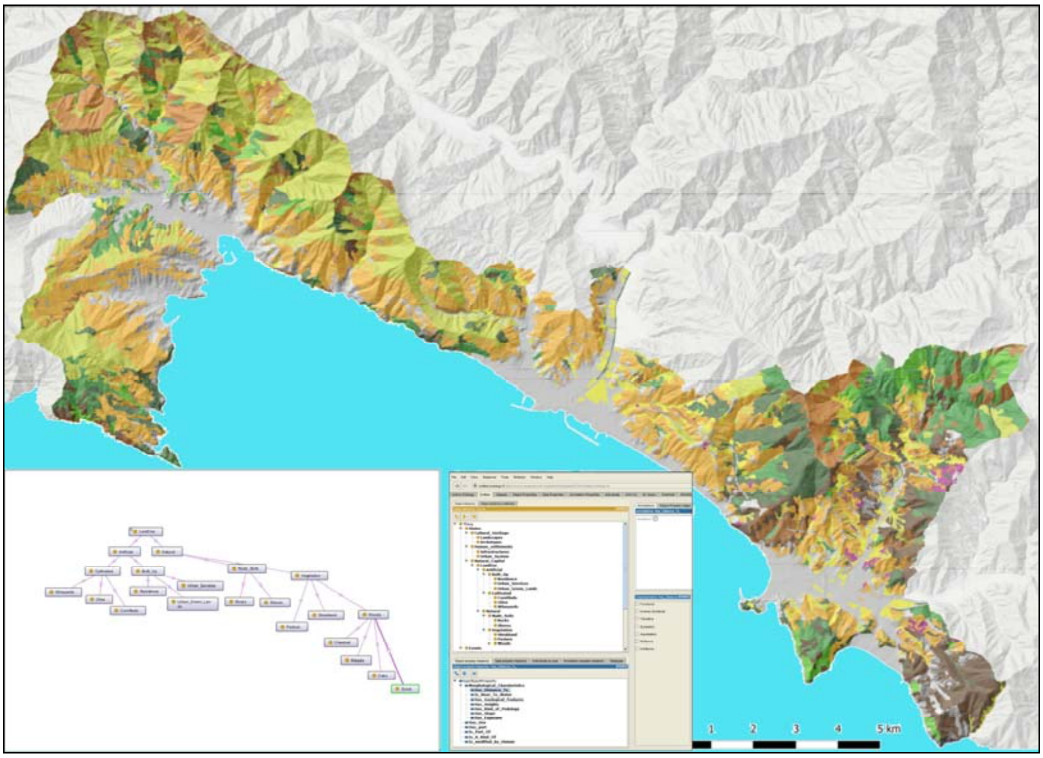

Fig. 3 A land use map built on the basis of a taxonomy (ontological organization of data)

Finally, queries define the intrinsic characteristics of resources and values: so the geographical map set of vulnerability or strength in done (Hagen-Zanker 2006; Maguire *et al.* 2005).

In a following step the set of anthropic actions defined within a framework of “stressor” (due to building and use of artificial infrastructures and manufacts and, more in general, to human activity) or “capability” (in the case of increasing of safety and wealth) are considered to reference to their impact and effects on originally state components. In this step it is possible to build the map of weakness (or critical areas) and then a set of map of resilience indicators. The analysis of impacts and actions generated by human factors or external events of natural type (especially extreme weather events), built with models of spatial type (so that it is possibile determine the location of the impacts themselves) leads to the construction of maps of criticality and capability. These results are obtained, from a logical point of view, with the same methodology used for the analysis of "states": that is through the construction of an ontology. In this case is an ontology of events (actions that can be created by anthropogenic or natural events, often the result of cumulative impacts). Even for the events has been constructed ontology built from their preliminary division into classes (in this sense it has been adopted the use of logic and topology) and subsequently awarding the properties to classes. The results of logical queries to databases so constructed has allowed to obtaining maps of criticality and capability. The overall assessment, that represent the formal outcome of the last logical step of the assessment model, was obtained through the processing of spatial queries to the two data sets: the "states" and "events". The queries are the means by which it was possible to construct a first set of indicators useful to specify the concept of resilience for the area under study. Each indicator has a temporal dimension: in this way, it is possible to construct scenery maps that can represent the evolution of the regional system with respect to possible change determined by traumatic events or incremental trajectories alteration and variation.

5 CONCLUSION

The construction of a single logical system for descriptive environmental, anthropic and cultural data permit to achieve some results. The first is reducing the complexity resulting from very large databases. The second was to be checked at each step the set of relationships that relate each other but interrelated phenomena so difficult to be synthesized. It has also permitted to make a set of indicators to describe the resilience and its trajectory I during the time. The model permit to evaluate forces and constraints of potential changes. This framework, with data derived, can be useful in the perspective to build a support system decision model, by that assess the choices for regional spatial and environmental planning. Finally, it allowed to organize knowledge in a way that would be represented spatially (key issue since the evaluation must be anchored to the geographical space).

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IMAGES SOURCES

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SOCIAL MEDIA GEOGRAPHIC INFORMATION:

RECENT FINDINGS AND OPPORTUNITIES FOR SMART SPATIAL PLANNING

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ABSTRACT

This paper deals with the opportunities of Social Media Geographic Information (SMGI) as valuable support for analysis, design and decision-making in urban and regional planning. In the light of the recent advances in digital geographic information, such as Spatial Data Infrastructures (SDI) and Volunteered Geographic Information (VGI) which are fostering innovation in urban and regional planning, the authors focus on the potentialities of Social Media as source of knowledge for the planning practices. The authors argue SMGI may play an important role to inform 'smart city' strategies extending authoritative and sensor data infrastructure with experiential and pluralist citizens knowledge. To support this thesis, an innovative methodology for the advance of Social Media Geographic Information (SMGI) Analytics is proposed. To this end, the authors present an original user-friendly tool able to extract information from popular Social Media such as Twitter.com and Youtube.com and to apply Spatial-Temporal Textual (STTx) analysis . Some examples are provided at the regional and at the local scale in order to demonstrate the potential of SMGI analytics in regional and urban planning. The results show how SMGI analytics can support design, analysis and decision making in planning, and add the value of pluralism to inform smart city initiatives.

The paper ends with some brief conclusions on the opportunities of SMGI analytics for possibly affecting decision-making dynamics and urban and regional planning processes, through citizens' dialogue and integration of experiential and professional knowledge.

KEYWORDS

Social Media Geographic Information SMGI – Urban Regional Planning – Volunteered Geographic Information VGI – Computational Social Science

1 INTRODUCTION

Nowadays, an unprecedented wealth of digital geographic information is made available to planners to support design, spatial analysis and decision-making. This trend could foster notable innovations in urban and regional planning methodologies. Advances in urban and regional planning practices may represent an opportunity of great potential to eventually enrich 'smart city' strategies with a broader, deeper and more pluralist knowledge of the places. Opportunities for innovation and development of planning practices emerge from the avalanche of "big" geographic information, which Web 2.0 technologies made available to the wider public. First of all, advances in Spatial Data Infrastructures (SDI) enabled the public access and reuse of available Authoritative Geographic Information (A-GI) according to common data, technology, and policy standards. The implementation of the Directive 2007/02/CE, establishing a shared INfrastructure for SPatial InfoRmation in Europe (INSPIRE), leads to the development of Spatial Data Infrastructures (SDI) in Member States and regions. SDIs impact may provide beneficial results for public administration, developers and planning practitioners, and slowly is bringing innovation into the planning practices (Campagna and Craglia 2012). For example, in many regions in Europe, the regional SDIs already represent the de-jure technical platform for the development of regional and local planning processes, by means of supplied data and services. This process is already slowly fostering innovation in the planning practices, although the target of a de-facto planning professional digital uptake is still a long way to go.

Secondly, developments in connectivity, geobrowsers and mobile technologies, enabled by Web 2.0, allow citizens acting as volunteer sensors (Goodchild 2007) to provide GI real-time in a bottom-up fashion. This information encloses both expert knowledge from professional and experiential knowledge from local communities, producing an enormous opportunity for enhancing the available knowledge base in urban and regional planning. Currently, this wealth of digital information, or Volunteered Geographic Information (VGI), can be easily collected, analysed, understood and used to support informed decision-making. These opportunities can both enable a transactive approach (Friedman 1973) in planning practices and foster the democracy and the sustainability in plan-making, according to a communicative process (Innes 1995). In several countries worldwide, the use of VGI is easing and fostering participatory processes, becaming a main source of information in planning emergency response, and in local planning for countries where authoritative data sources are absent at large scale. As a matter of facts, the concept of citizens observatories for environmental protection is an issue enclosed in the EU Framework Programme for Research and Innovation Horizon 2020 (i.e. Call SC5-17-2015).

In addition, widespread diffusion of social media is fostering the diffusion of geo-referenced multimedia (Sui and Goodchild 2011), or Social Media Geographic Information (SMGI), over the global Internet. Users can easily access information and also be the producers and broadcasters of personal geo-referenced contents on location-based social networks. These capabilities have overtaken past limits in data communication, and are disclosing innovative opportunities for disseminating and gathering geographic information among million of users, fostering the media convergence with GIS (Sui and Goodchild, ibidem). The social media contents can be considered an innovative Big Data source (Caverlee 2010), and the traditional spatial analysis methodologies and techniques may be considered not adequate to manage and take advantage of their knowledge potential (Campagna, forthcoming). The potential of SMGI may be considered still limited for the public users both in terms of accessibility and of available analytical instruments, and new methods and tools should be developed accordingly. However, petabytes of freely and publicly available information offered through social media may offer opportunities for innovation in spatial planning. SMGI could be detected and used to perform further analysis, in order to provide knowledge for decision-making (Zin *et al.*

2013). The integration of SMGI with A-GI can disclose innovative analysis opportunities in spatial planning, with regards not only to measures of geographic facts but also to users perceptions and opinions on places, localities and daily-routine events (Campagna *et al.* 2013). The management issues for this data avalanche gave rise to the emergence of a new field of research called Computational Social Science (Lazer *et al.* 2009). In literature several studies have been found, offering different approaches for the management and analysis of SMGI in order to provide useful knowledge for decision-making support in different domains.

The results of the elicitation of SMGI knowledge and its integration with A-GI, could foster the development of 'smart city' strategies informed by the local communities needs and opinions in a bottom-up approach. The concept of smart city performs an important and central role in the development of urban policies, as a way for combining innovative technological solutions to provide sustainability and livability in cities (Toppeta 2010). A smart city builds on investments in human and social capital, management of resources, transport infrastructures, and information and communication technologies (ICT) to ensure sustainable development and quality of life (Caragliu *et al.* 2009). Although in the past ICT and Web 2.0 have been considered fundamental for smart initiatives (Wilson 1997), and the Internet and broadband networks were seen as leading enablers of fundamental e-services (Kroes 2010), the smart city strategies should be considered as the organic integration of different systems (Dirks and Keeling 2009) or fundamental concurrent factors (Chourabi *et al.* 2012). For these reasons, the collection and analysis of SMGI should be fostered to inform and enrich the integrated system of a smart city.

In the light of these premises, the remainder of the paper is organised as follows. In section 2 recent trends on social media and the current convergence of social media with GIS are analysed in details, in order to describe opportunities of SMGI as support for design, analysis and decision-making in regional and urban planning. In section 3 the authors present a brief report on the main components related to smart city initiatives, with the aim of identifying the major elements that could be affected by SMGI. In section 4 a novel approach is proposed by the authors for the development of Spatial Multimedia Analytics (SMA) of SMGI in GIS by means of the tool Spatext. In section 5 the authors draw some conclusions, summarising the discussion on the opportunities offered by SMGI to inform smart city strategies and to support urban and regional planning.

2 FROM SOCIAL MEDIA TO BIG DATA ANALYTICS

The widespread diffusion in mobile social media applications, enabled by Web 2.0, is producing an unprecedented availability of information over the Internet. An important measure of this avalanche of information can be easily appraised by available statistics on major social platforms (100 Social Networking Statistics & Facts 2012). For example, Facebook exhibits 552 million of daily active users and over 1 billion of registered users, which spend over 6 hours by month on the social platform; YouTube, Twitter, Google+, Linkedin, Instagram, Pinterest, Flickr, Tumblr, representing only few of the major, despite smaller values in terms of users, show considerably contents production. Statistics depict the social media panorama as a world where every minute 2 million queries are submitted to Google, and every day 340 million tweets are sent, 300 million pictures are uploaded via Instagram, and 48 hour of videos are uploaded on YouTube, getting over 600 million views. These values show how petabytes of digital contents about any topic could be found through available internet services, fostering new opportunities for analysis and research. Social media platforms can be considered as the natural evolution of microblogging systems, that offered opportunities for the management, creation and diffusion of information in a recursive cycle of production and consumption (Vieweg *et al.* 2010). In addition, the current capabilities of social networks allow users to include geographic information into their own generated contents, driving geography into daily routines, and fostering the convergence of GIS and social media as argued by Sui and Goodchild (2011). As such, social networks could be considered as affordable and potentially boundless sources for information about daily life, events and also opinions, feelings and needs of users, related to geographical locations and facts. However, information provided by social platforms, should deal with several major issues for an useful use: data reliability, data management and knowledge extraction.

