for the transition toward resilient communities

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e-agorà/e-ἀγορά for the transition toward resilient communities

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INPUT 2016 is the ninth meeting with the name “INPUT”

A biennial appointment that started in 1999 in Venice at the IUAV.

We had two shifts in the conference, one in date: 2005 (Alghero) was followed by 2008 (Lecco), to avoid overlapping with the CUPUM conference (Computers in Urban Planning and Urban Management); and one in name: the acronym INPUT at the beginning stood for Informatica e Pianificazione Urbana e Territoriale and now it’s Innovazione e Pianificazione Urbana e Territoriale.

I have been one of the organizer of the first meeting and I’m very proud of the results the initial intuition has yielded through the organization of this long series of conferences.

In 9 conferences all across the country (Venezia, Isole Tremiti, Pisa, Alghero, Lecco, Potenza Cagliari, Napoli, and now Torino) hundreds of experts and users had the opportunity to share ideas, experiences, tools and projects; people from academic world (among them: urban planners, architects, engineers, computer scientists, sociologists), public administration, and industry (from small start-ups to big enterprises) have had the opportunity to explore and measure the relevance of the ICT for the new ways to think and practice planning and design.

Now we have to face new challenges and maybe rethink the formula of the conference.

We know we were right because nowadays one of the most common sense and mainstream expression is “smart city” (personally I’m not fond of this expression, but it is a fact that this is an expression widely used); we know we have to change exactly for the same reason: we need to avoid the abuse of that expression that can lead to an overly technocratic approach often imbued with ideology; as usual we need to make use of the best available technologies, but having an idea of the purpose of planning, a shared vision of the future.

For this reason I am wondering if this occasion could be the moment for a step forward: from the birth of an Association, to the organisation of a seminar for young researchers and professionals (one year the biennial conference, the next year the seminar), to the opening of the conference to other disciplines (history, restoration, archaeology, …).

The Torino conference could be the right occasion for this shift of perspective: among its organisers, in addition to the Interuniversity Department of Regional and Urban Studies and Planning of the Politecnico di Torino and Università di Torino (DIST), there are two research institutes: Istituto Superiore on Territorial Systems for Innovation (SiTI) and Istituto Superiore Mario Boella on the Information and Communication Technologies (ISBM); so that research, education, applications and projects are all brought together through the experiences of the organizing institutions: a good viaticum for the future course of INPUT.

Arnaldo Cecchini
INPUT 2016 “e-agorà/e-ἀγορά for the transition toward resilient communities”

It is universally recognised that the Smart City perspective raises a wide spectrum of unexplored and interdependent problems and extends the horizon over which the City growth strategies are defined. Energy generation and consumption models, urban mobility schemes, service processes, goods production mechanisms, citizens’ behaviour and community habits are all aspects radically challenged by this perspective. These are sufficient circumstances to affirm that the smart and sustainable perspective of our cities is fully inscribed in the fundamental questions of our age.

And it is exactly the character of these fundamental questions that makes Smart City an unrepeatable occasion for society to challenge on subjects of technical, economical, territorial and societal nature that need to be stimulated jointly if the essential aim of Smart City is really the good life for society. In this framework, it is fundamental that the technical discontinuities are responsive ahead of the unprecedented needs of a sustainable development and the financial system is flexible enough to support the new kinds of infrastructural solutions. The territorial and urban disciplines are singled out to elaborate innovative concepts enabling the completely renewed City processes to take place. The public administration systems must guarantee effective measures and incentives to facilitate the inevitable transformations. The societal bodies must play an essential role in increasing the level of consciousness and participation of the citizens in defining and verifying the suitability of the new social processes.

All these aspects are covered in our Input Conference, where a wide spectrum of scientific thoughts and sensibilities are brought together with the aim of creating a common and challenging perspective: an intelligent, sustainable and inclusive City as a fundamental contribution to the environmental health and the social wellbeing.

Giovanni Colombo
STeHeC - Smart Territories and Healthy Cities
The role of urban cyclability in promoting Public Health

Stefano Capolongo\textsuperscript{a}, Lorenzo Boati\textsuperscript{a}, Maddalena Buffoli\textsuperscript{a}, Marco Gola\textsuperscript{a}, Alessandra Oppio\textsuperscript{b} and Andrea Rebecchi\textsuperscript{a}

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Key-words: Cyclability; Evidence Based Public Health (EBPH); Health Promotion; Healthier Cities; Physical Activity.

Introduction

The state of a citizen's health is influenced by three different factors: environmental, behavioural and genetic ones (Gebel et Al, 2005); architects and planners could significantly improve the first two issues. In recent years, it increased the awareness that urban plan design and initiatives can have positive and negative influences on the urban conditions in which people live and work (Capolongo, Battistella, Buffoli and Oppio, 2011). Air quality, equity, services, green areas and accessibility depend on the authority and planners' decisions. To create healthier cities, planners have to focus on the physical and social environment aspects to improve people's lifestyles. Cities are complex entities and urban health needs a multi-sector approach (Fehr, Capolongo, 2016).

Topics concerning the health status of citizens have always inspired and stimulated the technological innovation of processes on different levels: territorial and urban development projects as well as architectural and interior design (Signorelli, Capolongo, Buffoli, Capasso, Fagioli, Moscato, Oberti, Petronio, and D'Alessandro, 2016). A consolidation process of the role of architects and planners as promoters of public health is ongoing (Capolongo, Buffoli and Oppio, 2015). Even if urban residents have better health conditions than those in rural settings, cities are cause of social inequity for reasons related to the social context. Changes in lifestyle and diet, together with reduced levels of outdoor Physical Activity (PA) in cities, all contribute to a rise in Non-Communicable Diseases (NCD's), including obesity, diabetes, and cardiovascular disease. In this context, PA could be encouraged by particular attention to the design of paths and urban spaces. However, in Italy both urban and suburban districts are often characterized by the low quality of public space. Italian regulations are not sufficient to ensure high standards of urban quality of life and unfortunately the urban culture is not oriented towards urban health. This lack is directly reflected on the liveability of contemporary urban centres, that are often not really at human scale, do not promote healthy lifestyles and are characterized by unsustainable social and environmental impacts (Capolongo, Lemaire, Oppio, Buffoli and Roue Le Gall, 2016).

Designing open spaces and urban paths that encourage PA (cycling and safe walking paths, green areas, etc.) means to have direct and indirect effects on people's health and environmental quality. These benefits have positive economic outcomes, which are too often underestimated by the Public Administration. For this reasons it's important to start epidemiological
researches capable of creating awareness and orienting Governments towards more sustainable choices and quality. In Europe, referring to an higher urban quality, there are many initiatives that are trying to measuring and monitoring the sustainability level of local communities or the PA citizenship's level through a different set of indicators (D’Alessandro, Buffoli, Capasso, Fara, Rebecchi, and Capolongo 2015). However, few of these measurements specifically study the relationship between urban design, lifestyle and health outcomes.

**Daily physical activity and health**

PA is considered a key protective factor against many diseases: a sedentary lifestyle is in fact the fourth cause of death in the world, among those related to non-communicable chronic diseases, involving the majority of deaths worldwide (92% in Italy). The main diseases that could be reduced through increased PA are cardiovascular and respiratory diseases, obesity, diabetes and depression, bone, muscle and several other types of cancer (colon, breast, prostate, etc.).

The WHO estimates that more than 40% of the world population does not carry out sufficient PA, is suggested to be at least 150 minutes per week (30 minutes a day for five days) of moderate exercise for an adult. In Europe this sedentary lifestyle is more common in large cities. However, 50% of car travel in urban context are shorter than 5 km, which could be covered by a 15-20 minute cycling. Daily routes consisting in short trips: in the presence of walking trails or bike lanes, the citizenship would be more capable of reaching the amount of daily PA highly recommended to stay healthy.

Moreover, an increased use of bicycles has beneficial effects not only on health but also could have a positive effect on the environment, pollution, traffic, road conditions, work and economy (Coppola, Ripamonti, Cereda, Gelmi, Pirrone and Rebecchi, 2016).

Physical inactivity is a significant public health problem in most Regions of the World. The promotion of active transport (cycling and walking) for everyday PA is a win-win approach that needs to be disseminated and encouraged, especially in congested urban areas. In a time that is characterized by a greater emphasis on the quality of life, health protection and environmental sustainability should guide the great urban transformation and renewal projects towards strategies that encourage active transport. Nowadays, it should be unthinkable to design new suburbs or redevelop existing ones without planning safe and capillaries routes without paying attention to designing public urban spaces or green areas.

This has been recognized by a number of international policy frameworks, such as the Toronto Charter for Physical Activity launched in May 2010 as a global call for action or the Action Plan for implementation of the European Strategy for the Prevention and Control of Non-communicable Diseases 2012–2016, adopted by the WHO Regional Committee for Europe (WHO, 2011). The strategy identifies the promotion of active mobility as one of the supporting interventions endorsed by WHO Member States.

**Physical Activity: measurements of positive effects**

Transport is an essential part of our lives and a basis for providing access to goods and services. Different kinds of transport are associated with specific impacts on society, health, and the environment (Maltese, Mariotti and Oppio, 2011). Analysing and comparing these effects is an important key to create evidence-based policies and strategies. Economic appraisal is an established practice in transport planning (Laine, Kuvaja- Kölner, Pietilä, Koivuneva, Valtonen and Kankaanpää, 2014). However, techniques for assessing the value of the health benefits of cycling and walking are underutilized.

Several epidemiological studies quantify some of the many benefits of PA (Moran, Van Cauwenberg, Hercky-Linnewiel, Cerin, Deforche and Plaut 2014), but such studies are rarely applied to both cycling and...
pedestrian pathways (Karusisi, Thomas, Meline, Brondeel and Chaix, 2014). For example, there are different and consolidated epidemiological studies reporting the Odds Ratio (OR) between activity and inactivity, but few case studies referring to changing individual habits influenced by the urban context were conducted.

The literature shows us that active people (> = of 150 minutes of activity per week) are healthier than sedentary people (Kwarteng, Schulz, Mentz, Zenk and Opperman, 2014). Rather, PA has a continuous dose-response relationship with most health outcomes: every intensification of PA is associated with additional health benefits (WHO, 2010). This has also been shown by studies looking specifically at walking or cycling (Oja, 2011).

Starting from the existing research, the World Health Organization, Regional Office for Europe, has developed a tool to evaluate the health effects associated with the use of bicycle and pedestrian infrastructure. Named “Health economic assessment tools (HEAT) for walking and for cycling”, the software follows an approach based on evaluating the relative risk referring causes of mortality. The final output is a provisional estimation of deaths saved, related economic saving. The Standard value of statistical life (VSL) derived from scientific literature published is a default value provided in HEAT by selecting a specific country.

Speaking about walking and cycling data, the effectiveness of economic evaluation is highly dependent on the validity and reliability of the data used. In order to draw up a survey capable of collecting relevant data to be analyzed using the HEAT tool, a specific questionnaire was created to be distributed to a representative sample of population, where the findings apply to the whole inhabitants of Zona 7 in the western part of Milan (population 180,000). The survey aims to learn about the habits and conduct of the population's PA, in particular the use of bicycles and cycling paths in the urban area analysed. Referring to this specific context, the research's objectives are two: first of all, enhance the research currently being developed to evaluate and measure the increase of PA in the urban environment related to an improvement of cycle lanes in urban design. Secondly, define positive effects in the short and long term related to the PA level due to time spent in urban cycling (before and after an hypotheses of the cycle lanes improvement).

Methodology

The research focuses on quantifying the increase of active of transport and then deducting the health gain in terms of reducing mortality rate.

Following this purpose, it was necessary to create a specific questionnaire: a literature review has allowed to analyze in detail and compare different tools to collect information about health, PA, amount of cycling and how this factors are linked to the environmental context. It has been drawn up an analytical comparison to identify the frequency of questions founded in several questionnaires: “International and Global Physical Activity Questionnaire”, (Mannocci, Di Thiene, Del Cimmuto, Masala, Boccia, De Vito and La Torre) “International Prevalence Study on Physical Activity” (Bull, Maslin and Armstrong, 2009) and “Questionario sui progressi delle aziende sanitarie per la salute in Italia” (Dettoni, Penasso, Suglia, 2009) (Buffoli M, Gola M, Rostagno M, Capolongo S, Nachiero D. 2014).

Compatibility and utility of identified questions have been compared with the HEAT Tool framework for a further evaluation of collected data. The result is a self administered survey made of 30 close-ended questions, formed by 3 different domains: 15 questions about personal information of the interviewed; 12 about their current and future level of PA; 3 about their opinions and advices about infrastructures, actions that could be made regarding cycling mobility and public spending.
The difference between the values coming from the last questions (actual use and hypothetical use) permits to evaluate the expected growth of cycling and to make consecutives evaluation about the benefits that comes from this improving of PA. The use of the software is aimed to determine in a short, medium and long term, how long a specific infrastructure project encourages daily use of bicycles. Through the use of the HEAT software, the final goal is to determine possible positive effects related to the potential construction of an extensive network of cycle paths in "Zona 7". Research is forecasting, comparing health gain in the face of an economic investment to improve the built environment.

Results and discussion

After 80 days of dissemination, 345 people answered to the survey: 2 part per thousand of the inhabitants of the Milanese area analysed (Zona 7). The current cycling rate is limited to 198 of 345 interviewed (57,4% of the sample) with an average time spent cycling from a single bike-user of 25,6 minutes/day for 143 days/year. If the infrastructure for cycling mobility will be implemented, integrated and improved in terms of street-scape qualities, forecasting data show a meaningful change: we would increase the number of cycling people to 248 of 345 interviewed (71,9% of the sample) and the cycling rate to 30,4 minutes/day for 196 days/year. The increased values are related both to the number of people that would use the bike (17,8% more), the average time (+19%) and the number of the days (+37%) in a year in which they would practice this kind of active transport.

Collected data have been analyzed with HEAT software, that defines as health outcome an increase (+4%, from 7% to 11%) of protective benefit on the risk of mortality and morbidity, for cyclists compared to non-cyclists. The forecast calculation of the HEAT software, in terms of reducing of mortality rate, defines 13 deaths avoided every year and a rising of the protective benefit of the 50% for cyclist compared to non-cyclists.