Social platforms offer different ways for management, sharing and extraction of contents, provoking a degree of uncertainty for the knowledge processing. Unlike traditional geographic information, SMGI either concerns dynamic processes on the Earth surface or users perceptions of them related to a specific time period, and requires advanced tools to support real-time monitoring, analysis and decision-making. The reliability and quality offered by SMGI for research and practice, as it is the case for VGI, are being discussed, and further efforts and investigations are required to define the reliability of this information (Jennex, 2010). VGI could be processed to elicit useful knowledge in relationship with specific degrees of uncertainty, in order to overtake credibility issues (Spinsanti and Osterman 2013).

Moreover, several hurdles arise in finding suitable practices and procedures to manage the available avalanche of information. Advanced Big Data analysis could represent a suitable solution to extract and manage social media information. Indeed, a direct extraction of the content (what?) rather than the causality (why?) from data (Pohl and Pohl 2013) could be performed, in order to avoid information volume issues and take advantage of current computing capabilities. In several domains, advanced Big Data analysis have been proposed and explored to manage the wealth of digital information, exposing interesting results for diverse analysis purposes.

Similarly, issues related to knowledge extraction can be addressed by the application of Big Data analysis techniques, Social Computing analysis, and also by the integration of crowd-sourced with authoritative data. The current rise of social media and computational capabilities can allow the process of several multimedia contents (text, video, image, sound), disclosing innovative opportunities for the study of human beings and society (Manovich 2011).

In literature, several studies conducted through analysis of SMGI have been found, embracing several fields of interest, such as: disaster events response, political events, media events, social studies and urban planning. Innovative instruments and analysis have been applied to detect events and information related to disasters both by means of analysis on Twitter (Li *et al.* 2012) or Twitter and YouTube (Zin *et al.* 2013). Flickr tags have been used in semantic analysis for the development of social studies (Rattenbury *et al.* 2007), or for investigating people movement and landmarks preferences in urban environment (Jankowski *et al.* 2010). In addition, the temporal component of Twitter contents has been used to determine urban land uses according to human dynamics (Frias-Martinez *et al.* 2012).

These considerations provide an overview on the wide diffusion of SMGI in several domains. However, despite the interesting results for elicitation of knowledge, further studies and advancements should be required for investigating views, needs, and opinions of individuals and communities. The wealth of information available from social media about facts, opinions and feelings of users could affect the current practices in design, analysis and decision-making, and could inform smart strategies with a real-time monitoring of needs and requirements of local communities.

A brief overview on the main components of smart city initiatives and the opportunities for integration of SMGI knowledge in such strategies is presented in the next section.

3 AN OVERVIEW ON 'SMART CITY' STRATEGIES

The label 'smart city' recently emerged as a broad term to identify several strategies for dealing with problems generated by rapid urbanization and population growth in cities. A smart city strategy builds on the central role of the Internet and Web 2.0 to deal with several societal challenges, as well as urban welfare, societal participation, environmental sustainability and quality of life (Schaffers *et Al.* 2011). In literature, several definitions of smart city can be found, concerning diverse elements that should be considered for the success of such kind of strategy. According to Hall (2000), a smart city should monitor and enhance the condition of its infrastructures, plan activities and increase the offer of services to its citizens. ICT and Web 2.0 should be considered fundamental to integrate, connect and make efficient the global system of infrastructures and services (Washburn and Sindhu 2010), or to improve livability and sustainability in the urban systems (Toppeta 2010). Moreover, the physical, IT, social, and business infrastructures are seen as fundamental components to foster the intelligence of the city (Harrison *et al.* 2010). Technology may be fundamental to achieve 'smart cities' as sources of spatial enablement for citizens, in order to improve access, sharing and integration of spatial data with services (Roche *et al.* 2012). Despite the increasing and common use of term 'smart', the concept behind these strategies has been investigated and considered from different points of view in literature, offering several clues and challenges for further investigation.

The technological component offered by ICT and Web 2.0 should not be considered as the only success key for advancements, but rather successful results of smart initiatives should depend upon the integration of technological components with managerial, political and contextual dimensions of the city (Nam and Pardo 2011). ICT should be merged, integrated and used to coordinate traditional infrastructures and services, easing the comprehension and analysis of urban complexity. At the same time, technologies should allow innovative forms of communication, governance and organization for the community engagement in evaluating and solving urban key problems (Batty *et al.* 2012). These dimensions can be further defined by a comprehensive set of factors (Chourabi *et al.* ibidem). In the study eight factors have been considered fundamental for shaping smart city strategies: management, technology, governance, policy, community, economy, physic infrastructure and natural environment. This set of components can be related to the requirements for collaboration, networking and coordinate interaction, as argued by Adam (1996) with regards to e-governance initiatives success factors. A similar classification of elements has been provided also by a study conducted on smart initiatives worldwide (Lindskog 2005), wherein synergy among components has been identified as the main success key factor.

Among the several factors, governance, policy and community, enclosed in the political dimension, could perform an important and central role for a 'smart' development. Several stakeholders are involved in the implementation of smart city strategies, and a deep exchange of information and tight relationships are required to avoid the failure of projects (Scholl *et al.* 2009). Policies establish laws and regulations and accordingly can supply the enabling conditions for integration of technology in urban development (Dawes and Pardo 2002). People and communities address a critical role in the development of smart cities, due to the fact that strategies directly affect the quality of citizens life. Furthermore, citizens and local communities supply a central role, with their needs and opinions, in the interests of smart cities for participation and transparency during the development of process.

Hence, the opportunities of SMGI for supplying a depiction of opinions, needs and perceptions of local communities real-time could represent a valuable source of information. Actually, scarcity of reliable and user-friendly methods for knowledge extraction from SMGI could prevent to exploit the full potential from these sources. In order to contribute to this challenge, a novel approach is proposed below for the Spatial

Multimedia Analytics (SMA) of SMGI. The method has been applied to a case study example using a tool called Spatext, that features several functionalities to analyze SMGI in GIS environment.

4 A NOVEL APPROACH TO SMGI ANALYTICS

Considerations on the widespread diffusion of SMGI over the global Internet, and the requirements of smart cities, lead toward the investigation of opportunities that SMGI may disclose in urban and regional planning. The investigation aims to demonstrate the opportunities of SMGI as support for design, analysis and decision making in planning, and the consequent value to inform smart city initiatives. The novel approach builds on the use of an ad-hoc instrument called Spatext for coupling the extraction, the management and the analysis of SMGI in GIS environment.

4.1 THE SPATEXT TOOL

The Spatext STTx suite is implemented as add-in for ESRI ArcGIS©. It includes ten tools, which can be used to achieve three main goals for analysis: (1) social media data retrieval from Twitter and YouTube, (2) data geocoding, and (3) tag clouding of textual content. These supplied features rely on four open Python modules, namely *tweetersearch* and *YouTubeExtractor* for data harvesting, *geopy* for the geocoding, and *pytagcloud* for the tag clouding, and ad-hoc scripts. The coupling of Spatext functionalities with standard GIS spatial analysis tools can ease the integration of SMGI with authorative data, for analysis, design and support of decision-making in urban and regional planning. In the remainder of the paper, the application of Spatext is briefly described with relevance to an original approach for the analysis of YouTube contents in GIS environment.

4.2 METHODOLOGY AND CASE STUDY

The approach builds on a preliminary exploratory analysis of YouTube contents of Sardinia (Italy) searching for most used and shared topics among user videos, without imposing any research filter. The analysis has been conducted by means of textual analysis in form of tag cloud and spatial analysis through GIS tools, on the textual contents embedded in videos metadata. The aim of the textual analysis is to identify words, which can be considered directly related to toponyms, activities or feelings, for depicting users perception of Sardinia and for allowing further analysis on detected topics.

The second step of the approach focuses on the analysis of a specific topic with relevance for urban and regional planning of Sardinia, namely: 'landscape', investigating potential meaningful spatial patterns by means of a textual analysis on harvested contents, and the integration of videos dataset with authorative geographic information. Indeed, the integration of A-GI with SMGI provided by users and local communities could disclose useful patterns and information both for design and decision-making.

The last step of the approach has been based on the analysis of datasets extracted from YouTube for several neighborhoods in the municipality of Cagliari (Sardinia, Italy) and the urban park of 'Molentargius'. The goal of the analysis is the investigation of perceptions and opinions of users on the neighborhoods and the park area, in the light of the topics emerging by the textual analysis of videos contents. All together these analysis are able to cover different scales of spatial planning.

In the next sections, the results of data retrieval, preliminary exploration, and spatial and textual analysis for the different steps of the approach are proposed. The results aim to demonstrate both the capabilities of the methodology for analysis at different scales and the opportunities for SMGI use in spatial planning.

4.3 DATA RETRIEVAL AND EXPLORATORY ANALYSIS AT THE REGIONAL SCALE

In Spatext the retrieval of contents from YouTube is performed by the *YouTube Extractor* tool, which allows the collection of data by a keyword search within a given radius around a specific location. Initially, for the purposes of the exploratory investigation, the dataset has been collected by setting the geographic area of extraction for the whole Sardinia, while no keyword has been set to avoid any constraint in the data extraction. The data retrieval allowed the extraction of the most relevant 3507 videos for Sardinia from YouTube and the automatic generation of a point feature dataset, based on the location attribute stored in the video metadata. The resulting dataset includes attributes providing information on title, author, description, data of publication and URL link, offering opportunities for the development of further analysis in combination with other spatial data layers.

The exploratory analysis of the dataset has been conducted through both the observation of spatial distribution of videos in Sardinia and the tag cloud analysis of textual contents. The dataset exposed an uniform spatial distribution over the Sardinian territory, so fostering opportunities for a general comprehension of user contents and trends at the regional scale.

A textual analysis was also conducted on the title and on the description of videos to discover the most frequent words in the dataset. The tag-cloud is the visualization of word frequency in a weighted list and graphical form, and it is suitable to depict the topicalities of a text and to recognize possible underlying information. The textual analysis searched the 200 most used words both on the titles and on the descriptions to investigate potential dissimilarities in contents and to improve the understanding of detected words. The resulting tag cloud shows different words for the considered textual contents, but a semantic analysis leads toward the identification of an underlying set of common categories.

Hence, the words have been classified accordingly. Several words can be considered as 'noise' caused by different languages and sentence structures, however, most of the words belongs to four main categories: (1) toponyms/places, (2) activities, (3) values, (4) links/URL. In the first category the words referring to specific toponyms (city name) or physical places (urban location) are considered, while in the second category the words related to events or objects are grouped. The third category encloses the words related to adjectives used for personal evaluation of places and events, and in last category the words relative to external links, persons, blog or URL are enclosed.

The 5 most used words for each category are provided in the next figures and tables, respectively for text of titles (fig. 1, tab. 1) and descriptions (fig. 2, tab. 2).

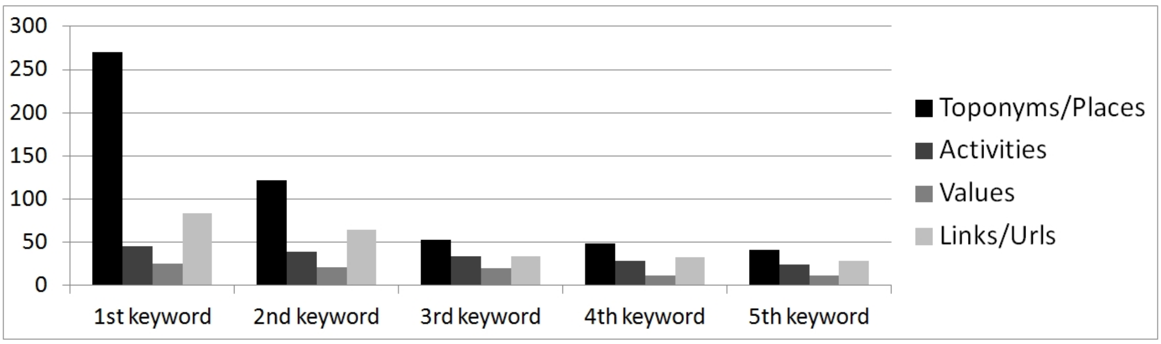

Fig. 1 Top 5 words for category in Title

CATEGORY	WORDS [frequency]
Toponyms/Places	Sardegna [270], Sardinia [122], Cagliari [53], Nuoro [49], Porto [41]
Activities	Eventi [45], Festa [39], Ballu* [34], Carnevale [29], Rally [24]
Values	Folk [25], Official [21], Verde [20], Italian [12], Lost [12]
Links/URL	By [84], Of [65], On [34], To [33], wmv [28]

Tab. 1 Top 5 words for category in Title. (*) Word expressed in Sardinian language

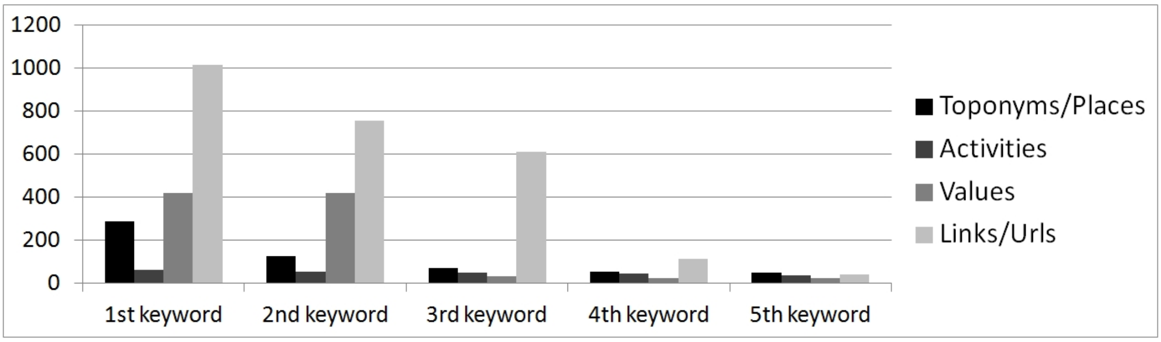

Fig. 2 Top 5 words for category in Description

CATEGORY	WORDS [frequency]
Toponyms/Places	Sardegna [290], Sardinia [126], Cagliari [72], Nuoro [54], Italy [49]
Activities	Music [65], Chitarra [55], Festa [51], Concerto [45], Musica [39]
Values	Updated [422], Published [422], Sito [33], Beatiful [26], Great [23]
Links/URL	http [1015], Youtube [756], www [612], Facebook [114], https [42]

Tab. 2 Top 5 words for category in Description

The exploratory analysis identifies several words that are used in the textual description of videos for each category. The results explain the different typologies, purposes and trends of videos related to Sardinian territory. On the one hand, several videos can be considered untied from physical places and exclusively related to daily routines of users. On the other hand, several videos can be considered strictly related to perceptions of users on events and physical places of the territory, introducing opportunities for further analysis support.

4.4 IN SEARCH FOR 'LANDSCAPE' AT THE REGIONAL SCALE

The second step of the approach focuses on the spatial and textual analysis of YouTube contents related to a specific topic of interest within a specific geographic area. For the purpose of this analysis the words *landscape* and the Italian translation '*paesaggio'* have been set as keywords for the extraction of videos in the Sardinian territory. The keyword has been set both in English and Italian to avoid eventual lacks of useful contents because of the language constraint. The resulting dataset contains 180 entries and allows the investigation of locations, activities and values, which can be considered tightly related to the topic according to user opinions. The investigation of the contents has been performed by means of tag cloud analysis and the words have been classified according to the 4 categories. Moreover, spatial analysis were carried on to evaluate the spatial distribution of videos. The first analysis aims to investigate potential underlying spatial patterns or relationships between the spatial distribution of on *landscape* and the different land uses expressed by the CORINE land cover. The second analysis was performed to evaluate the

percentage of videos occurring in the coastal area as defined by Regional Landscape Plan of Sardinia, firstly adopted in 2006. The goal of this analysis is the evaluation of where the thought 'landscape' of users is located in space.
The 10 most used words for each category are shown in figure (fig.3) and table (tab.3).

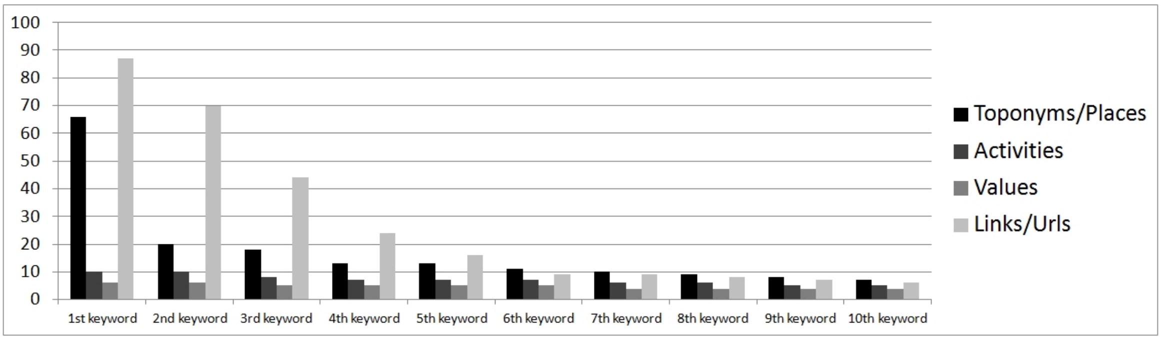

Fig. 3 Top 10 words related to 'Landscape'

CATEGORY	WORDS [frequency]
Toponyms/Places	Sardegna [66], Terra [20], Hotel [18], Nuoro [13], Cagliari [13], Italy [11], Mare [10], Cabras [9], Parco [8], Cala [7]
Activities	Musica [10], Marcia [10], Foto [8], Servizio [7], Idee [7], Progetto [7], Pittura [6], Ecocampus [6], Festival [5], Valorizzazione [5]
Values	Dedicata [6], Realizzato [6], Bella [5], Patrimonio [5], Grande [5], Panoramica [5], Interno [4], Animato [4], Verde [4], Eolico [4]
Links/URL	http [87], youtube [70], www [44], google [24], mp4 [16], on [9], by [9], for [8], to [7], wmv [6]

Tab. 3 Top 10 words related to 'Landscape'

Results of tag cloud analysis show similarities with the exploratory analysis outcomes in the distribution of terms among the different categories. The words related to toponyms/places and links/URL exhibit high frequency, while the activities category exposes a constant trend.
Results of the analysis on spatial distribution of videos with regards to the CORINE land cover classes display interesting results. The videos percentage for land class shows how 50% of videos falls in artificial surfaces areas (urban territory), but this value can be easily explained by two main reasons. The first reason, it is YouTube service allows users to upload personal contents either in real-time or not, causing anomalies in geographic location that can be consequently shifted from the location of video to the location of user during upload. In this case, the location usually refers to the hardware platform in the urban territory. The second reason concerns the development of several events related to the landscape in the urban territory, with massive participation of users. Several questions could arise for the 15.56% of videos occurring in agricultural areas, but a large scale spatial analysis explained the inclusion of artificial grassland in this land use class, and also the proximity of these areas with the urban centers. The percentage of videos in forest and semi-natural areas, wetlands and water bodies can be explained considering the tight relationships between these areas and the term landscape.
The analysis on the distribution of videos in coastal area shows the following percentages: 58.33% for internal areas, 37.22% for coastal areas, 4.45% for sea areas. The outcome displays an almost uniform distribution among the categories, but interesting results can be obtained analyzing the spatial distribution

for specific province and separately for each category. On the one hand, the Province of Cagliari provides 41.8% of videos for the coastal area and 6.67% for internal area; and similarly the Province of Olbia-Tempio exhibits 19.4% for coastal area and 4.76% for internal area. On the other hand, the Province of Nuoro supplies 5.97% of videos for coastal area and 36.19% for internal area, while the Province of Oristano provides 22.38% for coastal area and 20.95% for internal area.

These results can be considered significant of a different perception of landscape by users according to different geographic zone. Values for the Province of Cagliari and Olbia-Tempio could depict an high vocation toward the relationship of landscape with coastal area for these zones; in an opposite way the mountain Province of Nuoro could display an high vocation toward the internal zone landscape. The result of the analysis for other Provinces presents an uniform pattern in the distribution of videos. The results of the analysis are provided in figure 4.

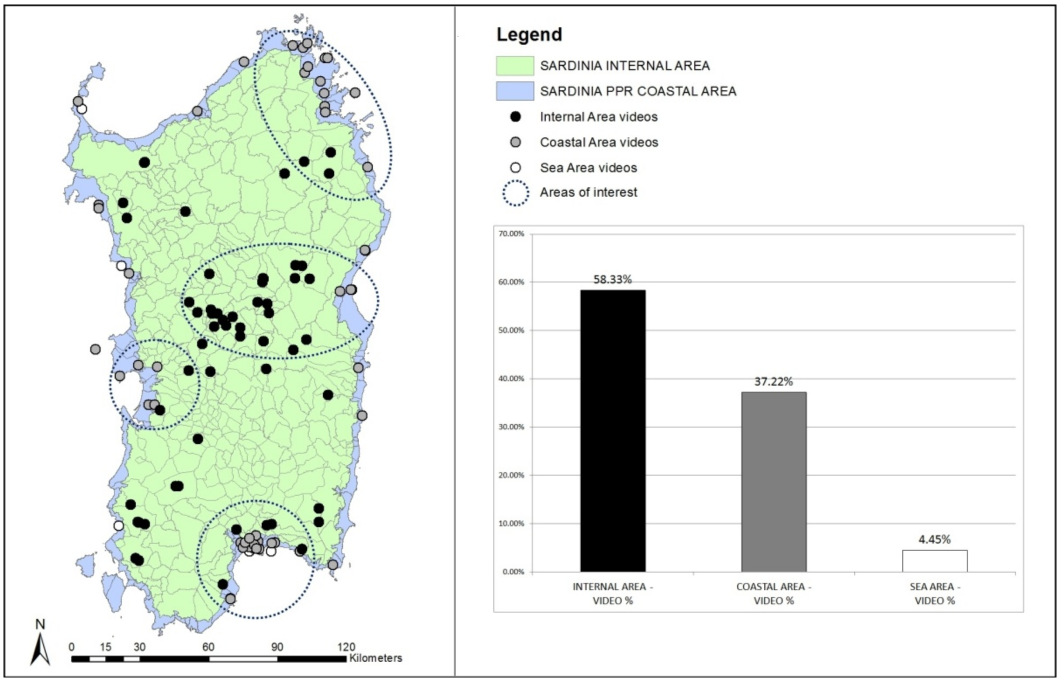

Fig. 4 Spatial distribution of videos for PPR coastal areas

4.5 ANALYSIS ON PERCEPTION OF NEIGHBORHOODS AND PARKS AT THE LOCAL SCALE

The last step of the approach focuses on the spatial and textual analysis of video contents for specific neighborhoods in the municipality of Cagliari (Sardinia, Italy) and for the 'Molentargius' Regional park. The aim of the analysis is the investigation of the differences in perceptions and opinions provided by users for the neighborhoods of 'Castello', 'Marina', 'Is Mirrionis' and the 'Molentargius' park area.

These neighborhoods have been chosen because of their physical, functional and social differences. Castello is the innermost historic central area, Marina is a commercial district that links the historic centre to the harbor of Cagliari, and Is Mirrionis is a community poor-housing area at the edge of the centre, built during the 1960s city sprawl. The Regional Natural Park of Molentargius, instituted in 1999, is a wetland, neighboring heavily populated urban areas. The park provides an ideal habitat for several animal species including flamingo. The most significant words related to places, events and values have been identified by means of tag cloud analysis for each neighborhood and for the park. The results can be useful for take a glimpse of the perception of users, showing information that usually is not provided in land use documents. The results of the textual analysis and spatial analysis are displayed respectively in table 4 and figure 5.

NEIGHBORHOODS	WORDS [frequency]
CASTELLO	Cagliari [48], Metropolitano [10], Sicuro [10], Concerto [6], Marmora [6], Palazzo [5], Regio [5], Storico [4], Cattedrale [2], Bastione [2]
IS MIRRIONIS	Cagliari [40], Torneo [10], Monteclaro [7], Cus [6], Calcio [4], FC [4], Sound [4], Finale [4], Music [3], Parco [2],
MARINA	Cagliari [61], Santa Lucia [13], Concerto [9], Capodanno [6], Festa [6], Sepolcro [5], Musica [5], Festival [4], Porto [4], Chiesa [4]
MOLENTARGIUS NATURAL PARK	Cagliari [62], Quartu Sant'Elena [15], Saline [10], Fenicotteri [8], Parco [8], Poetto [5], Conferenza [5], Servizio [5], Stagno [4], Monte Urpinu [3]

Tab. 4 Most significant words for neighborhood

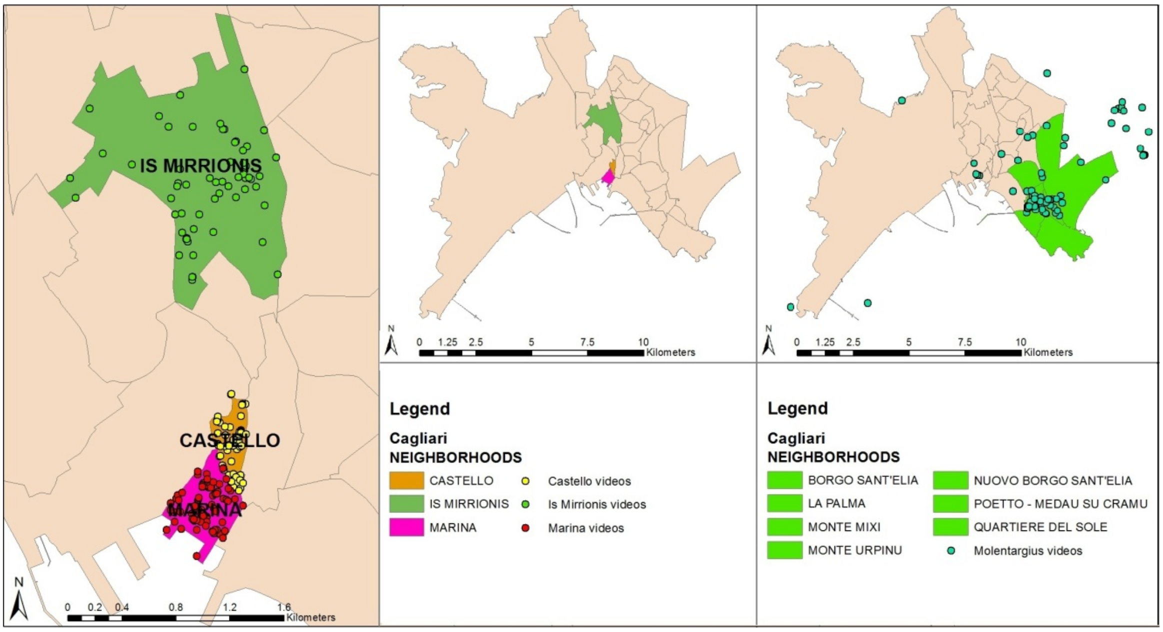

Fig. 5 Spatial distribution of videos for examined neighborhoods of Cagliari

The results define a clear image of the overall perception of users for each considered placemark. Several keywords obtained by tag cloud analysis of title and description of videos depict the main features of the neighborhoods. The words related to Castello concern historical buildings, places, ways and typical events, while for Marina the words are related both to celebrations and specific buildings, such as church and harbor. Results of analysis on Is Mirrionis show a current habit of users to identify the district as supplier of football-related activities, and highlight the presence of the urban park of Monteclaro. In addition, the analysis on Molentargius focuses on the presence of the park, the several features of the place, and the specific toponym of Quartu Sant'Elena, that is another municipality surrounding the park.