Additional outcome to take into consideration consist in comparing the construction costs of a new bike path with the savings quantified in terms of reduced health care costs and deaths saved. Specifically for Milan Zona 7, it has been made a construction costs' evaluation to complete the cycle path. It has been calculated the missing Kilometres necessary to make the existing networks more widespread. The comparison between the cost of cycle lines' implementation and the annual healthcare cost saved, related to less dead caused by NCD’s, shows that since the year of track's realization, the investments will be repaid. Note that in the following years, the cost of maintenance would be very low, compared to the durable savings for public healthcare spending.

Conclusions

The experience of the application of the HEAT tool is capable of showing policy makers, in a smart way, a cost-benefit analysis in face of an intervention to improve the built environment; implementing the walkability of an area, besides having a positive impact on the health of the population, leads to an increase in property values of the neighbourhood where it is applied.

In the future, to increase the attractiveness of cities, professional skills as well as local authorities focusing on the most important determinants of health and sustainability must be involved in the
planning processes. Therefore, assessing the direct and indirect benefits of different urban-scale design choices on health is becoming a priority. To sensitize the Public Administration and really protect public health, this assessment should be quantitative and economic. Involving professionals not only related to the medical sphere but technicians such as urban planners and architects, able to design a urban form (Capolongo, Buffoli, Oppio and Petronio 2014) that physically promotes active transport, or moving daily by slow mobility has been considered crucial (Capolongo, Buffoli, Oppio and Rizzitiello 2013).

Surveys similar to the one that is being conducted for a part of the metropolitan area of the city of Milan could be applied to different situations, such as when planning a new pathways for cycling or walking, helping to evaluate the project for investments, or to quantify the reduced mortality from past and/or current levels of cycling or walking. It is ongoing the disclosure of the same questionnaire on the entire metropolitan area of Milan (nine areas in total). The common goal is to illustrate the economic consequences of a potential future change in the levels of the population’s PA influenced by the project.

It is important to note that the software only calculates health in terms of lower death rate, but the benefits of increased PA have much larger effects on health. Although, the use of active and sustainable mobility has lots of direct effects on the environment and the social aspect, and thus indirectly on health.

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Social inclusion and use of equipped public space for physical activity. Analysis and promotion prospects

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Key-words: outdoor, urban spaces, fitness equipment, social inclusion, universal design.

Introduction

Physical inactivity is an important health risk factor that may be addressed at community level. In outdoor urban spaces and parks activity physical improves general wellbeing and plays an important role for reduction of chronic diseases. Different health impact assessment methodologies have been applied with distinctive assumptions on key parameters, in Europe and United States. The results of different methodological approaches have shown that the active transport and physical activity - in proximity and neighborhood areas - can provide substantial net health benefits, irrespective of geographical context. Nevertheless, there are difficult in reconciling the approach for measuring community development activities in outdoor spaces with the outcomes and impacts of health, like the World Health Organization (WHO) has underlined too (Ison 2009). On one side, physical activity can be done in a variety of ways, such as walking or cycling for transport, performing fitness exercises, participating in sports, playing in the park, working in the community garden, taking the stairs or embedding into daily routines. Therefore, it is difficult to define indicators that take into account not only the time spent, but also type and quality of activities, depending on different needs of health and adoption of different lifestyles. On the other side, disability, age, gender, race and ethnicity may illuminate the issues related to health disparities and they have a significant influence on likelihood of doing physical activity in outdoor spaces.

WHO Europe has outlined that disadvantaged populations are less likely to have easy access to the places that encourage an active lifestyle. Women and young people in minority groups are often excluded from mainstream sport and physical activity programmes, accessibility and integration are key to enabling people with different disabilities to enjoy enhanced levels of participation. When they choose to be active, they often face risks related to road security and perceived risk of crime (Edwards and Tsouros 2008).

Safe public neighborhood parks and outdoor spaces can reduce inequity in access and choices for physical activity, providing facilities and equipment for active living, such as fitness areas, playgrounds and multi-purpose sports fields. Parks and sites in the healthy city must offer a physical and built environment that supports recreation, well-being, security, social interaction, easy mobility, sense of cultural identity and accessibility to the needs of all urban users and citizens. Therefore, innovative neighborhood planning and design must respond to the different way of using the public space of coexisting communities for health, welfare and social exchange. Community facilities can stimulate users to increase their levels of physical activity and social inclusion, doing so they require attention to the outreach and the public
space management, complementary to the planning and design in urban regeneration.

In this view, the paper analyzes different propensity of urban communities to physical activity and identifies main factors and requirements in the design of outdoor public spaces, that can affect the increase of physical activity.

The included trials have revealed the main factors of health risk prevention for diseases (Levine 2015, Woodcock et al. 2011), the social inequality in access to physical activity and environmental factors that inhibit the use of public space for walking and physical activity (Shephard et al. 2004, Van Holle et al. 2012, Christine et al. 2015, Gascon et al. 2016).

Methodology

The methodological approach is developed through the analysis of factors and indicators in the scientific literature and testing, from the local planning to the design.

Insufficient physical activity is the 4th leading risk factor for mortality (WHO 2012), current urban planning choices also impact on the public lifestyles.

In the long term, a higher percentage of the population achieving regular physical activity in outdoor spaces may lead to a lower level of chronic illness. Certain epidemiological studies have found that the lack of green space potentially causes cardiovascular mortality and poorer mental health (Gascon and others 2016).

Instead, long-term exposure to urban environments with greater resources to support physical activity is associated with a lower incidence of obesity and type 2 diabetes mellitus (T2DM) (Christine et al. 2015).

Generally, individuals who are insufficiently physically active have a 20% to 30% increased risk of all-cause mortality compared to those who engage in at least 30 min of moderate intensity physical activity most days of the week (Woodcock et al. 2011).

A transition in urban planning and design is needed to make systematic plans to improve the relation between urban activities and health.

Research concerns guidelines for developing the operational design of areas for outdoor physical activity, the scale of local planning - regarding the choice of the site to transform and equip - to the definition of key environmental and space requirements of the areas, the definition of the types of site accommodation, and equipment to be installed.

A few recent studies provide relevant methodological approach and significant information about the propensity factors on the location of the equipped areas at the neighborhood level.

The International Physical activity and Environment Network (IPEN) study - a cross-sectional research including 6822 adults aged 18–66 years from 14 cities in ten countries on five continents - suggests the importance of engaging urban planning, transportation, and parks sectors in efforts to reduce the health burden of the global physical inactivity, in relation to the similarity of findings across various cities (Sallis et al. 2016).

In reference to the study, indicators of walkability, public transport access, and park access are particularly interesting for identify the preferential terms of localization of sites and facilities for physical activity.

These indicators are meaningful to inform neighborhood policy, with the perspective of creating and maintaining Healthy Places (cycling, walking, doing gymnastics). The IPEN study has measured physical activity connecting to variables related to built environment and four of six environmental attributes are significantly and linearly related to increasing physical activity, in the models: net residential density (1000 dwellings/km²); intersection density (100 intersections/km²); proportion of retail combined and civic land area to total buffer area; public transport density (10 transport points/km²); number of parks contained or intersected by buffer (10 parks/km²); street network distance to nearest transport stop (1000 m).
The study has used comparable objective measures of built environments (geographic information systems) and physical activity (electronic accelerometers that recorded motion every minute).

The IPEN study results provide the first elements to perform an alternative assessment of the local planning systems. On the level of selected project area, complex factors related to environmental, technical and perceptive quality of the site must be defined. The WHO Europe physical activity planning guide detects some meaningful factors (Edwards and Tsouros 2008):

- wide range of accessible and attractive routes, accessible by foot or bicycle for efficient public transport;
- mixed-use, high-density communities with easy access to principal neighborhood destinations and recreation facilities;
- walkable, attractive neighborhood and trail connections between neighborhoods;
- integration of planning decisions related to the built environment concerning public health and physical activity;
- accessible facilities for physical activity;
- areas that are safe in terms of road security and crime;
- plan and services for special groups that enable active living for all ages and abilities;
- strong involvement by a variety of stakeholders and citizens;
- social norms and expectations that support and encourage active living as a way of life in the city.

Safety and road security standards can be a unifying fundamental concern which impacts the whole community and can even bring it closer together rather than polarizing different user groups. The case studies of Amsterdam and Copenhagen as walkable cities also feature these factors as the key catalyst that triggered the shift towards human-centric cities in the 1970s.

The analysis reported and others studies (Heath et al. 2006) (van Holle et al. 2012) reveal that adults who lived in activity-friendly neighborhoods do more of physical activity per week (for example 68–89 min) than those in the least activity-friendly neighborhoods. The relation of built environments to physical activity is generally similar across advanced cities, where public parks provide places for recreational physical activity. In short, the design principles can be apply across countries, but the performance standards are still being defined.

**Results and discussion**

Design quality of urban environments has the potential to contribute substantially to physical activity. User-centred design can provide solutions to modern healthcare requirements, the emerging factors are:

- Designing for and with all, viewing accessibility requirements in public space as an opportunity, rather than a constraint, for designers;
- Providing life-support and equipments which are adapted to user comfort and spatial and climatic conditions in outdoor spaces.

The main factors and requirements considered regard security, protection from climate and air pollutants, visibility and accessibility, attractiveness and image, presence of multi-functional
areas (equipment for children and adults, loisir areas), fitness equipment for different ability levels (children, adults, elderly, physically disabled).

According to WHO studies (Shephard et al. 2004) and the direct survey of parks users in the North of Turin, the main technical, environmental and social factors that influence the physically activity in outdoor spaces are outlined.

Requirement of Class: spaces and equipment security
- adequate exercises to physical capacities (not available for people with different abilities);
- equipped areas for free fitness activities, individual or group: “no space of our own to do the things we like to do” (especially young people);
- presence of integrated equipped areas for physical activity (equipment for children, seniors, adults);

Requirement of Class: social security and inclusion
- road security (especially older people and parents in relation to their children);
- visible and controllable localization of physical activity areas and fitness equipment stations;
- attention to personal safety and crime prevention (especially girls, women and parents of small children);
- attention to ageism (too old to be active), sexism (not appropriate for girls and women) and cultural and religious restrictions;

Requirement of Class: acoustic, lighting, hydrothermal comfort
- weather conditions control: mitigation extreme heat, cold and icy conditions (especially older people), shading, presence of trees, “heat island effect” mitigation, wind containment;

Requirement of Class: accessibility, usability, visitability
- accessibility to sites for all;
- protection of being injured or have been injured (especially among seniors);
- contiguity with loose, pleasure and relax spaces (especially among seniors and mothers with small children);

Requirement of Class: reliability, management
- prevention against unattractive environment (litter, graffiti, vandalism);
- cyclic and ordinary maintenance;
- site management and periodic control;
- organization of separate waste collection and transport to landfills;

Requirement of Class: environmental load
- mitigation by air pollution and noise pollution related risk;
- devices for the treatment and reuse of storm water.
- technical elements and soil characterization that avoid the water stagnation, the soaking, the formation of mold;
- presence of eco-recycled elements and materials.

Specifically, the use of a design for all and inclusive approach represents a crucial factor in the design of outdoor equipment: accessibility from multiple directions, multi-functionality of equipment (for example the use of certain equipment for both children and old people), clarity in the signaling, use of color with signal function, equipment for motor disabled (also accessible by children and adults with average abilities).

Another set of relevant factors for social inclusion concern the conditions for overcoming cultural and religious restrictions.

From direct observation emerges, for example, how fitness equipments which are in a pleasant place, with the possibility of positive social surveillance, in proximity to areas for children’s games, as well as ease of use, are also used by Muslim women.
In addition, the proximity of safe fitness and children play stations – with visual and perceptive control of the zone - is essential to ensure activities carried out by parents with young children.

**Conclusions**

“The quality of a space will affect how well it is used” (CABE 2010).

More cities aspire to create more people-friendly places to encourage walking and physical activities by establishing new services and by designing suitable infrastructure safer and more comfortable. IPEN research and WHO guidelines have identified criteria for the location of equipped places for physical activity, into the local planning.

Quality improvement of health urban planning and design implies to experience a multidisciplinary methodological approach - epidemiological, morphological, technical performance, environmental, sensory-perceptive – and citizens participation. Experiences developed in the city of Turin (Barriera di Milano and San Salvatio neighborhoods) and the comparison with multidisciplinary international research has allowed to outline first guidelines for the design of public spaces in the Health City.

Furthermore, the study aims to testing the potential of the social media and the planning from the bottom up, to check inclinations and profiles of open public space users for physical activity - examining the vigorous and moderate physical activity and the walking - in an urban suburb.

On the example of the online "community map" of public space, the research intends to develop a "community map" of the health public space.

![Fig. 1. Project scenario: physical activity areas for different abilities. Workshop Urban micro-landscapes.Tasting the Landscape (Politecnico di Torino DAD, AIAPP-IFLA 2016).](image)

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e-agorâje-ayopâ for the transition toward resilient communities


Beyond geospatial visualisation: maps for health research

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Key-words: maps, data visualisation, GIS, graphic representation, health research.

Introduction

In this paper will be discussed the relationship between health research and geospatial visualization techniques and tools. Health data visualisation can be an effective tool to reveal new insights into the patterns of disease. Furthermore, the simultaneous visualisation of health data with environmental data obtained from different sources can further the understanding of environmental-health linkages and can generate new hypotheses to be tested in future research (Stensgaard et al 2009).

Disease mapping and environmental risk assessment using digital geospatial data resources are now established analytical tools in both human and veterinary public health (Bergquist, Rinaldi 2010; Richardson et al, 2013). Indeed, new subdisciplines aimed to visualise, describe and explain the spatial patterns of diseases are being developed in different research fields. In the last decade dedicated scientific journal have started to focus on this topics. Moreover, in 2002 started the publication of International Journal of Health Geographics and in 2006 Geospatial Health. An important aspect of heath research is the study of risk factors for diseases considered "environmental" diseases because a considerable fraction of their burden can be attributed to environmental factors (Listorti and Doumani 2001; Prüss.-stün, Corvalan 2007). Thus, distribution patterns are strongly associated with the spatially heterogeneous environment in which they are entranced (Woolhouse et al., 1997; Brooker and Clements, 2009).