The resulting overall opinion of the neighborhoods is particularly interesting because of its similarity with the results of another specific study developed on the same areas. Despite the differences in datasets, SMGI origin, users, and time period, the results of the study conducted through the platform Place, I Care! (PIC) and Cagliari, I Care! (CIC) (Campagna *et al.* 2013) show similar results both in opinion and interest of users for the examined neighborhoods. This phenomenon raises interesting questions on SMGI and on opportunities for analysis, and will be further investigated in future studies.

5 CONCLUSION

In this paper the authors present a novel approach for the advance of Social Media Geographic Information analytics based on the Spatial-Temporal Textual Analysis (STTx) of tweets and youtube posts. The insights obtained through this novel approach offer stimulating challenges towards the development of more specific analysis, concerning people spatial and thematic perception of places. Several analysis are provided to demonstrate how SMGI may be directly used and integrated with traditional authoritative spatial data layers in GIS environment. The results of analysis carried out by coupling SMGI and A-GI from open SDI show the potential in terms of provision of a novel kind of information which may add value to traditional planning knowledge bases so informing decision-making by community pluralism. As a matter of facts, SMGI may disclose opportunities for further analysis scenarios in urban and regional planning, and may offer useful suggestions for smart city strategies. In an integrated planning support framework, SMGI analytics might help to understand user observations, perspectives, interests, feelings, or needs, and possibly affect decision-making dynamics and urban and regional planning processes with customer oriented strategies. Moreover, the SMGI potentialities to generate useful knowledge for urban and regional planning, might foster citizens' dialogue about places and events giving the opportunity of being heard so further facilitating the integration of experiential and pluralist information with professional knowledge.

In conclusion, the knowledge of SMGI if proficiently elicited might be used to support analysis, design and decision-making in urban and regional planning, fostering the public participation in processes about the present and the future of places. Further experiments need to be carried on, and issues to be tested. Nevertheless, current advances in computational social science already demonstrate challenging and stimulating research opportunities which may eventually bring innovation to spatial planning, design and decision-making.

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ZERO EMISSION MOBILITY SYSTEMS IN CITIES

INDUCTIVE RECHARGE SYSTEM PLANNING IN URBAN AREAS

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ABSTRACT

In the last few years, “Sustainable” and “Smart” mobility became concepts of fundamental importance and led national government to adopt programmes and measures aimed at reducing the carbon emissions of private and commercial vehicles. The final goal is to pursue the EU objectives of reducing the greenhouse gases emission in transportation sector. The progressive electrification of the circulating vehicles represents a possible solution to the air pollution relating problems.
A recent innovative research field, which could significantly contribute to the diffusion of the electric vehicles, consists of the inductive recharge systems for electric vehicles. This technology could also bring to considerably environmental and logistic advantages, especially in urban areas. Starting from the analysis of the main ongoing experimentations of these innovative systems in the world, the present paper proposes a possible application of the inductive recharge technology to the public transport vehicles, through the presentation of the case study of Brescia.

KEYWORDS

Inductive recharge systems, electric vehicles, electric ways, Brescia

1 THE INDUCTIVE RECHARGE TECHNOLOGY FOR ELECTRIC VEHICLES

In the last few years, “Sustainable” and “Smart” mobility became concepts of fundamental importance and led national government to adopt programmes and measures aimed at reducing the carbon emissions of private and commercial vehicles. The final goal is to pursue the EU objectives of reducing the greenhouse gases emission in transportation sector. The progressive electrification of the circulating vehicles represents a possible solution to the air pollution relating problems.

A recent innovative research field consists of the inductive recharge systems for electric vehicles. This recharge system has been mainly deployed in small household electric appliances and is based on the electromagnetic induction physical phenomenon, discovered at the beginning of the nineteen century by Faraday. As application to the mobility sector, both private and collective, wireless systems allow to recharge vehicles passing or waiting over an equipped facility (the so called “Electric ways”), without physically plugging into recharging devices.

An Electric way for the recharge of vehicles on the move is composed of a series of segments of different length, able to generate magnetic fields thanks to the presence of coils; and of a device installed aboard the vehicle able to convert magnetic fields into electricity, allowing the batteries to be recharged.

The development of this technology could accelerate the diffusion of electric vehicles, leading to significant environmental and logistic advantages, such as the absence of local carbon gases emission or the possibility to count on higher autonomy levels and shorter batteries recharge times.

However, there are some important aspects to be taken into consideration. First of all, when an electric vehicle circulates outside the electric ways, it cannot be charged, therefore, it just can count on the batteries endurance. Batteries should be accurately dimensioned in relation to the itinerary and to the existing facility. The second aspect is about the fare system to apply: the recharge process takes electricity from the electricity grid. This implies some costs and it is not easy to quantify the amount of energy taken by each single vehicle, as vehicles significantly vary in dimensions, weigh and kind (passenger cars, buses, trams, etc.). A third aspect concerns the efficiency that this system is able to grant: it is not possible to reach a 100% efficiency in electromagnetic induction, as the Joule effect always produces dissipation of energy under the form of heat. As a consequence, the levels of efficiency granted by the recharge system should be deeply evaluated. Other aspects relating to the safety standards of the inductive recharge technology should be taken into consideration in e-mobility: radiations produced by electromagnetic fields generate overheating in the crossed bodies, therefore there are some concerns for the potential effects on the human body and for the interferences with other devices.

2 MAIN APPLICATION OF INDUCTIVE RECHARGE SYSTEMS IN THE WORLD

In the last five years, different research groups started experimentation of the inductive recharge systems for electric vehicles all over the world, pushed by the necessity of going beyond the traditional charging systems and of increasing the vehicles autonomy and by a growing interest toward the development of innovative sustainable vehicles.

At the moment some of the most significant experimentation projects in the field of the inductive recharging system for vehicles on the move are the following:

- OLEV project, carried on by the KAIST Group in South Korea;
- Primove system, carried on by the Bombardier Transportation Group in Canada;
- Hevo Power project, carried on by the Hevo Group in the United Stated (New York).

2.1 THE OLEV PROJECT IN SOUTH KOREA

The experimentation of the OLEV technology, carried on by the South Korean Group KAIST (Korea Advanced Institute of Science and Technology[1]) started in 2009 and is based on the innovative technology called SMFIR (Shaped Magnetic Field in Resonance). The main goals of the research are to minimize the batteries size, to reach high levels of autonomy (10 km for buses and 30 km for cars) reducing the distances covered recurring to the batteries alimentation and to cut down the harmful emissions for the environment, aiming at increasing the quality of life in urban areas.
KAIST, according to some recent studies, estimated that if about the 30% of the Seoul road network (where one of the applications is under experimentation) was equipped with electric coils underground, electric vehicles would be able to circulate throughout the city without the need of stopping to recharge them.
SMFIR technology, which allows vehicles to recharge the batteries both in static and dynamic ways, consists of installing the AC power lines directly under the road surface (see figure 1).

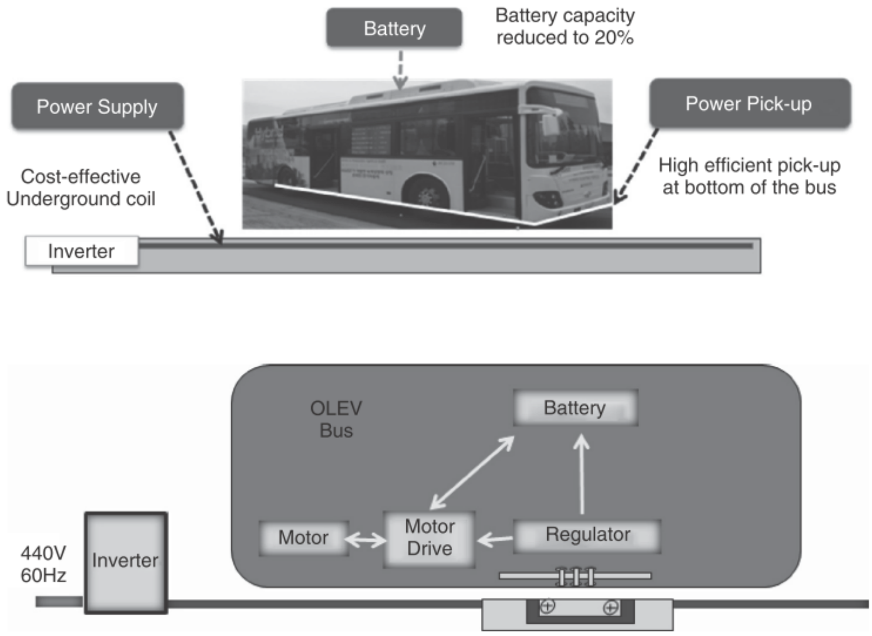

Figure 1 KAIST OLEV bus and the main component scheme

Underground coils generate electromagnetic fields which are then converted into electric power by apposite devices installed aboard the vehicles (Pick-up devices).
The first experimental application of the SMFIR technology started in 2009 at the Seoul Grand Park in Gwacheon City, in the north-western South Korea. The installed system is composed of an electric tram composed by a locomotive and three wagons. The tram circulates wireless along a certain path in the Park, powered by the underground devices.
In order to manage the problem of the radiations generated by the electromagnetic fields in the surrounding space, two kinds of shielding have been implemented: a first shielding system is located underground, a second one aboard the vehicle (called “passive cancel system”). In terms of power transmission efficiency, the KAIST tram reaches the value 74% by keeping a distance of 13 cm between the road surface and the lower surface of the vehicle.

[1] The KAIST Group was founded in 1971 by the Korean Government for researches in the field of science and engineering. The Institute is located in the City of Science of Daejeon, in South Korea.

A second experimentation of the SMFIR system is under experimentation in the city of Gumi, in South Korea. The experimentation started in July 2013 and regards the equipment of two buses running along an urban itinerary. The goal is to evaluate the reliability and the efficiency of the system in urban operational conditions. The line segment under experimentation links the Gumi train central station and the southern part of the city and is 24 km long. The electric ways are 3,5 km long, corresponding to the 15% of the total segment length.

Cables are placed 13 cm under the road surface, while the distance between the road surface and the lower surface of the vehicle is of 17 cm. The two buses receive a power of 100 kW at a frequency of 20 kHz. Along the observed itinerary there are devices able to recognize the two OLEV buses among the circulating buses. When OLEV buses pass over the electric way the involved segment is activated, starting the recharge process. When traditional buses pass over the coils, the system is not activated, limiting the electromagnetic radiations emission and optimizing the energy consumption.

2.2 THE PRIMOVE PROJECT[2]

Primove is a project promoted by Bombardier Transportation Inc.. The Primove technology regards various kind of transport vehicles (trains, trams, buses and cars) and is based on the induction power transfer principles: through the installation, underneath the road surface, of devices which are able to transfer wireless the energy to vehicles and of specific devices aboard the vehicles which are able to receive the electromagnetic radiations. The system is composed by two coils: a first coil generates a magnetic field thanks to the presence of alternating current circulating in it, while a second coil, immersed in the field generated by the first one, absorbs the magnetic energy and convert it into electric energy.

Alongside the dynamic recharge process, Primove is characterized by the presence of devices for the static recharge of vehicles installed at the collective transport stops. The Primove model is based on recharge intervals: at the beginning of the service batteries are totally full; as the vehicle begins to move, batteries start to decrease their charge level until the vehicle reaches a recharge station, where during the stop, batteries are partially recharged in static mode. The battery levels should be constantly monitored along the itinerary and the recharge stations should be accurately placed and dimensioned in order to prevent the complete or an excessive discharge of the batteries.