Geographical information systems (GIS), satellite-based remote sensing (RS), geographical positioning systems (GPS), spatial statistics and other computer-assisted applications made it possible to translate datasets into maps. The use of GIS in geospatial health have been firmly established as a useful tool for collating, exploring, visualizing and analysing health data in a graphic manner (Hendrickx et al. 2004, Cringoli et al. 2005, Yang et al. 2005; Rinaldi et al. 2006, Brooker, 2007).
Geospatial information for health research

Location is traditionally considered important for health. Hippocrates (460 to 377 BC) in his book ‘Airs, Waters and Places' observed that certain diseases tend to occur in some places and not in others.

Spatial analysis using maps to associate geographic information with disease can be traced as far back as the 17th century. Examples of the use of maps for the visualisation in the field of health research are been highlighted (Bergquist, Rinaldi 2010; Utzinger, Jürg, et al.) including the world map of diseases produced by the German physician Finke in 1792 and the mapping of yellow fever occurrences in the harbour of New York in 1798, the map of the addresses of cholera victims that in 1854 shown the relationship with the location of water supplies in London’s Soho district. The GIS development started in this century, in the 1832, with the spatial analysis of mortality in Cholera epidemic in the city of Paris experimented by the French geographer Charles Picquet (Yasobant, Vora, Upadhyay 2016). Beginning from these experiments, mapping the phenomena linked to health became usual. The map of the distribution of hookworm in Texas, drawn at the beginning of Twentieth century was crucial to the elimination of hookworm disease in the United States, as well as worldwide risk mapping of malaria was a key feature to guide control approaches.

Fig. 1. Map of yellow fever occurrences in the harbour of New York, 1798.

In 1970 Dr Barnett Cline experimented the application of computer technology and advanced statistics, until then applied only for military and economic needs, for epidemiological investigations for epidemiological research and public health (Cline 2006). These technologies continue to develop thanks to more sophisticated and user-friendly instruments and software and to the accessibility to data and applications through the Internet.
Open source mapping tools

A virtual globe is essentially a web-based GIS tools used for the 3D visualisation of the Earth based on satellite imagery upon which spatial information can be represented. Users are able to add and to share their own data and to freely explore the virtual environment by zooming and changing their position. Virtual globe technology has provided a cheap and accessible method to communicate data both to non-specialists and among scientists (Butler 2006) and the number of publication that use this virtual globe as tool for visualising and processing data is constantly growing in all the research fields (Stensgaard et al 2009). The most used virtual globe is Google
Earth, primarily aimed at the general public, but also widely used for display and disseminate scientific data and research results. Creating Keyhole markup language (KML) files it is possible the visualisation of data in Google Earth™.

Individual citizens are contributing to the production and the gathering of geospatial data by the real-time interactive GPS/GIS functionality embedded in mobile phones. The accessibility to the data gathered by this type of participatory GIS, or volunteered geographic information, are expanding also the opportunities for mapping health data (Mooney et al. 2013). The Volunteered Geographic Information community (Goodchild 2007), is a global community, which collaborate to create a detailed base map, similarly with the Wikipedia model of information collection. Some of these, as OpenStreetMap has been analysed as source of heath data (Mooney et al. 2013). OpenStreetMap is a project with the mission of creating free maps. Contributors collect spatial data mainly from portable GPS devices and make this data freely. Furthermore dedicated tools, such as WHO’s HealthMapper or CDC’s EpiMap, have been developed to mapping disease distribution and community treatment information (Föetcher-Lertey, Caprarelli 2016).
Beyond visualisation: maps for health research

Visualizations make it possible to provide interfaces for policy makers to visualize phenomena on health in an effort to help them to make informed decisions about improving health policies. However, visualization tools and methods require particular technical skills (Caprarelli and Fletcher 2014), which are necessary to ensure that knowledge transfer actually occurs. In the field of visualization, knowledge transfer ensures the application of the knowledge generated to stakeholder decision-making. Knowledge in health research can be of different types and can be well represented by a knowledge funnel (Graham et al. 2006). As knowledge moves through the funnel, it becomes more distilled and refined and presumably more useful to stakeholders. Referring to the classification of Graham et al. it is possible to distinguish the different level of elaboration of data in health research in

- Raw data. (First-generation knowledge).
- Visualisations. (Second-generation knowledge). It consists in the processing of existing knowledge by the application of explicit and reproducible methods to the identification, appraisal, and synthesis of studies or information relevant to specific questions.
- Maps. (Third-generation knowledge) It consists of knowledge tools or products. The purpose of these tools is to present knowledge in clear, concise, and user-friendly formats and ideally to provide explicit recommendations with the intent of influencing what stakeholders do and to meet the stakeholders’ knowledge or informational needs, thereby facilitating the uptake and application of knowledge.

From scientific publications in the field of health research emerges that the elaboration of health data has generally concluded at the second level (second generation knowledge), because of the lack of specific technical skills in the research teams that can allow the elaboration of information of the third level (third-generation knowledge). Visualisations are important tools for the interpretation of phenomena but they are readable mainly from audience with specific skills, differently from maps that are able to translate the knowledge in graphic forms easily readable and understandable. This kind of knowledge translation allow the transmission of the research result by means of graphic representations that can be used with different aims, as the involvement of stakeholders in the decision-making, the sensitisation of the public opinion in topics of public interest and, lastly, the knowledge transmission in an historic perspective. Indeed, only through the knowledge translation in refined and finished graphic representations can ensure to visualisation to be not only an useful tool for researchers involved in the phenomena interpretation at the moment of the production of research results but can be transmitted also to other scholars and research teams, thanks to mapping, the graphic translation processes aimed to codify information in a clear, unambiguous, and self-explanatory way. For this reason, it would be desirable a better collaboration between scholars involved in health research and experts with skills in graphic representation and visual communication. As evidenced by the case studies of historical medical maps presented in this paper, the knowledge transmission can be really effective only thanks to a specific attention to the graphic and visual dimension of the research results presentation, that graphic quality that make maps able to communicate clearly phenomena even after centuries.

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Urban Form from the Pedestrian Point of View: Spatial Patterns on a Street Network

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Introduction

The analysis of urban form represents a vast research field in its own. At the same time, it is a main research step in other fields of urban studies: the morphology of a city represents the canvas where events draw their occurrence patterns. Variables describing one or more aspects of urban form may carry different meanings, at different scales and with different effects on human behaviour and activities as well as on the evolution of the urban form itself (Levy 2005). In the Italian, French and English traditional schools of urban morphology, the analysis of urban form, and more specifically the analysis of the urban fabric, has focused on three main aspects (Pinon 1991): (i) the identification of urban form components (urban network, buildings and parcels), (ii) their geometrical description and (iii) the analysis of their spatial relationships. The analyses of the traditional school of urban morphology were normally carried out at the scale of a city neighbourhood, with manual calculations and a focus on the historical process behind observable urban forms. Geoprocessing of urban morphology within a GIS environment has become more widespread in the last twenty years, allowing for larger scales of analyses, but often losing the fine grain of the constituent elements of urban form (like in Berghauser Pont and Haupt 2010, or in Fusco 2016). Our research focuses in particular on the urban street network and the built-up space, which are the aspects of urban form more directly observable by pedestrians moving in urban space. Parcel structure plays a more important role in the historical of urban form and has been omitted in our research. Thanks to computational evolutions, the analysis of the spatial relationships between the two selected aspects, have been developed from the natural movement hypothesis. The assumption underlying these studies takes into consideration the way pedestrians move in urban space: on the one side visual-based movement (i.e. SSx, Hillier 1996), on the other physical impedance-based movement (i.e. MCA, Porta et al. 2006). Both approaches see human behaviour as a way to link elements of urban form: the former considers visible space as influencing urban movement and consequently the reachable places and elements. The latter analyses what is visible/reachable, considering walking position and movement (with a space or time impedance on the network). With this paper, we propose and test on empirical case studies a new method of analysis of the form of urban fabric from the pedestrian point of view, mixing the relations considered by classical urban morphology with the computational possibilities of geoprocessing. We consider the two main activities that humans do in the space simultaneously: walking and perceiving the urban landscape. As a consequence, we will be able to analyze the interaction between form elements combined with their geometrical description. At the same time, we will stop
short of applying the configurational calculus (whether SSx or MCA) and of studying urban form perception as revealed by mental maps of city dwellers (Lynch 1960). Unlike classical urban morphology, we will consider that urban form is not observed on a plan or as an aerial view, but from the pedestrian perspective. A new spatial unit definition will follow: this new space element is determined by the urban network segment (representing human movement and the main channel of perception of urban form) concurrently with its surrounding space limited to a given visual depth. Through this procedure, urban fabric will be defined as spatial patterns filtered through the possible perception of city users. The proposed approach is particularly powerful, as it allows computing on a larger scale and with geoprocessing methods what in previous research had been done manually or limited to a local urban project scale. Expert judgment becomes less crucial in the characterization of urban fabric (an advantage when the study area is a vast metropolitan area) and the bottom-up approach, by identifying spatial patterns through geostatistical analysis of form elements in the context of their surrounding environment, eliminates the problem of statistical analysis on pre-defined administrative boundaries.
Methodology

A. Study Area. Our analysis is applied to the French Riviera conurbation, in Southern France. Once the independent Principality of Monaco is included, this area has a population of more than one million inhabitants over 1500 km². This space is a unique conjunction of natural and urban landscapes: firstly, the topography, with elevation ranging from the sea level up to 1700 meters of the pre-Alps (passing through hills and valleys differently sloped). Secondly the socio-political and historical influences on the urban planning. Traditional villages, are spread around three high density urban areas. From east to west, we find: Monaco and its skyscrapers, the most densely populated sovereign nation in the world; the urban agglomeration of Nice with a regular meshed core inspired by the Turin model (Graff 2000), surrounded by hilly and less tightly planned areas. And finally the urban agglomeration of Cannes-Grasse-Antibes characterised by land irregularity together with the car-centred sprawl development of the lasts 50 years (Fusco 2016). The combination of all these elements produces a sequence of urban centres and peripheral areas of different size and different morpho-logy. This study area will give us the opportunity to test our method and to identify in a bottom-up approach different urban fabrics, which is a preliminary phase of future modelling of the relationship between urban form and functions.

B. Defining elementary spatial units. As introduced earlier, we consider a new division of urban space resulting from the combination of two elements: the urban street network, a connected set of segments allowing pedestrian movement, and the planar extension of urban space. A generalization of Thyssen polygons is thus created around each street segment to identify the portion of planar space conventionally served by the segment. For several morphological indicators, we only consider a double-sided proximity band of 20 m total width within this polygon, in order to approximate visible space (Fig. 1).

![Fig. 1. Generalized Thyssen Polygons around Street Segments.](image)

The rationale for this spatial unit definition is that a street segment should not be considered the limit, but rather the core of a fragment of urban fabric. This is often the case in European cities where discontinuities in urban fabric normally coincide with double carriageway boulevards, which produce two different spatial units. Moreover, this approach is the most consistent with the pedestrian point of view: when standing in public space, people perceive the urban fabric on both sides of the street not the elements within the four sides of a block. In our study area, 113,668 elements were thus identified with a street segment length between 4 and 300 m and an average area of 13000 m² (1670 m² when only visible space is considered).

B. Urban Form Indicators. As anticipated, the street network morphology and the built up forms are the main components of urban fabric considered in this research. Nine indicators, obtained through geoprocessing in GIS, were calculated for each spatial unit. Network morphology is analysed through the Linearity (or inversely, the Windingness) of its segments, computed as the ratio between the real and the straight-line distance between its nodes, together with the Local Connectivity, given by the combination of the degrees of the two nodes defining the segment.
Built-up morphology is represented not only by the classic *Coverage Ratio* index (ratio between building footprints and spatial unit surface). The same ratio is calculated for four different groups of built-up units (union of contiguous buildings) reflecting the presence of different building typologies within our study area: 0-150m² (independent houses), 150-600m² (row-houses of small multi-family buildings), 600-2400m² (compact urban block or big buildings), larger than 2400m² (mainly functionally specialized big buildings). We thus obtain a *Built-up Type Coverage Ratio* index, relative to each class. Urban density (total floorage space per surface unit) is omitted as it is redundant with building height (considered in the next section).

Network-Building Relationship indicators describe the building geometry analysed in relation with the relative position to the street segment. For this reason, they are computed only on the proximity band around the street segment, hence respecting the pedestrian perspective assumption. The *Street Corridor Effect* indicator (ranging between 0 and 2) is the ratio between the total length of the façades (built-up perimeter) being parallel to the street segment and the latter’s length. The *Proximity Band Coverage Ratio* indicator is obtained by applying the classic coverage ratio limited to the proximity band, while the *Proximity Band Building Height* indicator is the average ration of buildings in the proximity band.

Finally, the *Surface Slope*, implemented as the ratio between the high-sloped (30°) surfaces and the total spatial unit surface and the *Street Acclivity* are used as measures of the Site Morphology and its influence on the street network design.