The presence of double layer capacitor aboard the vehicles allows to regain energy during the braking phase, reducing the energy consumption and costs. The electric power the system is able to provide ranges between 100 and 500 kW, depending on the itinerary length, the number of circulating vehicles and the road longitudinal layout (presence of slopes).

A first application (still ongoing) of the Primove technology was presented in Germany in 2012. The experimentation was made in a test area of the tramway network in Augsburg. The first demo-vehicle was a tram and then the experimentation was extended to electric buses. This application allowed a validation of the wireless energy transfer system. As regards the tram experimentation, the involved line is the n. 3 which links the city to the exposition area. The road segment object of the experimentation was 0,8 km long and was characterized by a 6% maximum slope. The tram, realized ad hoc for this tests, had a variable length ranging between 30 and 42 m and was able to reach a 50 km/h maximum speed.

Another ongoing application of the Primove technology was made in the german city of Braunschweig. The experimentation tested for the first time the installation of a demo-station for the recharge of 2 buses (12 and 18 m long and with a weigh of 13 and 18 tons). Primove buses were introduced on the M19 line in

[2] Sources: www.bombardier.com and www.primove.bombardier.com.

Braunschweig, which is 12 km long and with 26 stops and characterized by an average operational speed of 18 km/h. This line was considered ideal to test the opportunity of charging buses along urban lines.

Since 2010 Bombardier has been participating to another experimental application of the Bombardier technology, in the framework of the project called "Flanders' Drive" in the Belgian city of Lommel. The objective of this project is to test the inductive recharge system in relation to different kind of vehicles and road surfaces (concrete and asphalt).

The experimentation interested two different line segments, respectively 3,6 and 8,1 m long and involved both buses and passenger cars. The system was tested in two different phases: during the first phase, the required facilities were designed and installed along the line, which is characterized by road surface covered with concrete. A traditional bus has been re-designed according to the Primove system requirements, coils were installed underneath the road surface and a first series of test was made. During the second phase, the road surface has been re-covered with a new layer of asphalt and a second series of tests was made, using a passenger car, with the objective of evaluating other vehicles besides buses, characterized by different sizes and masses.

2.3 THE HEVO POWER PROJECT

The Hevo Power project was launched in November 2011 in the city of New York by the Hevo Group in collaboration with the University of New York. The system, which is described at the moment only at theoretical level, consists in the realization of manhole at car parking spaces for the wireless static recharge of the parked vehicles. The project aims at encouraging the diffusion of the electric vehicles, at reducing the transport related costs and the pollutant gas emissions, through the promotion of the energetic independency in the mobility sector.

A first test phase is scheduled for the first semester 2014, when a pilot project will be activated. This pilot activity consists in the realization of 2 manhole in Washington Square Park, in the city of New York.

The Hevo recharge system is based on the "resonance" principle: the 2 coils (a transmitting one is located inside the manhole, while a receiving one is installed aboard the vehicle) resonate at specific frequencies and this feature allows to transfer energy with low dispersions. The Hevo power system is composed by three main components: a wireless recharge manhole, called HPS (*Hevo Power System*), integrated to the road surface and linked to the electricity grid; a receiver installed underneath the vehicle floor and linked to the battery; and a smartphone application, appositely developed by Hevo, which allows the user to access to an interactive map (where the available manhole are displayed) and, once the vehicle is aligned to the manhole, to activate the wireless battery recharge process (the application provide a park assist service to help the user in the alignment phase, which is crucial for a correct recharge). The application is also able to manage the aspects relating to the fares payment: during the recharge phase, the amount of energy taken from the electricity grid is instantly monitored and the user is able to pay for it directly from the application.

3 THE CASE STUDY OF BRESCIA

Taking inspiration from the analysis of the most relevant technologies under experimentation worldwide, the present study envisages a possible application of the inductive recharge technology for electric vehicles in the city of Brescia, a medium sized city (about 200,000 inhabitants) located in the North of Italy.

The city of Brescia seems to be sensitive towards the issues relating to the quality of the urban environment. As a matter of fact, in the recent past, the administration underwent a series of initiatives aimed to the improvement of the urban mobility, through the implementation of measures for the promotion of sustainable transport modes. With the collaboration of the local transport company, a “Green mobility plan” was drafted, with the intention of introducing CNG and hybrid buses[3] in the local transport network.

In this framework, the implementation of the inductive recharge system for electric vehicles could bring significant contribution to the local policies.

Overlooking the mere technological aspect relating the wireless recharge system, the goal of this paper is to plan a possible introduction of the inductive recharge system facilities in the existing road system of Brescia, taking into consideration both the constraints and the peculiarity of the city.

Urban buses have been selected for the wireless technology implementation, as the more “reliable” results derive from the experimentations, already implemented worldwide, which all deal with this kind of vehicle. Alongside this, experimentations on cars are not mature yet and, therefore, do not provide substantial results.

The mobility system of Brescia is mainly composed by 18 urban bus lines, by an automated light metro line (since March 2013) and by a bike sharing service. The existing facilities, from the bus stops to the metro stations, from the bike sharing stations to the underground structures for the municipal heating system, represent a strong constraint, able to hamper the implementation of this technology in the urban space. Even if the existing parking, some bus stops and the presence of dedicated bus lanes could host the required facilities, it is of extreme importance to analyse the local peculiarities and the available spaces before introducing such systems.

The main advantages for the city deriving from the new system implementation are mainly from the environment viewpoint. As already highlighted in the chapter dedicated to the international case studies, the implemented technology is first of all characterized by a good visual impact: as a matter of fact, the most part of the devices is installed underneath the road surface, therefore is invisible. This feature allows to better introduce this technology in the urban environment, especially in the city cores. Another advantage consists in reducing the pollutant gas emissions from local public transport: the progressive replacement of the vehicles using endothermic engines (hybrids or CNG vehicles) with exclusive electric powered vehicles would allow to cut down the greenhouse gases emissions. From the noise viewpoint, electric engines are silent, making the proposed technology suitable for urban areas.

3.1 APPLICATION PROPOSAL FOR AN URBAN BUS LINE IN THE CITY OF BRESCIA

The most suitable system for the city of Brescia seems to be the Primove technology by Bombardier Transportation Inc.: first of all, respect to the SMFIR system or to the OLEV vehicles, the Primove technology has been tested in European cities (such as Lommel in Belgium or Brauschweig in Germany) which can be considered similar to the Italian cities (or, which are more similar to Italian cities than the Asiatic ones); second, the Bombardier solution has been tested with two applications on buses, while the Korean system just with one application. This aspect is important because Bombardier can count on the results and the experience coming from two different contexts in the view of the potential exportation of the system in Brescia. Alongside this, in the near future, the Primove technology is going to be implemented also on trains and metros, unlike the other two technologies.

The selection of an urban bus line going through the city core (instead of a suburban line) has been a pondered choice, as it was important to find out a location able to completely exploit the advantages offered

[3] The use of CNG buses allows to reduce the pollutant gas emissions by 10%, respect to an equivalent vehicle powered by a traditional endothermic engine and significantly reduces the emission of CO_2, CO, NO_x, HC and PM_{10}. Finally, CNG powered vehicles reduce the fuel costs, the noise emissions and the vibrations aboard.

by the proposed system. Respect to peripheral areas, in city cores it is possible to find the most binding situations for the installation of the required facilities (dense residential and commercial areas, historic buildings, monuments, pedestrian areas), but is the ideal context where the electric mobility and the inductive recharge systems are able to offer the most relevant advantages: for example, the good visual and environmental impacts highlighted in the international case studies, as described in the previous paragraphs, could significantly contribute to the improvement of the quality of life in city cores. Within the Limited Traffic Zones, where shops, bars and vulnerable road users are present, such as Piazza della Loggia or Piazza del Duomo in Brescia, the circulation of silent sustainable electric vehicles would have a better impact in city centres respect to peripheral areas, where, in terms of pollutant gas emissions, the impact of Local Public Transport is less significant compared with the individual means of transport.

The proposed system for Brescia takes inspiration from the applications experienced so far in Europe and Worldwide.

For the static mode recharge process, the idea is to equip some of the existing bus stops by installing the required wireless devices, while, for the dynamic mode recharge process, it is necessary to identify a road segment along the itinerary which can be considered suitable for the electric way installation and for the experimentation purposes.

It is quite easy to adapt existing bus stops to the new technology and the system offers a good level of intermodality: the Primove system facilities at bus stops can be exploited not only by urban buses, but also by other electric vehicles, such as commercial vehicles for the last-mile freigth distribution in central areas or taxis and private passenger cars properly equiped with devices able to receive the batteries inductive recharge.

The Local Public Transport lines which could be selected for the experimentation purpose are the n. 15 (Noce-Montini), n. 17 (Castel Mella-Ospedale) and n. 18 (Castellini-P.le Beccaria), as they all go through the city core. Among them, the line n. 18 is considered ideal, as the 75% of its itinerary is located in the Brescia core.

Figure 2 Piazzale Beccaria in via Volturno a Brescia, partenza della linea 18 del servizio TPL

The northern terminus is located at the Piazzale Beccaria, located in Via Volturno, while the other terminus is located in Via Castellini. Piazzale Beccaria, which is close to the city core, is characterized by the presence of a large parking, where it is possible to dedicate part of the area to the installation of the facilities for the inductive recharge of the vehicles. The idea to separate the different parking users derives from the necessity to avoid interferences and dangerous situations relating to the exposition to radiations.

Line n. 18 is characterized by a fleet of 12 buses covering the 65 rides. The service starts every day at 7:28 and finishes at 20:03 and the time spent to make a complete tour of the line (go and back) is about 54 minutes.

As in the case of the German city of Brauschweig, Solaris Urbino buses, produced by the Polish company Solaris Bus & Coach are going to be considered for the application proposal. The above mentioned bus model is 8,9 m long, therefore it is ideal for the narrow road sections and the small curve radius of the Brescia city core.

According to the findings published by Bombardier, on average, the time required for the complete recharge of the batteries in static mode at the depot is of about 10 minutes. In order to grant the autonomy of the vehicles along the line n. 18 itinerary, which is 9,3 km long, it should be enough to place two intermediate recharge points[4]. In addition to the recharge stations, it is proposed to realize an electric way for the dynamic wireless recharge of the vehicles, as auxiliary source of energy during the only sloping road segment along the line.

The two recharge station would be placed at two intermediate bus stops along the itinerary. The selection of the bus stops to be equipped should be made with the objective to grant the buses autonomy for the whole service duration: the selected stops should be neither too close each other (in order to avoid idle recharges, i.e. when batteries are still full), nor too far each other, in order to prevent the premature batteries discharge (see Figure 3).

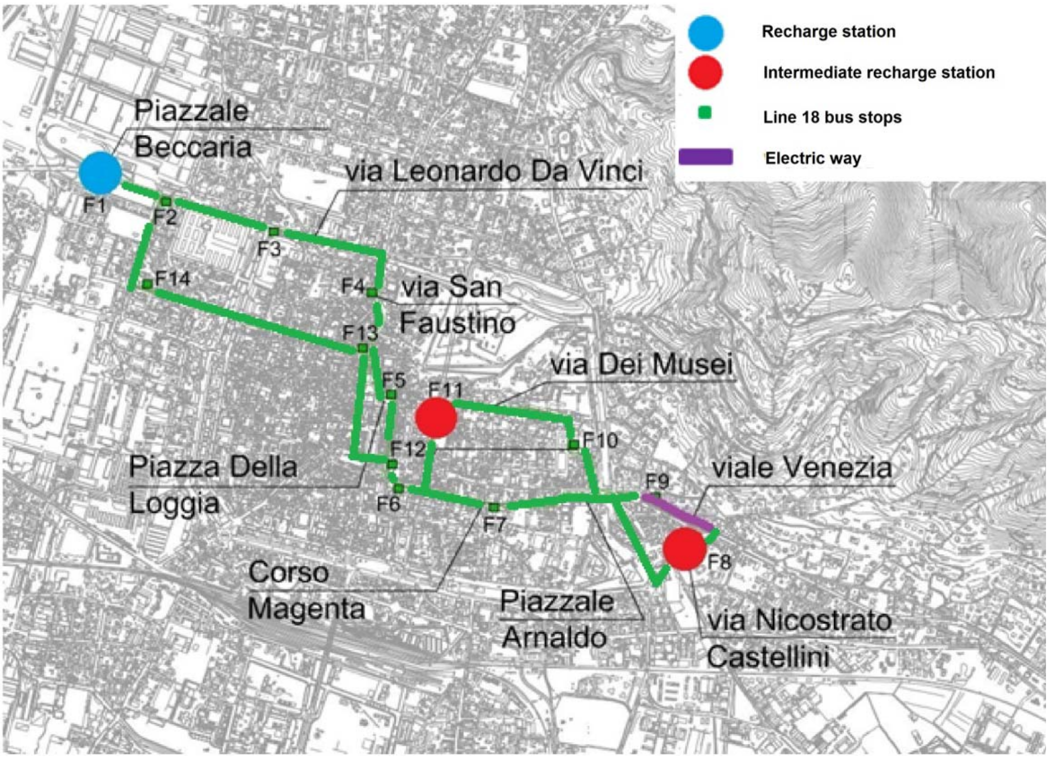

Figure 3 Localization of the recharge stations in static mode (intermediate stations) an in dynamic mode (electric way) for the line n. 18 according to the application proposal of the Primove system in Brescia

[4] In the case study of Brauschweig (Germany), where Bombardier tested a wireless recharge system for busses, the bus line was 12 km long and with 26 stops. In that case two recharge station were enough to cover the whole length. According to the Bombardier findings, theoretically just one station was enough, but a second one was introduced as precautionary measure in case of emergency.