<table>
<thead>
<tr>
<th>Urban Fabric Component</th>
<th>Indicator</th>
<th>Definition</th>
</tr>
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<tr>
<td>Network Morphology</td>
<td>Linearity/Windingness</td>
<td>Ratio between segment length and Euclidean distance</td>
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<tr>
<td></td>
<td>Local connectivity</td>
<td>Node degree</td>
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<tr>
<td>Built-up Morphology</td>
<td>Coverage ratio</td>
<td>Ratio between space-unit surface and total built-up</td>
</tr>
<tr>
<td></td>
<td>Built-up type coverage ratio</td>
<td>Ratio between space-unit surface and 0-150m² built-up; Ratio between space-unit surface and 150-600m² built-up; Ratio between space-unit surface and 600-2400m² built-up; Ratio between space-unit surface and &gt;2400m² built-up</td>
</tr>
<tr>
<td>Network-Building Relation ship</td>
<td>Street corridor effect</td>
<td>Ratio between parallel façades and street length</td>
</tr>
<tr>
<td></td>
<td>Proximity band coverage ratio</td>
<td>Buildings coverage on the 10 m proximity band</td>
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<td></td>
<td>Proximity band building height</td>
<td>Ratio between building vol. and surf inside 10 m</td>
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<tr>
<td>Site Morphology</td>
<td>Surface slope</td>
<td>Ratio between total and high sloped space-unit</td>
</tr>
<tr>
<td>Network-Site Relationship</td>
<td>Street acclivity</td>
<td>Computed as ( \frac{\arcsin(D/l)}{d/l} \cdot \sqrt{1-(d/l)^2} )</td>
</tr>
</tbody>
</table>

### C. Spatial statistical analysis

Once the indicators are calculated for the whole study area, the following step is to find how their values are associated in space so that larger scale urban features (urban fabric) can be identified. Spatial clustering indicates where a phenomenon of interest has high/low incidence level, outlining hot/cold spots; several methods have been developed, in different research fields and perspectives. Local Moran’s I indicator of spatial association (LISA, Anselin 1995), based on Moran’s I spatial correlation measure (Moran 1948), was identified as a valid geostatistical method. Despite its large application in other research fields, it has so far been used relatively little in the study of urban form (Tsai 2005, Musakwa and Niekerk 2014). In order to test the pedestrian perspective assumption, we analysed and compared the planar application of local Moran’s I statistic LISA with the corresponding network-constrained i-LINCS (Yamada and Thill 2007, 2010). To our knowledge, this is the first attempt to use the LINCS approach to the analysis of urban form. Several network and planar depths were considered, following a topological queen contiguity approach. With an *ad hoc* geometric model, GeoDa was used to calculate these statistics (Anselin 2003).
Results, discussion and conclusions

The present analysis focuses on the Street Corridor Effect indicator. Applying LISA and ILINCS to the whole of the French Riviera conurbation produces a large, interesting set of results. The global Moran’s I for the French Riviera is 0.38 with a planar approach and 0.45 with a network approach, with neighbourhood depth three. This shows both important spatial autocorrelation of the corridor effect and a better aptitude of the net-work approach to highlight the resulting spatial patterns. Global Moran’s I is 0.32 with a depth of eight in the network approach, highlighting the local dimension of the patterns. In what follows, we will focus on a geographically more restricted area: the southern part of the municipality of Saint-Laurent du Var, west of the city of Nice. This coastal area includes an old village to the north, a marina in the south and diverse 20th century residential and retail developments in-between, with two important urban barriers severing the urban fabric: the railway and the motorway.

Fig.2a shows the distribution of the Street Corridor Effect indicator values: the Var river banks (east) and Mediterranean waterfront (south) are detectable due to their lower values, while higher ones characterize the old village. The apparently heterogeneous distribution of values in the rest of the area makes spatial clustering and pattern identification hard tasks. LISA and ILINCS can thus identify patterns of homogeneously contiguous high/low street corridor effect as High-High/Low-Low areas. High-Low and Low-High are patterns of local discontinuities. Fig2.b and Fig2.d evaluate the difference between the two approaches at the same neighbourhood depth value of three. Firstly, as expected, a few misleading High-High and Low-Low LISA clusters disappear in the ILINCS approach because of the lack of network connections along the motorway (north-west in the map). Secondly, the network based approach identifies distinct clusters of high values, in addition to the old village. The spatial separation of these areas corresponds to the presence of the urban barriers, less/not detected by the planar approach. In both cases, features classified as not significant identify urban fabrics characterised by less clearly structured heterogeneity in the corridor effect. Increasing the contiguity depth value to eight (Fig2.c), expands the extent of High-High clusters like the planar-based analysis; but now, urban barriers corresponding to bridges or underground passages are well visible thanks to the Low-High cluster segments.

In conclusion, the proposed method offers the possibility to identify spatial feature patterns from a pedestrian perspective through a bottom up procedure. Not depending on pre-established area boundaries, it can be easily applied in different contexts and contribute to inductive identification of urban fabric. Finally, the neighbourhood depth parameter allows its application to different scales of analysis of urban form. Future work will address the empirical Bayesian correction (Assunção, Reis 1999) to evaluate population size effect consequences: scarcely urbanised units could show higher variability of morphological indicators, biasing the calculus of spatial association. Once this problem solved, the research could tackle its last step where feature patterns from all indicators will be analysed and combined for a complete urban form classification.
Fig. 2. Spatial Analysis of the Street Corridor Effect in Saint-Laurent du Var.

Acknowledgements

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**Introduction**

Functionality analysis of management and maintenance of individual buildings, now possible with BIM and GIS technologies, is often carried out considering the volume of the building in an isolated system in an urban space. This paper will describe an original project, starting from the management of the new DBGT (GeoTopographic DataBase - where nowadays structures are built using digital mapping of urban areas) to the three-dimensional modeling, using 3D City Modeling technology, which allows augmented navigation reality of building facades and urban infrastructure. A unique element of this project was the link of volumetric buildings, that were specifically georeferenced, with the database developed in the 3D BIM environment. This project was aimed at the management of resources and technological areas of public administration and staff in the Department of Architecture at the University of Sassari in Alghero (Sardinia - Italy).

The results showed that this integration, carried out with the interaction of a number of separate technologies, allows the construction of a useful product that starts from the urban planning stage and goes to an individual who makes use of it. This paper focuses on the methodology applied in the analysis of urban environments from the territorial scale, in which the structure and texture volume of the city of Alghero is analyzed, to the scale of detail. Here every building is made into a 3D model at the architectural scale, in which the building is analyzed inside and outside also using a management model.

In the first phase the paper illustrates how (also in Italy) digital mapping, applied to urban environments, is undergoing an extensive transformation process. This includes the changeover from a vector representation purely in 2D or 3D (graphical entities points, lines, closed polygons) to a logical and conceptual model in which the construction of the data and their management takes place exclusively in a GIS environment. This transformation is the result of an adjustment of the Italian legislation (IntesaGIS 1996-2006 Committee for the technical rules on the spatial data of the PA from 2007 to 2010 - www.centrointerregionale-gis.it) to the INSPIRE directive that, "Establish an infrastructure for spatial information in Europe to make spatial or geographical information more accessible and interoperable.

The intermediate study phase involved choosing an area of study which includes the historical centre of Alghero, and it was used for the construction of a 3D City Model of this area according to the standards of Open Geospatial Consortium (OGC) like the Web 3D Service and Web View Service (W3DS, WVS). At this stage the volumetric reconstruction of the buildings was, as usual, completed with photo texture of the front of the buildings.

Finally, a process that allows the passage of the multi-scale vision, from the urban environment to the internal management of the spaces and volumes of a building, was completed, in order to create a georeferenced DataBase in architectonic...
level using the tools offered by the technology of Building Information Modelling (BIM).

The last phase is connected to a project in which an internal working group of DADU (Department of Architecture, Design and Urban planning at the University of Sassari) was involved. It is called ReS- Resources and Spaces- and it is an Information System developed for the management and maintenance of the space, the installations, mobile assets and activities inside the Department with the possibility to be extended to all the real estate in the University of Sassari immediately.

The whole process of digital management of geometries, as uniquely georeferenced in an absolute reference system, allows viewing, editing and management of analysis that starts from the 3D City Modeling and can offer the possibility to query attributes of individual objects and/or facilities geolocated.
Methodology and area of investigation

As the study area has been selected the historical centre of Alghero with some adjacent area, in order to analyze some buildings of the Department of Architecture, for the evaluation of proposals for an urban planning project and for the visualization of building modifications for the Facility Management (Moser, 2010).

The base of the data was built starting from some sources, comprising of:

- DBGT products from the Regione Autonoma della Sardegna (Sardinian Regional Government) and it includes a detail of the nominal scale 1: 2000 for the urbanized area of Alghero;
- DEM with a mesh 1x1m acquired with LiDAR technologies and processed for the production of Digital Surface Model (DSM) for filtered building, vegetation and terrain;
- shooting digital of the front of buildings for the following phase of texture mapping;
- acquisition and editing of the 2D floor plans of the interior of the buildings in BIM environment;
- population of the DB of furniture, equipment and instrumental goods.

The DBGT produced by Regione Sardegna has a very complex structured geometric data which is managed differently to the layers in the CAD environment that were handled by the old Regional Technical Cartography (CTR). The tree structure includes LAYERS> THEMES> CLASSES and, for a rapid query, the entire DB includes only whole numerical data attributes. An interesting example in this project is analyzing one of the layers related to the buildings in order to have the following sequence: STRATO_02 ("Public and private construction") > TEMA_0201 ("Buildings") > CLASSE_020102 ("Building unit").

However the majority of 3D City Models was developed mainly for visualization purposes, as the technology limits and high costs did not allow construction of complex models which could include also various types of data. The usage of models only for visual analysis can nowadays be considered as one of several options for its enforcement. At the moment the rising demand for the extension of all the models with the wide database can be found in various fields of research and practice. The 3D City Models of today must offer the high level of interoperability. The 3D models can be created by using various types of methods and ways of data collection. The main goal is to achieve more and more accuracy in less time with lower costs, connecting the geometric and semantic aspects together, so the models can be adjusted in the future and used for different purposes. In this paper we focus on the procedural modelling as one of the types of modelling methods and its ability to create the complex 3D city model (Surendra, 2013).
The technological development of the past few years has brought the immense growth of application working with 3D spatial data in different sectors. The field of architecture and urban planning has been influenced by this trend as well and the raising interest in creation of 3D City Models can be observed through the past years. 3D City Models has become a key tool for various types of applications in urban and landscape planning, facility management, crisis management and other fields all over the world.

The 3D City Model of Alghero is a digital model of the city that represents terrain surfaces, sites, buildings, infrastructure and selected landscape elements in the environment of the specialized software ESRI City Engine 2012. The components of the model are created and represented by corresponding two-dimensional and three-dimensional spatial data and geo-referenced data.

As mentioned above, the aim was to create the 3D City Model based on geospatial data by using procedural modelling methods in order to represent a large number of objects in short time. Procedural modelling is in general applied, when large numbers of iterations of a design or large numbers of objects have to be created (Parish, 2001). The created model works in total with 1037 objects. Procedural approach with manual adjustment was used to create specific objects and landmark buildings.

The georeferenced GIS data of DBGT of Regione Sardegna was used as the input data for creating the 3D City Model of Alghero. The database was finished in 2014 and the model can be considered up to date. The selected 2D data was converted into the 3D volumes by using the procedural rules written in the environment of program.

With the created rules the buildings were extruded into their height and in this phase, the city was represented by simple 3D volumes. After extrusion the model corresponded to the City GML LOD 2 (buildings are represented by block models) as seen in figure 1. The streets, city walls and pavements were created manually by adjusting the heights to the points of the dxf file. As the procedural modelling brings the possibility to create combined geometric-semantic models at the same time, in the second step the procedural rules were changed in order to work with the attributes needed to create the semantic part of the model. In the end the procedural rules worked with following parameters:

- slope of the roof
- shape of the roof
- absolute and relative height of the buildings
- terrain heights
- number of floors
- usage of building.

All objects of the model are linked to the corresponding attributes in the source dataset. This allows further updates in the model, changing and adjusting different parameters. Different types
of colours were added to the different building types, as they correspond to the existing GIS database.

After this the set of textures was prepared. For this purpose it was necessary to take the photos of the buildings of selected parts of the city. The pictures were taken with a high resolution digital camera. The generic textures for minimizing the time of creation of the model were used for roofs, streets and pavements.

![Image of the textured model of Piazza Civica with LOD3 according to the CityGML standard.](image)

**BIM implementation, result and discussion**

The next task was to create the parametric model of the buildings of Architecture Department using the BIM (Building Information Modeling) tools in order to create three-dimensional models of the internal surfaces of the building using floor plans with the correct geometric dimensions. As it is known, BIM means a parametric information model, integrated in a 3D model that does not contain only graphical information but collects, in its internal database, information concerning the times of production (4D), the costs (5D) and the facility management of the building (6D). Remodelling can be defined in six dimensions of a building already constructed but which, after careful analysis, all the details such as those concerning the thermal characteristics of the materials, energy factors, the characteristics of the plants etc. are known. Each component of the building contains geometric information in 2D, 3D graphics and a number of attributes attached to it. These attributes can be sorted, counted and queried thanks to the presence of the schedules. These are windows of the project in the form of lists that catalogue all the elements of the model and their related information (objects, materials, quantities, areas, volumes, etc.). As previously stated, the ReS is a system based on geographical management of space, staff, assets and property used by the university public administration.

The aim was to have a work tool that is able to coordinate maintenance activities, to optimize operating costs and to organize services in a more effective and programmable way. All the DB is uniquely georeferenced and represents the operational details that start from DBGT of urban area and passes through the 3D City Modeling.

The completion of geolocalization first permitted the identification of all three aspects including: human resources, properties and facilities. In particular, the aspect of facilities includes safety devices, the heating system, the fire fighting system, the air conditioning system and the electrical system. All these information are the basis of the construction of the performance related to Facility Management.

After this phase an accurate list of all electrical systems, the sprinkler system, the security system, the water system and the climate control system was made and their position in the spaces was located.
Conclusions

In the last few years different attempts that allow integration of GIS models and BIM models have been observed (El-Mekawy 2010). This two systems need to interact: "BIM provides physical and functional detail that is not typically available in GIS, instead GIS places facilities within an existing context" (in our example the city of Alghero where the department of Architecture is) while BIM’s focus is much more specific within the facility context (Przybyla, 2010).

For this reason, the aim of our project was to create a powerful tool by using GIS, DB documents, 3D City Modelling method and BIM, in order to provide the high level of interoperability that is necessary for analyzing georeferenced buildings in the urban environment and in order to manage, analyse and visualize Data from the Urban scale to the single room of the building.

At this stage the created geometric-semantic model of the city can have different types of applications. It can be used for the urban planning process, it offers the possibility to compare and analyse the future scenarios of various projects. It can be used by architects, investors and urban planners to design their proposals in simulated environments and in this way prevent the city of the irreversible changes. It represents also the powerful tool of public participation and mean of communication between the professionals and public. Our experience has shown that the BIM technology can be beneficial also for the management of existing buildings.

The 3D City Model can be connected with BIM, exported on the web sites in order to become a platform for sharing different ideas.