A further constraint in the selection of the most suitable bus station along the itinerary is represented by the necessity of granting as much as possible low interferences (in terms of electromagnetic radiations) with the other road users, especially the vulnerable ones.

According to these considerations, the first recharge stations is located at the F8 stop at the Castellini parking, which is also the line terminus. The second recharge station has been placed at the F11 stop in Via Martiri di Belfiore, sufficiently far from the first, along a road which is characterized by two lanes per direction and there where the platform allows the simultaneous stop of two buses. This last feature mainly generates two positive effects: on the one hand, if the recharge duration lasted more than the scheduled, traffic would not be hampered; on the other hand, a part of the platform could be dedicated to the inductive recharge of buses.

The two intermediate stations just allow a partial recharge of the bus batteries, therefore, in order to prevent delays and long waiting times, stops could last 30 seconds, corresponding to the time required for the batteries to recharge and for the passengers to get on/off the vehicles.

As regards the installation of the electric way, the selected road segment is located in Viale Venezia. This choice was made mainly for two reasons. First of all, the segment is located outside the city core, where there's more available space for an easy installation of the necessary facilities. The second reason is related to the line layout: the main function of an electric way is to assist the electric vehicle during the most critical phases of the motion, as for example during the acceleration phase or along a road with an upward slope. In these circumstances, buses requires a stronger traction effort, which corresponds to higher energetic requirements for the electric vehicles.

Along line n. 18 there are some road segments with an upward slope (like the one in Viale Venezia) and other segments with a downward one (like for example in Via Mazzini). The ideal solution is to place the electric way (which is 200 m long) at the road segment characterized by an upward slope, which represents the most critical operational condition from the energetic consumption viewpoint. Its position does not generate particular interferences with the presence of pedestrian or cyclists, due to the geometric and functional features of the road.

The trend of the batteries charge level along the itinerary should be analysed, taking into consideration the most adverse operational conditions, including the meteoric conditions or the accidental temporary malfunctioning of the recharge stations, in order to assure the energy autonomy for the whole service duration. Figure n. 4 shows the qualitative trend of the batteries charge levels along the line: the distance covered by the vehicle along the line is displayed along the x-axis and it is put into relation with the batteries charge level (displayed as percentage in the y-axis). The green segments represents the recharge phase of batteries (which corresponds to the presence of recharge stations or electric ways).

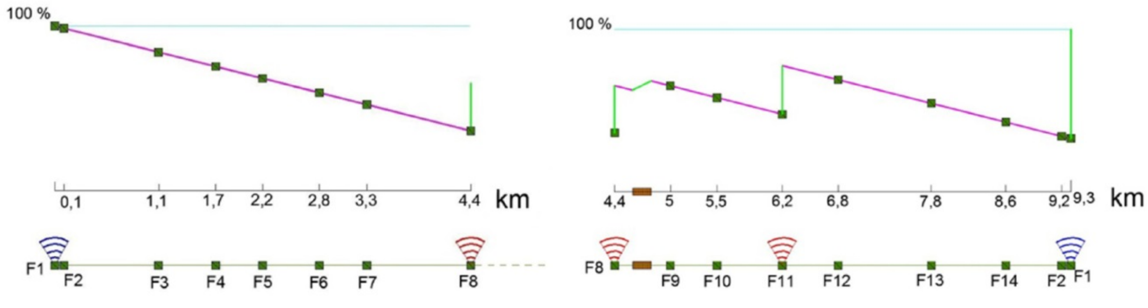

Figure 4. Qualitative trend of the batteries recharge phase along the bus line n.18 (go and back)

4 CONCLUSIONS AND POSSIBLE DEVELOPMENTS OF THE RESEARCH

The inductive technology for the recharge of the electric vehicles represents a great opportunity in the view of the improvement of the life quality in urban areas.

The observed international case studies pushed to new researches and experimentations which will led to optimistic results in this field.

Aiming at promoting and spreading this technology, it is fundamental to get the final results of the ongoing experimentations, so that consolidated best practices will be available for the formulation of new application proposals. For example, the system management costs and reliability or the vehicles maintenance/broken down frequency are aspects to be better assessed once the experimentations are finished, in order to establish the actual potentialities and the prospects of such systems.

The analysis of the case studies and the formulation of the application proposal for Brescia showed that it is fundamental to match the necessity to promote these technologies and, at the same time, to adopt policies for the diffusion of intelligent mobility forms and for the transport system improvement.

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Fig. 1: www.kaist.edu;

Figs. 2, 3 and 4: self-elaboration.

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URBAN LABELLING:

RESILIENCE AND VULNERABILITY AS KEY CONCEPTS FOR A SUSTAINABLE PLANNING

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ABSTRACT

Planning and implementation of sustainable urban neighborhoods has led in Europe and in other countries to the development of some recognized best practices. Each of these cases has followed specific aims and methodologies but it is still far the systematization of the results and the translation of the good practices into action lines.

The paper involves the necessity of new tools for local planning directed to the overall sustainability of the city. Sustainable energy, reduction of the climate-change causes, waste reduction, attention to water resources and to the natural ones are specific operational elements. A possible way to face this challenge is to consider the potentialities of executive plans addressed to increase the sustainability of urban areas starting from limited portions of they. These plans should foresee the minimum impact of volumes and functions to be set up, will provide for the realization of public spaces with zero or almost zero impact, will promote the integration of all the technologies to reduce consumption and encourage energy generation, in order to increase the resilience of the city reducing its vulnerability.

On this basis, aim of the paper is to deepen the issue of the measure of the expected results. To this purpose it is necessary to structure a new certification system (Urban Labelling) that can be able to assign a specific sustainability level to a plan using both traditional and new indexes. The same system can also be applied to existing urban areas and as a basis for evaluating reward operations. The impact of the new tool will be cultural (to switch by a description to the facts in relation to urban sustainability), economic (to involve the supply chain from design, implementation, and urban transformation) and technological (the sustainability of urban areas requires the use of advanced technologies not only for the buildings but also in the control of green areas, public spaces and mobility).

KEYWORDS

Urban labelling, Sustainability, Resilience, Vulnerability, Action plans

1 INTRODUCTION

The paper involves the necessity of new action planning tools directed to the overall sustainability of the city. Alternative energies, lowering of the climate-change causes, waste reduction, attention to natural resources are specific operative elements of this type of new planning. The push towards this change of paradigm derives from the assumption that any serious attempt must be tempted to shift from "fossil planning" to "sustainable planning", also if this shift demands greater global efforts.

It is possible to consider a variety of opportunities to reduce the anthropic impact on the environment. New technologies for the production and the use of energy, but also the awareness of new behaviours and the construction of new regulative perspectives are the factors for acting on urban planning, on building project, on urban design and on a more sustainable mobility. «The new framework demands a renovated mission and a new tool-kit for urban planning focusing on increasingly complex and urgent issues» (Moccia 2013, 12). In this way there is a change of attitude, from a defensive to an attack position.

One of the possible ways is to deepen the potentialities of an evolution of the local plan, a sustainable action plan (SAP), extended to limited sections of urban areas and directed to their sustainability. The SAP will foresee the minimum impact of volumes and functions to be set up, will provide for the realization of public spaces with zero or almost zero impact, will promote the integration of the technologies that reduce consumption and encourage energy generation.

Starting from SAP, the paper want to deepen the possibility to measure expected and real results through the formulation of a new system of certification tool, the Urban Labelling. In addition for the action plans, the same assessment will be applied to existing and/or new construction/conversion of urban areas. Another potential use of the Urban Labelling is its application to reward's actions that are in need of assessments.

In Europe and around the world the realization of sustainable urban neighbourhoods has led to the creation of some recognized best practices. Each of these projects has followed specific aims and methodologies. The step forward is the systematization of the results and the translation of the good practices into action lines.

In relation to urban sustainability the expected impact of the combination among SAP and Urban Labelling will be cultural (to switch from the analyses to the facts), economic (to involve the supply chain formed by design, implementation and urban transformation) and technological (the sustainability of urban areas requires the use of innovations and advanced technologies not only for the buildings but also for the control of green areas, public spaces and mobility). In other word a concrete possibility to implement a real intelligent city in place of the ordinary current city (Mazzeo 2013).

2 PRELIMINARY QUESTIONS

The need to address the consequences of the phenomena of unsustainability, for example the global warming, is internationally recognized as one of the priorities of development's policies in the medium/long term. Similarly, it is recognized the negative impact of urban and metropolitan areas on the evolution of these phenomena (Rosensweig and Solecki 2001; EEA 2012).

The reason of the considerable negative influence of the cities on the environment derives from its being in every country the main economic hearth, a place where the exchanges reach their maximum degree of force. For this reason the city shows a concentrations of interests that have one of their main outcomes in the intensive consumption of resources.

Two are the preliminary matter to emphasize:

1. in theoretical terms there is now a global awareness on the assertion that the urban phenomenon has reached a global importance and, for this reason, it is necessary to face it. Indeed, however, in many

countries are in place great speed and impact's actions on urban expansion without attention to the environmental issues that seem to be secondary. This is true, in particular, in the countries with emerging economies and with high rates of development;

2. the cities are not equal among themselves also because they show notable differences in terms of satisfaction of the citizens' primary rights. This means that they must often recover historical delays, and for this reason they are forced to allocate significant resources on the implementation of basic services rather than on the deployment of environmental policies. The historical delays of the cities of Southern Italy in relation to the Central and Northern Italy get a plastic confirmation of this statement.

From these two matters could derive a robust skepticism on the real application of environmentally sustainable policies to the city. Despite this temptation is strong, it is necessary to face with the problems resulting from ecological changes: to adapt the anthropic activities to these changes is increasingly a vital issue.

2 FITTING CITIES AND PLANS

One of the fields in which enforcement and adaptation's actions to the sustainability principles may lead to significant results is the transformation of the urban systems to address the problems arising from the climate changes. The reason lies in the observation that the current city is unsustainable and that its unsustainability will not slow down, given the rates of increase of the world/urban population (UN 2013) (Figure 1). To reverse this trend a primary role can be assumed by an urban planning finally conscious of their duties with respect to environmental issues.

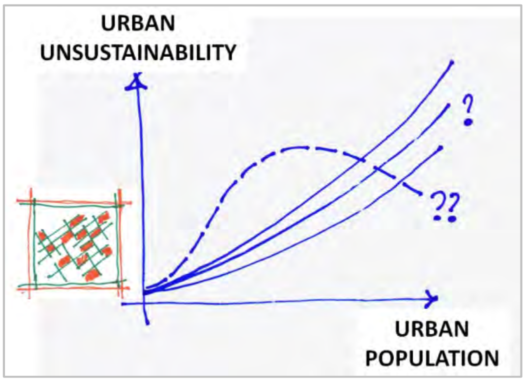


Figure 1 Growing of urban population and unsustainability theoretical trend

In relation to the attitude towards the environment it is to emphasize some distance between the attention to the principles and their actual application to the planning actions. While the first is constantly evolving because exposed to research's results, the second seems to settle on bureaucratized procedures and methodologies, with some liveliness found only at the level of territorial strategic assessment (Di Ludovico 2011). The result is a lack of effectiveness of the assessments which seem pay more attention to procedural requirements instead the concreteness of the solutions.

It follow that the urban and regional planning has the problem of adapting models and techniques to the reality of an unsustainable trend, in order to formalize new governance tools (Stone 2005).

For this purpose it is necessary to identify the key concepts that should guide the processes towards a really sustainable planning. In this regard the paper proposes to consider that the key concepts of resilience and vulnerability can represent the basis on which to build a new planning model addressed to sustainability and climate adaptation (Fabietti 1999; Medd and Marvin 2005; Tyler and Moench 2012).

Both these key concepts are, at this moment, very fashionable, even though, by their intrinsic nature and by the large number of sectors using them, they are not uniquely defined.

If we consider resilience as a design principle, we can find it as a fundamental part of traditional construction knowledge. Before the 19th century resilience was based, principally, on oversizing of components and on reparability (Schön 1983). In 19th, the deepening of material technology leaded to modern concept of resilience, with formal rules of calculations used to optimize structural safety with a reduced consumption of materials. It is evident that in some situations the two interpretations can be in contradiction (Hassler and Kohler 2014).

The concept's evolution is also reflected in other meanings. In particular, it is possible to recognize the shift from an approach to conserve stability, as in the elastic behaviour of materials, to one that accepts a dynamic system changing over times and involving multiple equilibria and an adaptive change notion.

Over the last 40 years, a number of different branches of knowledge have used and applied the term "resilience". The wide use has transformed the original definition and now there isn't one single definition, to the point that it can defined as a "boundary object" widely used in the studies on complexity.

For example, the disaster management and the sustainability science are two fields in which the notion of resilience have a greater use. The core of the notion is the ability to respond, fit and evolve to different types of pressure, without assuming the return to a static, idealized future.

The concept of resilience is connected with that of "built environment". Initially coined by social scientists (Rapoport 1976), it includes all the elements that constitute the physical, economic, natural, social and cultural capital, at its different scales and with their different times, actors and institutional structures. Another field of analysis are the relations between built and unbuilt part of environment. If we consider the built environment we can say that the speed of transformation is not linear but it could be seen as a succession of slow or rapid changes, as well as a risk may be characterized by a slow or a rapid evolution (Figure 2).

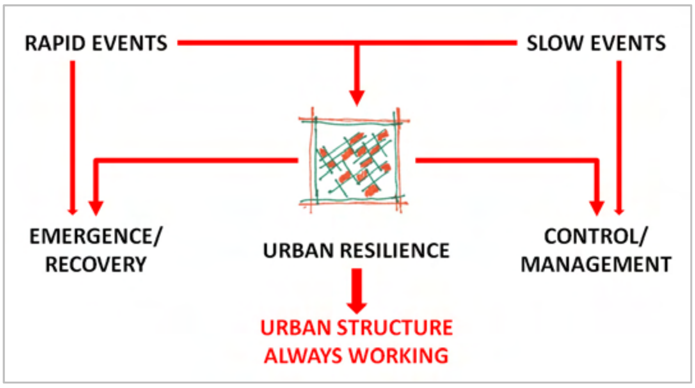


Figure 2 Urban resilience and speed of events

The resilience approach concentrates on these processes with a wide opening. «The fact that resilience has not only developed in different disciplinary fields but also that it is considered as a possible bridge between the implementation of sustainability targets and adaptation to climate change offers a transdisciplinary field of research with high societal importance» (Hassler and Kohler 2014, 120).

Vulnerability refers to the inability to withstand the effects of a hostile environment, as reported in a popular website (Wikipedia). It is possible to say that this inability is related to pre-existing conditions. Their social, economic, physical and environmental conditions can be so weak to have a low resistance when triggers a catastrophic natural (earthquake, flood, landslide, ...) or technical (explosion, fire, spill, ...) event. In a more technical way we can say that «... a disaster is preceded by at least two predispositions: the possibility that the triggering event takes place, usually called a hazard at this potential state; and a pre-existing vulnerability; the pre-disposition of people, processes, infrastructure, services, organizations, or systems to be affected, damaged, or destroyed by the event» (Villagran De Leon 2006).

The basic mathematical expression for risks (R) connects hazards (H) and vulnerability (V), with a function (here pointed with *) that describes the different possible combinations:

$$R = H * V.$$

The simplest formula uses the simple product, as proposed by ISDR (2004). Other functions were prepared by other researcher, involving elements as the coping capacity, the exposure, the deficiency in preparedness, and so on.

Another thing to consider is that vulnerability is a term used with different meanings by different groups, each one with their aims. Research groups are interested in analysing all issues concerning to the term (social, environmental, technical, ...), while disaster reduction and development agencies are interested to simplify the meaning for addressing the attention to the intervention phase. In general, the meaning of vulnerability varies from a particular state of a system before a disaster triggered by an event, to a direct consequence of the exposure to an hazard, or to the possibility that a system have a consequence from an exposure to an external event.

3 URBAN LABELLING AS PROPOSAL

The evolution towards a more risky urban environment can be summarized by few trends: warmer atmosphere, more extreme weather events, increasing of the greenhouses gas concentration, reduction of water quality, high food handling, difficulty to the access to fossil energy sources.

	RESILIENCE	VULNERABILITY
Atmospheric warning	●	○
Climatic events	●	●
Greenhouse gases	○	●
Water pollution	○	●
High handling food	●	○
Energy sources access	●	●

● Direct relationship
○ Indirect relationship

Figure 3 Environmental factors influencing urban resilience and vulnerability

The listed phenomena have an increasing impact on urban systems also if, for their characteristics, they are associated with a "slow" evolutionary process which excludes from the analysis the "speed" phenomena belonging to other types of researches. On the other hand, even on the concept of "slowness" the recent scientific literature has highlighted elements of acceleration, indicating a greater speed of trends compared to previous periods (Loarie *et al.* 2009).

Each of these trends impacts both on urban resilience and on its vulnerability, even if in different manner. Their uncontrolled variation may tend to make the cities more vulnerable reducing their response's capacity.

It is therefore evident the need to affect such trends in order to reduce the urban vulnerability and to increase the urban resilience. Discriminating factor in such processes is the dimension of the urban population. We can assume that urban systems with low or high population can be difficult to control in relation to the levels of resilience an vulnerability. In particular, a strong criticality is to be associated with high population centres, while a weaker criticality is to associate with low population centres, where could occur mostly a problem of slowness in response to events. Consequently it is conceivable the existence of an ideal size of population, such as to ensure an optimal management in case of occurrence of specific risks (Figure 4). This statement is, at this stage, only hypothetical and should be deepened and checked.

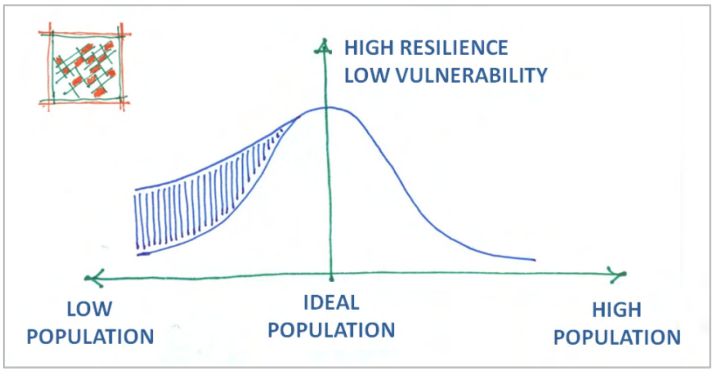


Figure 4 Population as key factor to measure levels of resilience and vulnerability

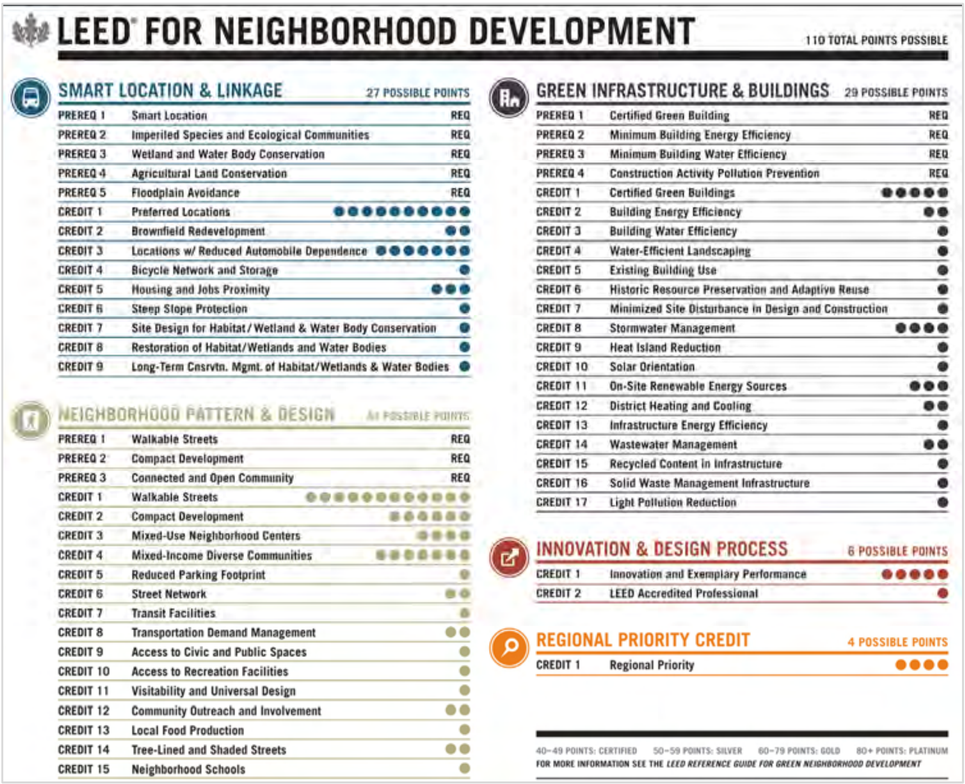
From the aforegoing it is clear the extension of the meanings attributed to the concepts of resilience and vulnerability. Our goal is rather to define the perimeter of their better utilization. It is necessary to understand, in fact, that their inclusion in the planning practice will be effective only when will be possible to translate them into analytical and measurable indicators, like other traditional indexes. In other words, it is necessary that the practice of planning remains anchored to the physical dimension of the territory and that new concepts and ideas are translated into indicators to use in the construction of urban and regional models. It is through numbers and patterns, in fact, that the need to continue to think the city as a physical and manageable structure is realized.

On the other hand, the city can be considered as a changeable space for physical and functional relationships, and the spatial influence of the sustainability development is uncertain. For this it is necessary, above all, to define the appropriate scale in an evaluation, with the awareness that the appropriate boundaries should be adopted case by case, also if the neighbourhood level seem to be the best solution.

In the last years, cities have increasingly recognized their role for sustainability, as shown by several documents as the Charter of European Cities and Town Towards Sustainability (Aalborg, 1994), Leipzig Charter on Sustainable European Cities (2007), Local Governments for Sustainability Preparing for Tomorrow Strategy 2010-2015 (ICLEI, 2010), World Sustainable Capitals, http://www.c40.org/ (2010).

Assessment systems at the neighbourhood and city levels are currently under development for several systems (Cole 2011). Main cases are the LEED for Neighbourhood Development (LEED ND), recently proposed by US Green Building Council, and the Japanese systems CASBEE for Urban Development (CASBEE-UD) in 2006 and CASBEE-City in 2011.

LEED ND starts from the consideration that land use and neighbourhood design patterns create a particular physical reality and force behaviours that have a significant effect on the environmental performance of a place. A neighbourhood planned for the car use, or for pedestrian and for the public transport use have two different consequences on the environment. This is noticeable not only in the more developed countries, because all the world is interested by negative impacts of the urbanized space on the wide spaces.



LEED® FOR NEIGHBORHOOD DEVELOPMENT — 110 TOTAL POINTS POSSIBLE

SMART LOCATION & LINKAGE		27 POSSIBLE POINTS
PREREQ 1	Smart Location	REQ
PREREQ 2	Imperiled Species and Ecological Communities	REQ
PREREQ 3	Wetland and Water Body Conservation	REQ
PREREQ 4	Agricultural Land Conservation	REQ
PREREQ 5	Floodplain Avoidance	REQ
CREDIT 1	Preferred Locations	●●●●●●●●●●
CREDIT 2	Brownfield Redevelopment	●●
CREDIT 3	Locations w/ Reduced Automobile Dependence	●●●●●●●
CREDIT 4	Bicycle Network and Storage	●
CREDIT 5	Housing and Jobs Proximity	●●●
CREDIT 6	Steep Slope Protection	●
CREDIT 7	Site Design for Habitat/Wetland & Water Body Conservation	●
CREDIT 8	Restoration of Habitat/Wetlands and Water Bodies	●
CREDIT 9	Long-Term Cnsrvtn. Mgmt. of Habitat/Wetlands & Water Bodies	●

NEIGHBORHOOD PATTERN & DESIGN		44 POSSIBLE POINTS
PREREQ 1	Walkable Streets	REQ
PREREQ 2	Compact Development	REQ
PREREQ 3	Connected and Open Community	REQ
CREDIT 1	Walkable Streets	●●●●●●●●●●●●
CREDIT 2	Compact Development	●●●●●●
CREDIT 3	Mixed-Use Neighborhood Centers	●●●●
CREDIT 4	Mixed-Income Diverse Communities	●●●●●●●
CREDIT 5	Reduced Parking Footprint	●
CREDIT 6	Street Network	●●
CREDIT 7	Transit Facilities	●
CREDIT 8	Transportation Demand Management	●●
CREDIT 9	Access to Civic and Public Spaces	●
CREDIT 10	Access to Recreation Facilities	●
CREDIT 11	Visitability and Universal Design	●
CREDIT 12	Community Outreach and Involvement	●●
CREDIT 13	Local Food Production	●
CREDIT 14	Tree-Lined and Shaded Streets	●●
CREDIT 15	Neighborhood Schools	●

GREEN INFRASTRUCTURE & BUILDINGS		29 POSSIBLE POINTS
PREREQ 1	Certified Green Building	REQ
PREREQ 2	Minimum Building Energy Efficiency	REQ
PREREQ 3	Minimum Building Water Efficiency	REQ
PREREQ 4	Construction Activity Pollution Prevention	REQ
CREDIT 1	Certified Green Buildings	●●●●●
CREDIT 2	Building Energy Efficiency	●●
CREDIT 3	Building Water Efficiency	●
CREDIT 4	Water-Efficient Landscaping	●
CREDIT 5	Existing Building Use	●
CREDIT 6	Historic Resource Preservation and Adaptive Reuse	●
CREDIT 7	Minimized Site Disturbance in Design and Construction	●
CREDIT 8	Stormwater Management	●●●●
CREDIT 9	Heat Island Reduction	●
CREDIT 10	Solar Orientation	●
CREDIT 11	On-Site Renewable Energy Sources	●●●
CREDIT 12	District Heating and Cooling	●●
CREDIT 13	Infrastructure Energy Efficiency	●
CREDIT 14	Wastewater Management	●●
CREDIT 15	Recycled Content in Infrastructure	●
CREDIT 16	Solid Waste Management Infrastructure	●
CREDIT 17	Light Pollution Reduction	●

INNOVATION & DESIGN PROCESS		6 POSSIBLE POINTS
CREDIT 1	Innovation and Exemplary Performance	●●●●●
CREDIT 2	LEED Accredited Professional	●

REGIONAL PRIORITY CREDIT		4 POSSIBLE POINTS
CREDIT 1	Regional Priority	●●●●

40–49 POINTS: CERTIFIED 50–59 POINTS: SILVER 60–79 POINTS: GOLD 80+ POINTS: PLATINUM

FOR MORE INFORMATION SEE THE *LEED REFERENCE GUIDE FOR GREEN NEIGHBORHOOD DEVELOPMENT*

Figure 5 Showing LEED-ND Criterion, Priorities and Requirements

Figure 6 Northwest Garden, Fort Lauderdale, USA. LEED ND Project V2009, LEED Gold 2012

«Environmentally responsible buildings and infrastructure are an important component of any green neighborhood, further reducing greenhouse gas emissions by decreasing energy consumption. Green buildings and infrastructure also lessen negative consequences for water resources, air quality, and natural resource consumption» (LEED 2013).