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e-agorà|e-αγορά for the transition toward resilient communities


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We have argued elsewhere that the Capability Approach (CA), introduced by Amartya Sen (1992, 1993, 1999, 2009) and developed, among others, by Martha Nussbaum (2000, 2011), could be used as a powerful normative framework to redefine the concept of quality of urban life (i.e. to identify and describe the city-specific contribution to the individual quality of life) and to design innovative methodological and operational tools for planning and urban design (Blečić et al., 2013; Talu, 2013; Talu, 2014). The CA attaches central importance to individual functionings and individual capabilities, that is the effective freedom people have to lead the kind of lives they have reason to value. The underlying idea of the CA is that individual wellbeing is a process of interaction of the person with his/her social and physical context. Within this process, available commodities are only instrumental to reach the goal of increased wellbeing and should not, therefore, be used as a metric for assessing quality of life. The urban quality of life should, therefore, be defined with reference to actual opportunities each person has to “use” the city, such as spaces, services and information, to enhance his/her own wellbeing, and urban policies and projects should be designed in order to be able to identify (unveil and describe) and then remove urban obstacles - the urban “unfreedoms” introduced by Samuels (2005) - hence enhancing individual “urban capabilities” (Blečić et al. 2013; Samuels 2005; Talu 2013; Talu 2014). Capability perspective turns out to be particularly fruitful in order to design (and evaluate) urban policies and projects aimed at promoting quality of life of the most disadvantaged inhabitants living in deprived neighbourhoods (Belli, 2006). Urban poverty is a multifaceted and complex phenomenon: it has multiple contributing factors, which tend to combine with others to create a vicious cycle of disadvantage. As a consequence, it is hard to effectively face urban poverty with seemingly effective tools, such as cash compensation. A more effective approach instead is, as Wolff and De Shalit (2007) argue, to find the ways of addressing disadvantage which avoid stigma, through status enhancement processes: “A way of improving people’s opportunities by, in some sense, changing the rules to improve their standing” (pp. 174), namely by changing their social condition and living environment. Urban policies and projects aimed at improving quality of urban life of the most disadvantaged people should, therefore, be truly integrated and they should be able to improve individual’s opportunities through a change in the configuration of their material environment which must be consistent with a change in social environment.

Technologies could play a crucial role in improving the quality of urban life of the most disadvantaged people living in marginalized urban areas. However, as Oosterlaken (2015) pointed out, the “technological change needs, just like economic growth, to be assessed in terms of ultimate societal goals, like enabling each and every person to lead a flourishing human life” (pp.104). Sen (1983) also highlighted the importance of considering technologies as mere means, not ends in themselves: “Having a bike gives a person the ability to move about in a certain way that he may not be able to do without the bike. So the transportation characteristic of the bike gives the person the capability of moving in a certain way. That capability may give the person utility or happiness if he seeks such movement or finds it pleasurable. So there is, as it were, a sequence from a commodity (in this case a bike), to characteristic (in this case, transportation), to capability to function (in this case, the ability to move), to utility (in this case, pleasure from moving). It can be
argued that it is the third category – that of capability to function – that comes closest to the notion of standard of living. The commodity ownership or availability itself is not the right focus since it does not tell us what the person can, in fact, do. I may be not able to use the bike if – say – I happen to be handicapped - having the bike – or something else with that characteristic – may provide the basis for a contribution to the standard of living, but it is not in itself a constituent part of that standard.” (pp. 160).

Along the same line of argument, some urban planning scholars have questioned the vision of the Smart City and its usefulness in enhancing the capacity of urban policies and projects to serve the interests of the real people who live in the real cities. Greenfield (2013) in his pamphlet Against the Smart City sharply criticized the initial Smart City narrative: “The enterprises enumerated here are to a surprisingly great degree responsible for producing both the technical systems on which the smart city is founded and the rhetoric that binds them together in a conceptual whole. While this may not be a particularly remarkable circumstance by the standards prevailing in industry, the deep involvement of large-scale commercial actors in the germination of ideas about the design and equipment of cities does make it somewhat unusual in the history of urbanism. It’s as if the foundational works on twentieth-century urbanist thought has been collectively authored by United States Steel, General Motors, the Otis Elevator Company and Bell Telephone rather than Le Corbusier or Jane Jacobs”.

The initial Smart City movement considers the Information and Communication Technologies (ICTs) as the panacea of the urban development (Aoun, 2013; Bradley et al., 2013; Ericsson, 2012; Schaffers et al., 2011; Komninos & Tsarchopoulos, 2013; Batty, 2013). Cities must deploy massive infrastructure for broadband Internet access and enrich, merge the physical fabrics of cities with cutting-edge ICTs to enable real-time monitoring and control of all their processes. Then the application economy (design, development, sale and fruition of mobile and web applications) can take place and enable collective intelligence, creativity and innovation that in turn leads to smart urban development. This approach to the Smart City acts as business logic to meet objectives as competitiveness, active labour market, wealth creation, efficient management of non-renewable resources and energy efficiency by means of large-scale deployment of ICTs. Technologies are a means to an end themselves and the quality of life is several times confused with the quality of service, a metric widely used to measure the performance of the technological systems.

It is now clear to us and to the new Smart City movement that there is the need to re-thinking the role of ICTs applications in urban development in order to follow a more inclusive and people-oriented approach that really increase the quality of life of all citizens, in contrast to more conventional approaches aimed to emphasize the importance of ICT itself on sustainable development (Ratti 2013; Blečić & Cecchini, 2015; Caiati, 2016).

Understanding the relation between technologies (and in general artefacts) and individual human capabilities requires to reason about the appropriateness, not only about the availability, the efficiency, the high performance, of technologies, in relation both to the selected individual capability (or capabilities) and to actual and possible constraining conversion factors. Oosterlaken (2015), discussed the relation between the Appropriate Technology movement and the CA and stressed the importance of considering not only the details of (artefacts) design, but also the embedding of technical artefacts in socio-technical networks: “The effect of technical artefacts on human capabilities depends on how exactly they are embedded in broader socio-technical networks. At the same time technical artefacts partly shape such networks. Thus it is not only important to zoom in on the details of design […] but also to zoom out to see the broader picture. If we want to introduce new technical artefacts in order to expand human capabilities, for example in the context of development projects, it is necessary to also invest in the surrounding socio-technical networks” (pp. 94-95).
This people-centric approach suggests that it is the viable concept of Smart Citizenship, rather than the vision of the Smart City, that should lie behind the actions aimed at promoting quality of urban life of the most disadvantaged inhabitants living in deprived neighbourhoods: “Furthermore, although landmark buildings shape our historical understanding of many metropolises, in reality most of the physical stuff in cities was built by everyday people. City building was highly democratized, decentralized, free-flowing and adaptive, just like its social and economic life, a rich tapestry of communal architecture whose design achievements were the result of collective effort rather than celebrity “starchitects”. This organic growth of classical cities holds several lessons for future Smart Cities. First, by imposing a preordained design, centralized planners often fail to create a city that is tailored to inhabitants’ needs, that reflects their culture or that creates the rich mix of activities that distinguishes great places. (…) Second, top-down visions ignore the enormous innovative potential of grass-roots efforts”. We have all witnessed how the decentralization of design transformed the World Wide Web into a fascinating milieu for social interaction. By providing finished solutions rather than new raw materials for building the physical and social fabric of smarter cities, top-down designs rob themselves of any capability to invent new ideas for how to make cities better. (…) Finally, a focus solely on efficiency ignores fundamental civic goals such as social cohesion, quality of life, democracy and the rule of law. Improving sociability through technology, however, does target these needs, while also unlocking new approaches to efficiency” (Ratti & Townsend 2014).

Of course we are aware not only of the problems, but also of the opportunities of deploying ICTs. The ICTs, in the right context, are a potential enabler of sustainable development, potential because there is not a linear correlation between access to information and knowledge and the process of empowerment (of individual or community) that lead to sustainable development. This is even truer (i) if disadvantaged people are not supported and trained to access information and knowledge and (ii) if ICT-based solutions are imposed instead of being co-created with the citizens. Co-creation is an active, creative and social process, which entails: connections and interactions between people; collaboration, rather than just involvement; and co-creativity, not simply co-construction or co-production. The aim of this participatory approach to design is to create processes that are more responsive and appropriate to their inhabitants’ and users’ cultural, emotional, spiritual and practical needs. In accordance to this, Gigler (2004), proves three extremely important hypothesis: (i) a successful mediation process by local intermediary is required so that ICTs can contribute in a meaningful way to improve livelihoods of the disadvantaged people (ii) ICTs have to be locally appropriated for the poor communities in order to facilitate their empowerment and (iii) ICTs have to build on and strengthen existing social and organizational community structures to foster collective empowerment. When ICT-based solution are co-created they really have the potential to enhance people’s capabilities to make choice in various area of their lives and in this sense contribute to the empowerment of disadvantaged people and to the increase of their quality of life.

Several and different in nature ICTs (e.g. sensors, wireless communication, Internet, cloud computing, software analytics, programming languages, etc.) are the main building blocks of the information and communication architecture that enable the provision of several applications and services, directly enjoyed by citizens through personal computers and smart devices, that can positively contribute to enhance their capabilities.

The actual Web 2.0 allows citizens to gain access to a huge amount of information, to interact and collaborate with each other in a social media dialogue as creators of user-generated content and thus use the web as a form of cultural expression. Voice over IP (VoIP) is at the basis of several teleconference technologies that improve ability to communicate with parents and friends around the globe while reducing the costs.
Educational technologies such as E-Learning and Serious Games are spreading and opening new opportunities for valuable (often free) training and enhancement of self-reflection and problem solving that in turn lead to improved ability to make strategic life choices.

E-commerce opens new opportunities for accessing and diversifying the market with minimum capital investment, for simplifying the business processes and makes them faster and efficient and in principle can enhance the people capacity to interact with the market.

Infomobility applications provide people with massive, up-to-date and real-time information on mobility services available and potentially open for new mobility opportunities.

Several applications for smart devices are specifically conceived to increase awareness around specific issues, for example, fitness and food-related applications together with wearable technologies can increase awareness about life-style and potentially lead to better personal health.

ICT-based platform specifically conceived to mediate the relationship between citizens and government enable the participatory governance or rather the citizen participation and greater political representation than traditional representative democracy (Peixoto and Fox, 2016). The right and the chance to participate improve people’s awareness about political issue and their capabilities to interact with the local government.

Finally, the right use ICTs in the typical application domain of an urban area (e.g. energy, mobility, water, buildings) has the potential to improve efficiency and to create economic savings that can be realistically re-invested in social services aiming at mitigating urban poverty.

According to this line of argument, we suggest that a promising and viable way to address, in a durable and comprehensive manner, the problem of urban poverty through status enhancement processes, as Wolff and De Shalit (2007) suggest, is to co-conceive and co-design (with all members of the local communities and preferably with social services workers, teachers of the local schools and other relevant stakeholders) innovative neighbourhood community hubs called Capabilities Houses. Inside these ICT-enhanced houses the disadvantaged people can co-create a diversified set of mutual-help services that provide them the freedom to do a productive job, that is also an opportunity to build new skills. We envision to create production spaces inside the Capabilities Houses, mainly based on co-production systems and on sharing economy principles, that can provide benefits for the people involved and the local businesses. The basic assumption of this idea is that ensuring and promoting opportunities to hold a formal, recognised, not merely symbolic nor symbolically subordinate economic role and autonomy is a fertile action capable of triggering a virtuous path of gradual improvement of the quality of life of the people involved and of the local communities. However, since communities are not homogeneous entities, the appropriateness of ICTs (naturally, the same applies to design too) should be evaluated on the basis of the specific needs of the most disadvantaged groups (i.e. children, women, elderly) to avoid unexpected side-effects, which may worsen, rather than improve, their quality of life, as stated by Fernández-Baldor et al. (2014) and Oosterlaken et al. (2012) with reference to the relation between gender and technology.

References


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Planning, managing and empowering while pursuing change: integrating community map-making and geographic information technologies

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Key-words: community mapping; participatory planning; participatory GIS; community development; natural resource management.

Introduction

The paper outlines the main ideas which found the core of a research work currently in progress. The focus is on community map-making and its integration with geographic information technologies within participatory design and planning processes as well as participatory resources management, in disadvantaged areas particularly of developing countries. Participatory initiatives in these problematic territories range from attempts to improve living condition through infrastructural physical and social upgrading in slum areas, to managing natural resources for mitigation of climate change impacts in particularly affected territories. Frequently, while trying to meet practical exigencies community-driven approaches generate self-determination paths through which those who normally are not involved in decision-making claim their right to a more concerted transformation of habitats. To reach this intent and in order to be institutionalized, concerted practices need instruments for information gathering and knowledge co-production which aim at authoritative outcomes and clear communication. Thereby effective means, in fact, dialogue and negotiation among different and sometimes conflictual stakeholders is enabled. In this realm, mapping becomes at the same time a tool of place making and a catalyst of change. Several scholars worldwide are trying to integrate methods and languages normally belonging to community mapping hands-on practices with the use of geo-information technologies and digital tools, coming across critics and constraints while confirming the enormous potential of this attempt. Through a sociological point of view, supported by technical skills on GIS and thank to several field experiences in different countries worldwide, this work explores the integration of diverse methods and technologies, its implications, benefits and hitches in development sphere and its role within a broader objective of structural change.
Background

The issue of community involvement in planning practices or natural resource management has been widely analysed within the field of development. It is recognized by several school of thoughts the need for a shift from considering people as target of planning activities, to conceive them as main key actors of socio-spatial processes (Madanipour, 1996; Cuthbert, 2007). This is why a more collaborative style of project planning is today pursued (Healey, 2003). For many scholars and professionals, indeed, people involvement is a fundamental and constituent aspect of development projects and its importance is undoubted. According to Hamdi (2014) participation is essential to build community; to unfold reality; to respect and accommodate diversity; to find alternative ways of provision, co-production and ownership; to mobilize resources, reduce dependency, build resilience. Diverse approaches to upgrading or rehabilitation in problematic areas have been adopted worldwide depending on different countries, peculiar social context and specific national policies. Generally, “participation” in design processes for development, ranges from a more physical-deterministic attitude often resulted in mere “consultation” about already established plans; otherwise social-deterministic initiatives with fragmented mobilization and weakly representative groups demanding government intervention; to more constructive and comprehensive approaches, in which physical and social dimensions are well balanced and a major control by local communities is promoted both over the ‘process’ and the ‘product’ of participatory design and planning (Frediani and Boano 2012).

During community involvement a rich amount of information are generated and social dynamics triggered, which are essential for contextualized actions. The challenge is to have instruments capable to capture local knowledge, realistically represent socio-spatial conditions and support analysis and dialogue among stakeholders. Within this picture, many are the aspects involved to get the process doable and effective as desired, particularly if the pursued outcome is truly “concerted” in terms of empowerment from below, partnership with the above and socio-spatial suitable interventions. Certainly a particular attention needs to be paid on methodologies of involvement and community work, seeking for stimulating tools of interaction and embracing grounded approaches which safeguard, recognize and value local inhabitants’ contribution. The goal is fostering a collective output that is authoritative, communicative, replicable and easily adoptable by specialists, officials and technicians.

Methodologies

Community map-making is a creative process in which people deconstruct their reality, unfold the invisible structure of their place of living, its apparently disordered logic and its potentials. Analysing inner features and problematic issues, they uncover existing resources and capabilities and find opportunities for improvement and transformation.

They represent their territories according to their life experience, sense of belonging and local knowledge, an extremely important richness when planning or managing for development. Maps are tools for understanding places, building awareness, reduce vulnerabilities; visualizing, representing and communicating; they stimulate analysis and provide holistic and systemic perspective essential for better strategies. The inter-action between different actors in map-making contributes in the creation of a unique comprehension of territories which entails the co-production of a new vision and knowledge. In this sense, it is explicative the idea of “performativity of maps” by Del Casino & Hanna (2011) who considers maps not as fixed objects but in constant flux of becoming and producing new meanings and engagements. Resulting from
the complex interplay between maps and the world they represent, the two scholars assert (ibid.), spaces and maps are able to co-produce each other through their construction, transformation and use. Community mapping has been adopted worldwide as a ground practice in different contexts and with various purposes. An example of the current effective application of this kind of hands-on methods is the work of the Asian Coalition of Housing Rights (ACHR) through the Asian Coalition for Community Action (ACCA) program. The ACCA Program was set out to transform development options for Asia’s urban poor by supporting a process of community-led change in 19 Asian countries. It is carried out with the support of the Community Architects Network (CAN), operative partner of ACHR. Community mapping (particularly sketch mapping and scale mapping), coupled with saving scheme programs, is the main approaches adopted on the ground to support poor communities in taking the initiative from below, scale up their actions and contribute in development processes. With these objectives communities get together and carry out mapping activities both at the settlement level and at the city level. Then, pushing for platform of dialogue with local governments, they design intervention and draft comprehensive site planning with the support of young architects and experts (Archer et al. 2012).

The research work whose this paper is about, was inspired by a field work developed in central Vietnam within ACCA program in 2013. The practice on the ground unfolded in Hung Hoa Commune, a peri-urban area of the city of Vinh made of nine villages, through a map-making process carried out with local communities. The area is affected by significant flood once a year which destroys one of the two crops potentially available, mainly caused by an inadequate water drainage system which cannot support the load of heavy rain during the monsoon time. The community maps focused on the design of the drainage system upgrading since recognized by people as their priority. The mapping sessions revealed the technical expertise of farmers embedded in their everyday working life, highlighting their struggles when trying to manage the flood damage both over the rice fields and their houses. Cadastral maps provided by the local government were used as a base for community scale mapping.

These were the same maps adopted by the government for rural development planning thus entailed a good mean of interaction. Community members independently identified existing ducts to be upgraded and planned the construction of those missing, first hamlet by hamlet and then working together on the entire commune’s system.

The process was definitely successful: community maps were presented to local government which welcomed the community effort with interest and started considering people involvement in other communes located in the peri-urban area. This was a small but important achievement as community participation, particularly for infrastructure upgrading, is not praxis in the country of Vietnam.

Community sketch and scale mapping can be conceptually located within “counter-mapping”, defined by Harris & Hazen (2006) as any effort that fundamentally aims at contesting and undermining predominant structures both regarding cartographic conventional products or processes, and in relation to power hierarchies and spatial injustices. The term “counter-mapping” was introduced by Nancy Peluso to refer to mapping practices by indigenous people in Kalimantan, Indonesia as they successfully made maps to contest Indonesian state land-use plans (1995). However, from that experience the term kept resonating not only to refer to indigenous mapping, but also to other experiences and practices worldwide such as protest maps, map art, critical cartography (Wood 1992), community Parish Maps (Clifford 1996) and the critical GIS literature (Sheppard, 1995, Schuurman, 2000) which more recently developed towards the Participatory GIS practice. Participatory GIS (PGIS), in fact, originated in the in the 90s with the idea of emphasizing community involvement in the production and/or use of geographical
A participatory GIS celebrates the multiplicity of geographical realities rather than the disembodied, objective and technical ‘solutions’ which have tended to characterize many conventional GIS applications" (Dunn, 2007, p.616). Under this idea, several different approaches have been developed such as Public Participation GIS –PPGIS (NGCIA ,1996); Community-integrated GIS (Harris & Weiner, 1998); Participatory 3-Dimensional Modelling (G Rambaldi and Callosa-Tarr 2001) and GIS for participation (Cinderby, Snell, & Forrester, 2014). Their applications range over different forms and levels of people involvement. Sometimes focusing more on the attempt for them to directly manipulate digital and official spatial data, in other cases mobilizing people in data gathering through traditional participatory methods (transect-walks, focus groups, questionnaires etc.) to digitalize information through experts’ desk work in a second stage. Some projects of PGIS (e.g. Map Kibera in Kenya) involved web mapping through open sources - such as OpenStreetMaps or web GIS created *ad hoc* - with the use of related tools by the community (applications for smartphones -e.g.Ushahidi- or handheld GPS). Other important experiences put the attention on the representation of “tacit” local knowledge, particularly related to spatial knowledge and its possible integration into GIS. Some approach on PGIS developed more in the North, while some scholars attempted the use of GIS in the developing world (Abbott, 2000, 2003; Sliuzas, 2003; Rambaldi et al., 2006). Some interesting results of these attempts are the enhancement of communication within the process through the adoption of small format aerial photography (SFAP) to engage with communities on the ground (Sliuzas 2003); the community active involvement in data gathering (Abbott 2000, 2003) and the participatory creation of scaled and geo-referenced relief models, like in the case of Participatory 3 Dimensional Modelling – P3DM (Rambaldi and Callosa-Tarr 2001).

Specifically, P3DM is a participatory mapping method based on extracting topographic information from scale maps and then, together with local communities, constructing a physical and geo-referenced 3D model, which inhabitants easily use to map their settlements and territories locating directly on the model any kind of features (Rambaldi, 2010). The method has been adopted in Africa, Caribbean and Pacific (ACP) area through the technical support of the Technological Centre for Agricultural and Rural Cooperation (CTA) which operates within the ACP-EU development cooperation.

In diverse areas of several countries, P3DM was adopted by NGOs, CBOs and/or local governments with great success, mainly focusing on participatory natural resource management and planning.

As part of the research work of which this paper is about, a participatory evaluation has been carried out in March/April 2016 in Western Samoa. The intent was to explore the practice of Participatory Three Dimensional Modelling in the country within a five years GEF-funded project (ICCRIFS 2011-2016) executed by the Ministry of Natural Resources and Environment (MNRE) through implementation support by United Nation Development Program (UNDP). P3DM was adopted for increasing the resilience and adaptive capacity of communities to climate change into forestry management.

While the main purpose was to sensitize communities on climate change issues, as well as planning and implementing practical actions aimed at increasing their resilience, the contexts and the spheres of intervention that have been addressed through P3DM in Samoa were various and the success of the tool’s application in these different fields of interest demonstrates its great flexibility and adaptability. The participatory evaluation from a sociological prospective focused on physical and socio-behavioural changes triggered by P3DM. The study revealed the significant transformation effects of the practice at different levels and within different dimensions; the benefits that this work on the ground is bringing about and the practical constraints encountered. The case of P3DM practice in Samoa represents a particularly interesting case and important precedent for two main reasons: firstly, while generally participatory processes are embraced at the community level with the intent of building platforms of dialogue with local
authorities, in the Samoan example the initiative was taken at the government level and the process of models’ construction was used to actually reach communities, get their trust as well as ensuring their valued involvement. Secondly, P3DM in Samoa due to its important role in building communities’ awareness on climate change impacts and mitigation measures, is on the way of becoming a consolidate practice in resource management and development planning.

Results and discussion

In both, North and South the PGIS has been adopted in urban planning, revitalization, natural resources management and preservation, settlement upgrading, conflict management, land access, service access. Generally, for practitioners involved in PGIS, this practice has a significant potential for community empowerment in development processes; its utility is widely recognized, since contributing in building legitimacy and advocacy from below (Rambaldi et al. 2006). This idea is based on the evidence that local inhabitants possess expert knowledge of their own life environments which can be expressed in a geographical framework, easily understandable and universally recognized. Although the variable levels of success of different forms and modes of GIS democratization worldwide, the pitfalls and constraints this practice encounters are many and the attempt to put “GIS into a technology with a social conscience” (Dunn, 2007, p.617) is quite controversial continuously navigating among criticism, optimism and frustration. One concern within the debate is that, being GIS historically and widely used in top-down spatial decision-making, its use in participatory processes from below could result in forms of co-optation and in doing this it could contribute to perpetuate hierarchical and established patterns. This probably depends on how the tool is conceived and used, yet, one of the main questions among scholars is whether GIS can be truly “participatory”, directly handled by communities, since it requires a certain expertise to be used and, despite the great potential about what this instrument can actually do for community work, it is not considered user-friendly. Moreover, how the deepness of local knowledge, the richness of people involvement, the amount of qualitative data (culturally and socially meaningful) not always with spatial reference, not always precise, not always scaled, can be integrated into a GIS and well represented within such an exigent tool, is still debated. ‘Capturing local knowledge in a GIS that relies heavily on the spatial primitives of points, lines, polygons and the quantitative ordering of info is not easy task’ (Craig et al. 2002, p.247). Another issue discussed is the opportunity of capacity building on GIS knowledge both at the local government level and at the community level, as well as the sustainability of this local expertise in the long term. Furthermore, the process of map-making and of PGIS in particular, include questions of access, control and ownership of information, data and outputs (Dunn, 2007) to be adequately taken in consideration both by facilitators and communities themselves, particularly when these questions become “sensitive issues” (Fox et al. 2006).

Regarding the two case studies analysed in this paper, the experience in Vietnam highlights the potential of the mapping tool and confirms its success, however regarding the outcome, in terms of “product” of the participatory process, it can be said that the basic hand-drawn maps did not do justice to the great work community members carried out. In particular the possibility of adoption by officials and experts of the precious information and knowledge contained in the “drawn-papers”, to be used in the planning process, was definitely limited. An experiment of digitization of maps’ information through GIS, made by the author after the fieldwork, demonstrated the importance of this data elaboration. This allows, indeed, a form of representation of information gathered and communication of design proposals developed during the community mapping process which technicians and policy makers most likely would find more credible and, particularly, more usable. Furthermore, geo-information instruments permit a more complex and integrated analysis building up on the good base of community
knowledge and experience. In this sense, the case of Samoa draws attention to the potential of a mapping process which not only moves from the 2d dimension to the 3d dimension bringing about great benefit to community work and contributing to its efficacy, but also shows how the P3DM method significantly facilitates the digitization process of information through the direct “geo-referenced manual population” of the physical relief model.

**Conclusion**

Combining tools of modern cartography with participatory methods to represent spatial and social features through the experience of inhabitants and the interaction with experts and officials, gives the chance to local expertise, embedded in social and cultural understanding of places, to be expressed within geographical framework, integrating scientific knowledge on official maps and contributing to create a solid base for concerted planning and community-driven resource management.

This is to say that for proper co-production knowledge in development processes it is essential a hybrid approach. This should be able to welcome and integrate, in a useful and proper manner depending on objectives and specific contexts, different methodologies. Without replacing one instrument with the other, it is about finding ways to combine different methodologies which can benefit from each other, giving the right autonomy and relevance to each and considering their contribution to planning processes equally valuable. Community map-making and PGIS include two different languages that can be complementary, as expressing differently about the same place, they can learn from and enrich each other. This relation is expressed in the belonging of both community mapping and PGIS to counter-mapping practice, where ‘counter-’ should be considered in its double meaning not “being against” but instead “being complementary” or “occurring simultaneously”. In this latter sense, map-making from below is for design and planning what can be considered a counter-narrative of space production; while PGIS can be considered a “counter-melody” by a geo-spatial trend which aims at being more social sensible. However, the conditions which can allow communities to actually approach technologies in the right and effective way, still need explorations. The possible loss of information, particularly in terms of socio-cultural features, when converting data in digital forms, should be considered and faced. The collective and social nature of practices should be preserved and not only in the community mapping process itself, but also when the digitization phase occurs. Moreover, the relevance of tacit knowledge should always be cared. Digital inequalities and access constraints to technologies should be weighed and the possibility for community members to be trained on new tools should be promoted and sustained. Through the analysis and critical reflection on studies and experiences, the intent of this research work aims at delineating the hybrid approach which best combines different methodologies, technologies and practices, possibly replicable in different contexts and with diverse purposes. This intent has a bidirectional objective: on one hand to get professionals and government officials closer, respectful and more aware of people expertise and importance of community involvement in design, planning and resources management. On the other hand, fostering the co-production of knowledge, through communicative and usable ‘products’ of participatory ‘processes’, which gives authority to inhabitants’ contribution while enabling the institutionalization of concerted procedures within development practice.
References


Flexible Design to Smart User-Centered Territory

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Key-words: User oriented approach, Inclusive Design, Active Adaptability, Spatial Flexibility, Technological Flexibility.