The sustainability of a ND is based on the score reached by the single case. LEED 2009 for Neighborhood Development Certification Levels have 100 base points plus 6 possible points for Innovation and Design Process and 4 possible points for Regional Priority Credit. The possible score provides 4 potential level of sustainability: 1. Certified (40-49 points); 2. Silver (50-59 points); 3. Gold (60-79 points); and Platinum (80 points and above). The score derives from 5 categories of indicators:

– Smart Location and Linkage (27 possible points).
– Neighbourhood Pattern and Design (44 possible points).
– Green Infrastructure and Buildings (29 possible points).
– Innovation and Design Process (6 possible points).
– Regional Priority Credit (4 possible points).

The CASBEE City (Comprehensive Assessment System for Built Environment Efficiency) tool is specifically designed for city assessment. It aids local governments and other stakeholders in identifying the environmental, social and economic characteristics of their city and in quantifying the effectiveness of their city-wide policies. CASBEE-City is based on the hypothesis of environmental efficiency and it produces a combined evaluation of a city regarding two aspects: 1) the environmental load imposed by the city on the wider space outside its boundary, and 2) the quality of life (environmental, social, economic) inside the city.
A city with low environmental load and high quality presents a high BEE (Built Environment Efficiency) value and is regarded as a sustainable city within the CASBEE framework (CASBEE 2012).

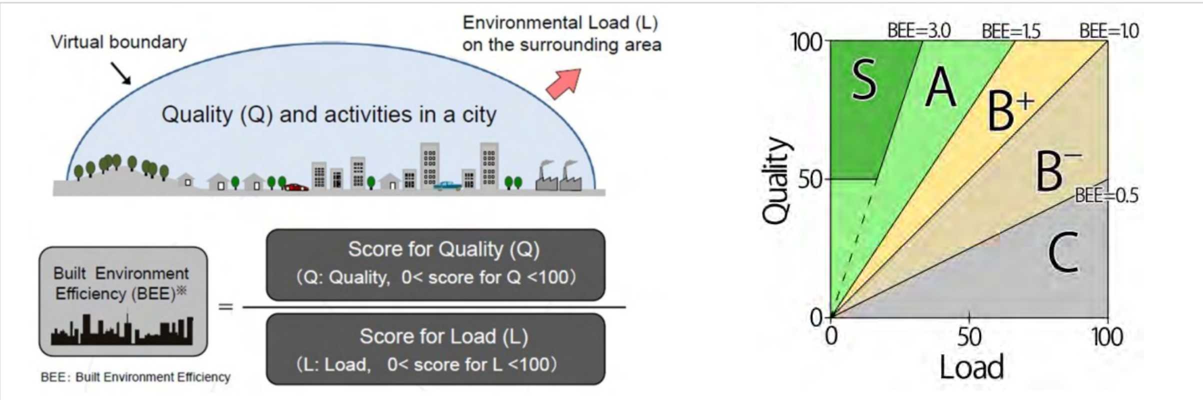


Figure 7 Hypothetical closed space in CASBEE-City and graph of the results of BEE index

The two examples above presented are addressed to the building of environmental assessment systems for urban neighbourhoods, also if they use quite different methods from other more structured environmental assessments (Environmental Impact Assessment, Strategic Environmental Assessment, ...). Inside them, also, there are notable differences.
While LEED analyses a specific neighbourhood certifying the sustainability level on the basis of its physical and technological characteristics, CASBEE builds an index (BEE) that connects urban quality and urban load, extending in this way the analysis of the existing connections among city and around area. Finally, neither of the two tools seems to take into account the previous planning phase and the sustainability of the urban plans.
From these examples should be checked the possibility of building a new tool addressed to sustainability analysis.
Starting from the above mentioned concepts of resilience and vulnerability we propose the formalization of a new tool, called "Urban Labelling". The tool can be applied on two well defined fields: 1. the action urban plans, namely the operative plans, more detailed of the urban plans, and 2. the neighbourhoods, as part of the city and as recognizable sectors of an urban structure. For specific characters, the first is connected with

the governance planning tools, the second with the physical morphology of an urban system (Mazzeo 2014) (Figure 8).

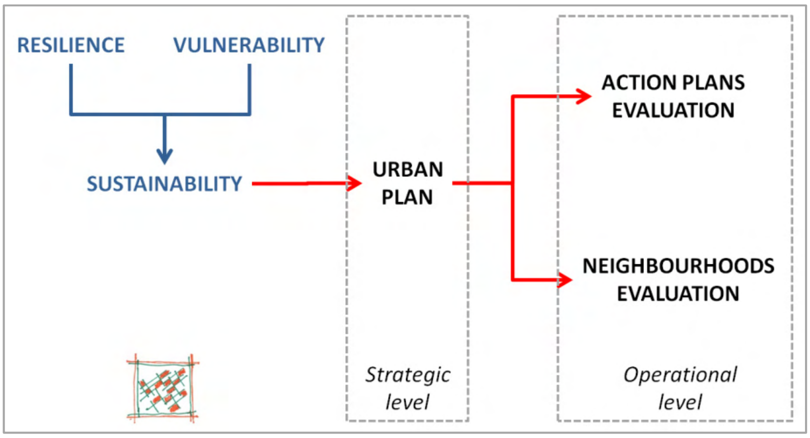


Figure 8 Sustainability as arrangement of vulnerability and resilience

We can define "Urban Labelling" as a formalized procedure for detecting the sustainability level of an urban structure, existing or planned. The environmental certification joins the object to evaluate with a set of values going from the environmental neutrality (Z/NZN – Zero/Near Zero Neighborough) to the highest environmental unsustainability.

The Urban Labelling enriches the traditional planning systems with an evaluation tool having the aim to define the urban sustainability both quantitatively and qualitatively, placing it on a default grading scale. The formalization of it will base, as said, on measurable indexes (formed by numerical data, if possible, but also by qualitative factors objectively handled) from which can derive a clear and shared assessment. This means to measure the sustainability of a plan, on the one hand, and of an urban structure (a built environment), on the other.

The formulation of this rating system derives from the identification of two categories of indexes describing vulnerability and resilience principles gathered in the sustainability concept. The first category applies to the physical and functional aspects, the second applies to the characteristics of use of urban space and on the anthropic behaviour, once achieved or transformed.

The first category encloses indexes formed by volumes, areas, highness, densities and other urban indexes, type of activity, sustainability indexes of buildings, green and permeable surfaces, origin and type of materials, colour, production of energy, recycled water, flexibility of the spaces and their adaptability to change, production of physical and not physical pollutants. Resilience and vulnerability related to spaces and volumes are redefined in measurable terms, with the identification of indicators that measure their capacity to adapt to specific situations and to improve the knowledge and reaction processes.

The second category encloses qualitative indicators related to the use of the urban spaces from citizens and users. They derive from the knowledge on the use of the city, from the process of activities' carrying out and from the time-related changes in behaviour, changes that can be read in terms of persistence or mutation (EEA 2013).

For each of these indicators are to identify minimum and maximum thresholds, using legal, practical or research values (EPA – Malaga City Council, 2012) and characterizing them in relation to the sustainable use of the space.

The two categories of indicators can be used in different ways to make a judgment for the plans and the urban areas. While for the plans it is possible the use only the first set of indicators (physical and functional), for the analysis of urban areas we can use both set of indicators, in order to verify the physical-functional and the behavioural characters (Figure 9).

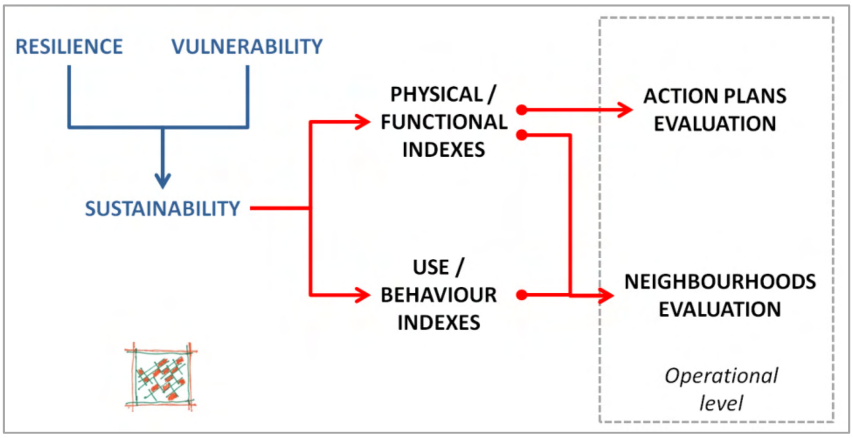


Figure 9 Type of indexes and their influence on the assessment of action plans and neighbourhoods

The characterization by labelling is achieved through a process that involves several steps (Figure 10). Once established the object of analysis (an action plan or an urban neighbourhood) and formalized their main characters, it is possible to determine the list of indicators and splitting them in the two classes (physical/functional or behavioural indexes). For each of these are to define the minimum and maximum variance thresholds, associating them with the quality (high, medium, low and/or other degrees) in terms of sustainability.

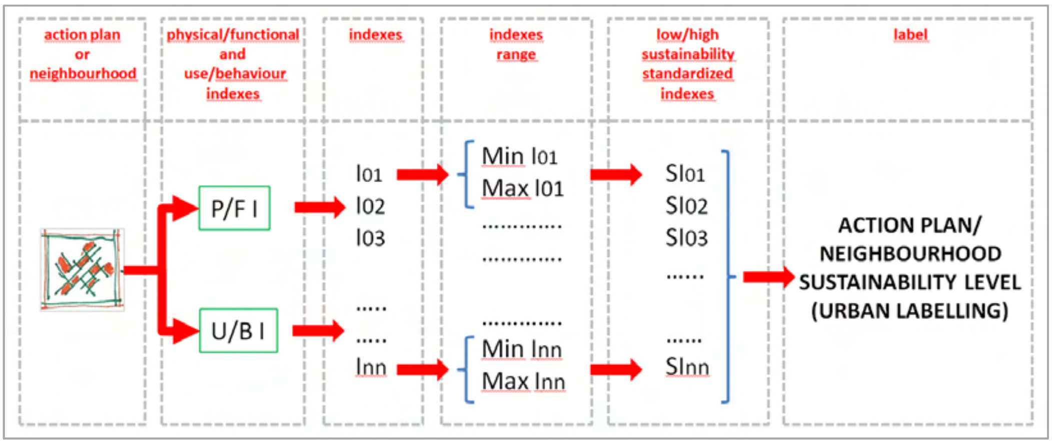


Figure 10 Procedure for the emission of the judgement (urban labelling)

This passage is fundamental for to homogenize the sustainability scale. We consider, for example, two indexes as the volumetric density and the soil sealing: while low densities are associable with low sustainability, low waterproofing is associable with high sustainability. The shift from data (I) to sustainability indexes (SI) may be implemented with the choice of a method of transformation (standardization). At this point we get a homogeneous system of indicators in a default scale for which it is possible to characterize the level of plan's or neighbourhood's sustainability.

In this way we obtain to reach the aim to define a certification system for plans/urban neighbourhoods able to define consumption values for resources and impact values for environmental elements. This certification system must be able also to allocate to each neighbourhood a synthetic index defining its sustainability level, index to extend to the city as a whole. The pursuit of this aim could be favoured by the insertion of the urban labelling inside the procedures of plan making, in contrast to what happens for the current assessment's procedures.

Other great interest's expected result is the spreading resulting from the use of such a methodology, nearly a dissemination effect, especially if it will not be end in itself but it will become the basis for the promotion of incentive policies rewarding the overall sustainability of planning tools and their implementation.

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