Introduction

The contemporary city is an organism that lives of connection and relationship between the different element and layers that it is made and of everything that exists around it; the same concept of city has radically changed. The speed at which the social and economic context changes, the uncertainty of the tastes and the interests of consumers make spaces unable to be rigidly characterized based on a function but need to be flexible to be readapted to the needs that users are faced with from time to time. Where a space was defined for the positioning of an activity or a service (useful to living in stability the territory), the user change (population made mostly of children, elder people, people with mental and physical disabilities, the poor or temporary city-users) involves rethinking the organization of the city about a new programmatic flexibility model is based on a “logistically open” structure, programmable by subsequent additions and “self-evolutionary” from an organizational point of view (in which the evolution of a part leads to the evolution of the whole). Then a Healthy City that bases its organization on the relationship between design-man-environment, where the design is one of basic human activities – implementing such strategies as to allow humans to improve their living conditions in their relationship with the natural or artificial environment. Suh (1999) defines design as an essential activity that determines the generation of systems, i.e. that associates the users’ requirements with a system that can meet them with matching solutions. The issue of correlation between project and user is not new and has been constantly debated both in practice and in theory throughout the XX century. In this respect, we can identify three generations of approaches to user-oriented design which, despite sharing the objective “of the well-being of humans while being environmentally-friendly”, differ in meanings and man-space relational strategies. Among all of these approaches, the flexible design, analyzed in the paper seems more appropriate to the creation of a smart user-centered territory (Cellucci and Di Sivo 2016).
Methodology: User-Oriented Approach

The first generation of designers, in the last century, pursued functional optimization, ergonomics and distribution efficiency, emphasizing the need for an optimum planning of the city and architectural space. This type of design approach, called Optimized Design, refers to an ideal model of users, resulting from an abstract mean of characteristics of the real population. Optimization thus consists in the choice - in a set of alternatives – of the best design solution to meet a specific objective. We could say that the Optimized Design approach makes the system reliable, i.e. the system will very likely do the job it has been designed for (McManus and Hastings 2005). This type of approach has then evolved towards “exclusive” forms of design, aimed at optimizing design based on specific users categories (young couples, disabled, elderlies etc.) and consequently making it non optimal for the others (Mark 2005). The same Barrier-Free Design, identifying the architectural barrier as the main obstacle to be overcome, draws its approach from Optimized Design, indicating as reference users people in wheelchairs, who become the new standard of an “exclusive” design.

Today we are living in the second generation, focused on more evolved objectives, such as universal design, sustainable and environmentally-friendly design. Undoubtedly, the basic concepts (see Universal Design, Ubiquitous Design, Sustainable Design, Environmentally-friendly Design) of this trend are decidedly more advanced than those of the first generation, since a number of previously neglected factors are now being considered: the care for “non-standard humans”, the need for a urban environment that meets the requirements of users with their different abilities, the importance of the city life cycle and the preservation of the natural environment. From design by standard with Universal Design, Inclusive Design and Design for All, we shift to design “for all” with its objective being to increase the possibility to live autonomously for as long as possible. In spite of the fact that we are now aware of the need for a design that is able to meet the requirements of the largest number of users, if we translated theories into design practice, all these approaches would still keep the attitude of the first generation. In user-oriented design approaches, whether they are exclusive or inclusive, there is a vision of the space, either “adequate” or “versatile”, that is fixed in its shape and its dimension. The same Center for Universal Design at the school of Design of the University of North Carolina, defines Universal Design as “the design of products and environments that may be used by everyone, to the widest possible extent, without need for adjustments or specialized designs” (Steinfeld and Maisel 2012). Such definition explains how Universal Design conceives systems that - without being changed - may be used in a variety of ways, distinguishing it from the third generation of user-oriented design approaches that is Flexible Design (Cellucci 2016).
In the IT sector, a software application is considered universal if it is used in a variety of situations without being changed or modified, while a software application is considered flexible if it can be easily modified or extended, to be used in a variety of ways (Parnas 1979). Stefan Picusa has explained this distinction by comparing two types of adaptability, “inherent adaptability” and “potential adaptability”. In his opinion, the former, conceived in the project design, allows the users to choose how to use space within fixed physical boundaries in a set layout, while the latter is achieved by providing spatial solutions and flexible technologies, which allow for an easy modifiability of the space. The former is “passive adaptability”, understood as a system’s ability to keep operating despite the changes of the set of requirements (resistance to change); the latter is “active adaptability”, understood as a user’s ability to act on the system to meet new circumstances (Madelbaum 1978) (Cellucci 2016).

Flexible Design: Spatial Flexibility and Technological Flexibility

A flexible, adaptable and inclusive approach to design overcomes the idea of space optimization in relation to functions, first and foremost by pursuing the search for an “equal, simple and safe” use (in compliance with the seven principles of universal design) while implementing a reading of the specific needs of users, through the observation of actions in relation to space, technological and functional objects (as urban furniture) and technical-constructive elements featured in the public space (as roofing and flooring technology). The third generation of user-oriented design approach, considers the man/environment relationship based on the complexity of “real” users, expression of the multiple and diversified characteristics that human beings can take or acquire during their existence. Both cities and users are therefore considered as “open systems” in constant evolution. Therefore, the evolution/adaptation of cities to social-economic and technological changes and its technical systems and infrastructures depend from the organization and its relationship before the perturbation, the more the city-system will be flexible all the more rapid will be the resumption to normal activities in a perspective of improvement and awareness. The following table summarizes the results concerning the relationship between vulnerability and strategic levels of intervention, property and requirements of flexible systems (Cellucci and Di Sivo 2014).
Conclusions

The approach of Flexible Design of the city-system can be useful: the uncertainty of the context is such that there is a need to reduce the risks arising from exposure of the system in this uncertainty; the system is subject to one or more target changes, due to variability of requirements of users, requiring a solution to mitigate the risks associated with functional obsolescence, the basic technology of the system evolves in a time shorter than the lifecycle of the system, requesting a solution to mitigate the risks associated with technological obsolescence (Cellucci Di Sivo 2014). This approach involve:

- **Programmatic Complexity**: Space and technology solutions able to ensure easiness of modifiability over time relative to the variability of users needs and the satisfaction of psychological and functional needs.

- **Simplicity in the interface**: Choice of technical solutions capable of guaranteeing the possibility of intervening with easiness on system components, that is ensuring the dismantling, substitutability, reparability of system components.

The properties and requirements identified constitute only an initial and incomplete list of the possible axes of tactical intervention in the design of new and regeneration of cities, towards a resilient, inclusive and need-based vision.

References


Integrated Accessibility: a Macro-Requirement for the Healthy City

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Introduction

The definition of healthy city, expressed by the World Health Organization, underlines a deep responsibility of the technological design in addressing dimensional, functional, and performative relationships of urban collective space. The WHO itself, with the ICF classification, puts in the domain of Environmental Factors the city too (WHO 2006, 139-164). Then, the city is considered as a system of artefacts that can enable/limit or include/exclude people in carrying out their activities related to the urbanity. According to this definition, the city and its collective spaces take on the connotation of a complex inhabiting system that can facilitate or inhibit the bio-psycho-techno-social inclusion. In fact, the design culture of urban standards, since World War II to today, has tied the idea of collective urban space in an automobile-centred vision of the city. The space of the city is focused on the logic of mechanized mobility (public and/or private) that almost completely excludes the possibility to live the city and use its spaces in a healthy way (moving, working, shopping, studying, and relaxing).

To complement the logic of standards – that tends to quantify all forms of the land use – then it is necessary a soft technology (Ciribini 1970, 11-28) for the development of links between organizations of spaces, uses and transformations of the built environment (Amirante 1987, 53-91). A technology that could contribute to the qualitative evaluation of alternative choices and technical-constructive solutions considering three tactical binomial relationships: the technical-individual relationship, the technical-nature relationship, and the technical-society relationship (Ciribini et al. 1970). Urban collective spaces are not then places within which to perform, maintain and improve their physical and cognitive capabilities, find the conditions of participation in collective activities, carry out practices to overcome any disability during daily actions of living together (Edwards and Tsouros 2008).

In these terms, in the vision of healthy city, the issue of accessibility of urban collective spaces – which is one of the urban quality variations – should be seen not as a set of responses that consider only the technical aspects of mobility in the spaces (e.g. types of vehicle or operating times). Urban accessibility is a more complex design issue that must ensure the access to all urban resources (tangible and intangible) extended to all kinds of users (by age, cultures, skills, activities). The accessibility of contemporary cities must therefore be attributed to the overcoming of the concept of dimensional, functional, and performative standard. This expanded declination of accessibility puts in play three concepts that are emerging in the social, ecological, and technological sciences: inclusiveness, liveability, and resilience.

This paper intends to present in the INPUT conference a technological contribution for the design of healthy city, to highlight the innovative directions (methodological and practical) for an integrated accessibility project. This is an idea of urban accessibility understood as a bio-psycho-social-techno...
reconnection between the city’s resources and the health of its citizens, through technologies that can facilitate the development of design solutions considering new needs of inclusiveness, liveability and resiliency expressed by the inhabitants.
Methodology

The issue of integrated accessibility of collective urban spaces defines new design problems in technological terms. How to interpret the urban space not more as a specialized space dedicated to specific functions and users, but as a complex system of integrated “living places” adaptable with the change of people’s skills in relation to physical resources and environmental conditions. The integrated accessibility (IA) requests a necessary change in the use of technical and building solutions. It is necessary to adopt a new design vision for the implementation of an open process with which to achieve the evolutivity of collective space and the transformability of its technical components with the change of users’ needs and abilities. In fact, the goal of IA it is important to establish new spatial relationships of collective space with body structures, functions, skills and people’s abilities to participate in urban life.

From a methodological point of view, it is necessary to recognize the strategic and prosthetic value of collective urban spaces as interfacing systems between inhabitants and resources that, appropriately designed, can guarantee the right conditions:

- To release the urban collective space from the exclusive/exclusionary logic of generic/capsularized city (de Cauter 2004, 40-55);
- To re-think collective spaces as a system within which meet aggregate needs to make healthy, pleasant and liveable the city (NAAA 2007);
- To re-design collective spaces to enable the resilience of socio-technical system called city (ARUP and Rockefeller Foundation 2014).

Those methodological reflections show that the IA assumes the value of a macro-requirement for the design of collective spaces of the healthy city. A macro-requirement which must be declined in both its conditions to satisfy the needs of inclusion, life quality and resilience of citizens, both in the technological-environmental qualities that will characterize forms and performance of collective space.

Results and discussion

The integrated accessibility macro-requirement gives rise to a different conception and design of the collective space of the city. It is to rethink the definition of “urban smartness” not only as use of sensors and digital networks that threaten to cut off more and more the physical relationships between spaces and people. The smartness, in the logic of IA, should be seen as the ability to configure complex systems based on the interconnected qualities of the city and on enabling capabilities of the collective space.

Despite the accessibility theme can be substantially related to the needs of use of the collective urban spaces, with this integrated vision (CESE 2010) (European Commission 2011) it will instead take on a particular relational relevance to the expanded framework of inclusion, liveability, and resilience needs of the inhabitants.

What are the possible roles that the technological culture it can play as part of the implementation process of the integrated accessibility macro-requirement?

In the design performance based approach, a requirement can have a dual connotation: as a quality descriptor, addressed to conceptualize the conditions of satisfaction of one or more users’ needs; as a parametric indicator of quality, aimed to measure performance of the technological system. In these terms, must be identified the integrated accessibility conditions of the healthy city (how to think the IA) and its measurability domains (what to implement for the IA and how to evaluate it).
Integrated Accessibility: How to think it?

Among the results (still in progress) that can be expected from the actualization of the IA macro-requirement, we can first identify a new framework of conceptual, strategic and implementation relationships/connections that become part of the design process of collective space of a healthy city. Before thinking about the form, functions and performance so that a collective space can respond to the IA macro-requirement, it is necessary to work on the following aspects:

Inter-scalarity. The issue of accessibility of urban collective spaces must be focused as a re-connection among the strategic-programmatic aspects of planning and the operative-constructive aspects (Angelucci and Di Sivo 2013) in a phase referred to as “tactical” (Giribini 1978). In this sense, it would be possible the governance of the «no man’s land» (Giallocosta 2006, 119-126) that has come into being as a result of the segmentation of competences operating at the large scale and others acting at the building scale. In particular, they can be identified the conditions to transfer the long time general goals into the middle-short time local actions that vary with the mutability of the behaviour of the inhabitants.

Interfaces. It is necessary thinking and designing the IA to urban resources using technological-environmental interfaces between open and closed spaces of the city. This permits an integration of actions with an effect on the global/local urban system in accordance with a vision that returns to considering the «making» of space and the «making of the city» (Landry 2009), focusing less on buildings, city blocks or quarters and more on co-evolutionary technological-environmental entities.

These entities should rebuild and cultivate virtuous relations between the inhabitants and resources of the city. It is necessary to work on spatial planning areas (axes, intersections, borders), spatial units (streets, plazas, green-fields, third landscapes) and spatial sub-units (street-building cross-sections) (Angelucci et al. 2015).

Aggregated qualities. It is important to address the IA of urban collective spaces by designing technological-environmental interfaces compared to a more complex framework of needs that go beyond the specific requirements of technical components (e.g. safety, use, management). This new needs framework will include new requirements of inclusion and resilience as: ecological-environmental, socio-organizational, and technologic-space aspects; urban liveability requirements related to the access to health conditions (e.g. light, shade, air, green areas, water etc.).

Universality. It is important to think primarily in terms of an IA continuous collective space for healthy of all the inhabitants. It is necessary to exceed the idea of standardized generalist space, but also that of dedicated space for specific users; it is also important to consider the evolution/involution of people’s skills in relation to the performing/evolving capacities of the space tending towards the concept of adaptive customization.

Integrated Accessibility: What to implement and how to evaluate?

The integrated accessibility macro-requirement, as capability to satisfy a complex framework of complementary and highly interdependent needs of inclusion, liveability, and resilience, it also requires an ability to configure space out of the logic of quantifiable performance of specific components.

This new designing framework will provide for the possibility to use single quantitative indicators (Performance Based Approach), but also evaluation systems extrapolated from good practices and design experimentations (Evidence Based Approach).
The new design framework for integrated accessibility of collective spaces will have to consider three different aspects.

The inclusive relationships that urban collective spaces can establish with: the variability of users’ bodily functions (proxemics characteristics and gestures); the different body structures of people (anthropometric characteristics); the physical activity of citizens (walking, running, crossing, relaxing), and their levels of participation (Gehl 1991, 141-196).

The liveable configurations of collective space in conditions of: comfort (air, light, shadow), safety, dimensional/morphological adequacy (shapes, colours), environmental qualities and identification, economic management (maintainability with directly actions of users).

The enabling capabilities of collective space to facilitate the resilience of: people and natural resources (care/maintenance of natural heritage as physical/recreational activities), individuals (adaptation induced by the quality of space); organizations (change in collective practices); artefacts (convertibility of spaces and equipment with the involvement of users).

First elements of application and open conclusions

The vision of healthy city assumes that the concept of well-being of citizens and smartness of the urban settlement must be re-interpreted in a systemic and integrated approach. Mauro Bonaiuti, referring to the “paradox of well-being”, specifies that the idea of building or city as a concentration of more and more innovative technical solutions, also acting for sustainability, generates an increase of new needs.

The methodological proposal put forward in this paper summarizes the first results emerging from some experimental activities we are conducting with our research group BETHA (Built Environment Technologies and Healthy Architectures) on the DeLiCiA project (Designing Livable City for All). In a case study area localized in Pescara are being analyzed:

- aspects relating to the conditions of satisfaction of the IA macro-requirement operating on interscalar/tactical level, by technological-environmental interfaces, aggregate qualities, and with different kind of users.

- aspects relating to the ex ante/in fieri evaluation of the satisfaction levels of IA macro-requirement, through the development of tools for the analysis of inclusive relations, livable configurations, and enabling capabilities of intervention proposals.

Surpassing the concept of technique only as a service resource for the quantitative productivity dynamics, is now also necessary to rethink the accessibility of the city as an opportunity to integrate biophysical, socio-economic, cultural, human and technical resources. The accessibility of healthy city should thus be seen as the capacity of maintaining and improving the conditions of well-being of citizens, and resources that can generate such conditions. Resources with which to re-establish a new framework of relationships between nature, man and techniques and open the transition from the current rationality of intensive building production to a reasonable “care” of the city and its inhabitants (Pope Franciscus 2015, 142-156).

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Environment – Cities – Users: a multidisciplinary approach for the quality of urban spaces

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Key-words: urban quality, environmental analysis, perceptual analysis, Tomographic Environmental Section (TENS), Perceived Residential Environment Quality Indicators (PREQIs).

Introduction

From the late eighteenth century, man’s relationship with the environment has changed and continues to change at a rate such that the events of yesterday have already passed. At the same time, the future prospects are uncertain and almost always unpredictable in their evolution, giving us the impression that we are living a "critical period", both from social point of view and environmental. Among the many changes, those affecting the environment and the related problems, have played a decisive role over the past 50 years, coming to represent "the most important social problem in the world".

We are faced with an environmental crisis of vast proportions: a crisis that is causing, and will cause problems so complex as to require ‘new ways of thinking and acting’ (Pozzati and Palmieri, 2007).

State of the art

The studies aimed at understanding the causes of the progressive increase of the earth’s temperature attribute the 40% of energy consumption and air pollution in urban structures and buildings. This, in itself worrying, becomes alarming when analyzing the social implications that this involves for humanity, in economic terms, health and safety.

There is a clear need to re-think in ethical way, the technical and scientific world, which is facing social and environmental issues.

Several scientific studies, in architecture and environmental psychology, demonstrate the influence of urban design in causing stress conditions or in promoting well-being and high quality of life for users.

Through the UnHabitat Program, the ONU define as Equitable Prosperous Sustainable, that city that manages to be:

1. a Safe and Healthy City
2. a Green City
3. a Resilient City
4. a Productive City
5. an Inclusive City
6. a Planned City

However, it is obviously complex to consider, in the urban space’s design, all those elements which contribute to built a comfortable, healthy and safe environment. But it is the only way to design real smart cities; in which, citizens and public administration cooperate in establishing common objectives, to recovery and promotion of the wide historical, artistic, natural, cultural and societal heritage, that characterizes our cities.
Methodology

The research aims at join two evaluation methods of the environmental quality, at neighbourhood scale. The first tool: Tomographic Environmental Section methodology allows to estimate the performances of outdoor space in terms of physical aspects. It permit to evaluate physiological comfort through the PMV. The second one: Perceived Residential Environment Quality Indicators provides the valuation of psychological comfort, through an index based on statistical analysis of assessment questionnaire administered to residents.

**Tomographic Environmental Section (TENS)**

The complexity of energetic and environmental phenomena, at urban scale, requires an integrated approach to their analysis and resolution. The TENS method seems to be the most appropriate instrument; because it can identify elements, often not visible to the human eye, but able to make the urban spaces more livable and to improve their quality.

The methodology, developed by Maria Federica Ottone and Roberta Cocci Grifoni, allows to calculate the climatic functions resulting from thermal mass, air flow, and sun exposure. It is not only a qualitative synthesis tool, based on dimensional or formal parameters, but is also based on a range of physical and environmental data. TENS should be used in a repetitive and continuous mode along the urban cavity, along with environmental cross-sectional tomography in order to manage urban project requalification. Tomography is a method of exploring a phenomenon through a large number of perspectives. The sections, repeated at close range, explore deep into the earth and above, measure distances and heights, determine relationships between what is immaterial and material and define the intrinsic qualities of individual objects. Environmental tomography applies this approach to the study of urban areas and can be considered a methodology of diagnostic practice for a new environmental strategy.’ (Ottone and Cocci Grifoni, 2012)

To evaluate comfort condition in outdoor spaces, the TENS tool consider Fanger’s equation and the Predicted Mean Vote (PMV). A Predicted Mean Vote around zero (-0.5 to +0.5) indicates comfort. Deviation from zero is referred to as thermal stress and varies on a seven-point scale from -3 (cold stress) to +3 (heat stress). To apply the TENS, it used ENVI – met Software: it is an efficient tool that analyzes micro scale thermal interactions in urban environments. ENVI – met is a three dimensional non-hydrostatic model for the simulation of surface-plant-air interactions inside urban environments. It aims to reproduce major processes in the atmosphere that affect the microclimate on a well founded physical basis. It is designed for micro-scale simulations with an horizontal resolution from 0.5 to 10 m; with this resolution is possible to obtain a really detailed reading of the microclimate changes, especially sensitive to urban geometry and relevant for comfort issues and the analysis of small-scale interactions between buildings, surfaces and plants.
Perceived Residential Environment Quality Indicators (PREQIs)

The perceived quality assessment of urban spaces is the subject of numerous studies and several tools have been proposed to conduct analysis to that effect. The analysis based on Perceived Residential Environment Quality Indicators has been considered the most compatible with the TENS; considering the size of the investigation field and type of collected data.

The PREQIs is a tool to analyze and verify the quality of urban environment, perceived by users, developed and perfected by Marino Bonaiuto, Ferdinando Fornara and Mirilia Bonnes (Bonaiuto, Fornara and Bonnes, 2006); this tool analyzes four macro-valuation aspects of residential quality:

1. Architectural/town-planning features (three scales): architectural and town-planning space (22 items), organization of accessibility and roads (14 items), green areas (10 items);
2. Socio-relational features (one scale): people and social relations (24 items);
3. Functional features (four scales): welfare services (12 items), recreational services (16 items), commercial services (eight items), transport services (eight items);
4. Context features (three scales): pace of life (16 items), environmental health (eight items), upkeep and care (12 items).

The tool consists of a self-report questionnaire; it is administered to residents in the urban area object of analysis. The collected data are interpreted using mathematical models that allow to synthesize them in a perceived quality index. From identified indicators, it is possible to develop the synthetic thematic maps that recall the four macro-valuation aspects of residential quality.

Results and discussion

The overlap of the results obtained by the two analysis tools, allows to identify those which can be defined implementable areas, on which action to improve urban quality, from an environmental and perceptive point of view.

The analysis of the TENS output data, on air temperature, relative humidity, wind direction and intensity and PMV, provides a comprehensive picture of urban comfort conditions. This data is then interpolated with the framework of needs and performance obtained through the perceived quality, evaluated by the PREQIs tool. So it is possible to consider all design variables, responsible of the urban quality.
Combine the results of both tools may appears not easy: the TENS gives us a graphical output, while PREQIs produces a numerical index. We have studied an empirical model to add at the TENS maps a conceptual graphic synthesis of the PREQIs results. We have developed, through Excell, a scatter plot, where the Cartesian space coincides with the grid (mesh) of the analysis made by ENVI - met. In this way it was possible to locate the neighborhoods within the diagram and allow the overlap of PREQI indicators on the map of environmental tomography.

<table>
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<tr>
<th>QUESTION NUM.</th>
<th>DISTRICT 1</th>
<th>DISTRICT 2</th>
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**Fig. 2. The subdivision of neighborhood based on the Cartesian grid.**

This was made possible by assigning a space defined by xy values for each analyzed area, locating the districts (neighborhood) on the abscissa and on the ordinate. We then reported the answers of PREQIs questionnaires, developed exclusively in the Yes or Not form, on the graph. Obviously, it was necessary to calibrate the proper place in the abscissa and ordinate of the answers, to match results to the location of each area of analysis in the scatter plot.

**Fig. 3. The graphic rendering of PREQIs analysis**

In this way we have obtained a diagram, that is graphically superimposed on the TENS map. The overlapping generate an image of urban comfort, from which we can extrapolate the relationship between physiological comfort and quality perceived by users.
The obtained conceptual map represents a simplified tool able to interpret the features of outdoor spaces in a dynamic way. By the reading of this map, it is possible to understand the relationship within the urban form, the environmental resources and the perceived quality. The correct analysis of the urban outdoor space allows to define the interventions necessary to obtain benefits in terms of comfort, health, safety and social inclusion. As a result of the correct data reading, the project will define the most appropriate means to obtain the best possible configuration based on all the aspects that contribute to define the urban space.

Completed the empirical phase, now we are carrying out the experimental one to check the methodology, through the application in a case study: the city of Ascoli Piceno. Despite the application phase is not yet complete, the data so far obtained lead us to affirm that the overlap of the results of TENS analysis and those based on PREQIs is not only "compatible", but even complementary from the point of view of the data analyzed and the results obtained.

**Conclusions**

We can consider the environmental quality as the perfect synthesis that is established through the control of various interactions: physical, sensory and functional, that are established between users and the environment where they live. Often, the analysis of those aspects are carried out in separated way; this doesn’t allows to evaluate the urban quality, in its complexity. The proposed study aims at provide a user friendly tool, for a careful reading of all the factors that define the outdoor urban quality (architectural, physical, environmental, perceptual). By this investigation methodology may derive more aware and sustainable urban development models, able to draw the city on a human scale.

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Walk, See, Know: Modelling Landscape Accessibilities

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Key-words: landscape, maps, modelling, visualisation, walks.

Introduction

The aim of this paper is to propose a method for the sustainable fruition of the landscapes based on their representation. According to this method, representation can be an effective tool able to foster the accessibility of the territories in physical, visual and knowledge terms, which are not separate levels of fruition but can be seen as strictly linked. Thus, in this paper are discussed the Visual Landscape Maps, or "map of accessibilities to landscape resources". The Visual Landscape research can give a contribution to the identification and to the communication of the landscape resources, fostering their physical, visual and knowledge accessibility. Accessibility and visibility are effective knowledge instruments; and knowledge is the most effective strategy for the preservation. What it is accessible, visible and known to the wider public can be more easily preserved. In this way, the representation and communication of resources and knowledge are being increasingly configured important tools for the preservation of the heritage and for socio-economic development of territories. Indeed, landscapes are considered the main resource on which basing the social and economic development policies of the rural and marginal territories in crisis, so it is necessary to focus the research activities on the exploration of sustainable uses and of strategies of preservation.

The Visual Landscape Maps are aimed to draw a network of pedestrian paths for the perception of landscapes and for the connection and the crossing of the territories allowing knowing the regional environmental, cultural and historic heritage. All the territories, if properly designed, can be travelled on foot, through different routes that allow drawing new tourist flows interested to the knowledge of new places and to a different perception of the landscape. Visual Landscape (Nijhuis et al. 2011) is a science that investigates perception, representation, and communication of landscape in relation to the new demands emerging from the territories and their local populations. Visual Landscapes is a research project aimed to the identification of new paradigm of landscape fruition, through the integration of different tools and methods as GIS, maps, modelling, spatial analysis, geomatics and digital visualisation in order to investigate and to represent the landscapes and their scenic beauty as tourist resources.
The visual dimension of landscape

Although it is not possible to give a unique and shared definition, the concept of landscape - as a cross-cutting theme to many disciplines - remains inherent to the perception and visualisation of the environment and to its multiple dimensions tangible and intangible. The “European Landscape Convention” defines landscape as “an area, as perceived by people, which character is the result of the action and interaction of natural and/or human factors”. This definition highlights the importance of perception in the analysis of the landscape and officially introduces this topic in the development of policies for safeguarding and enhancing the landscape. Although ‘perceived by people’ refers to a holistic experience with all senses (Palang and Fry 2003) and different dimensions – cognitive, affective, interpretative and evaluative (Ittelson 1974) -, it is generally considered in visual terms because, for the human being, vision is the primary way of knowing the material world. Since the primary way of knowing the material world is through vision (Harris, Ruggles 2007) it has been emphasized the optical-perceptual component compressing and placing at the margin the other sensory aspects (Salerno 2015). The scientific debate on landscape preservation tends to focus mainly on the production of atlases, focusing on the definition of criteria for the classification of the different typologies and devoting less attention to the relationship between representations and transformation process. Recently, the attention of researchers has mainly focused on the objective measurement of visual quality of the landscape and in terms of aesthetics preferences of users. For its complexity and for its multiplicity, the research area of visual communication of landscape, for both educative and consultative purposes, has been little studied in spite of the technological innovations and the numerous areas of application. However, it is still one of the most interesting fields of experimentation in the field of the protection, design and enjoyment of landscape. Visual communication of landscape has a long history in environmental management, particularly in landscape architecture and planning. Particularly, the visual landscape research has a long tradition that has its roots in the research on the representation of the perception of the urban environment studied by Lynch and Cullen in the United States. Starting from these studies, in the 1960s in the Netherlands was developed a long and important tradition of visual landscape research studied by De Veer and Burrough (1978), which continues until today. In the last decade, the landscapes visualisations have spread in the field of the environmental impact assessment, of the involving of local populations in the decision-making on landscape interventions and on the communication of environment changes (Sheppard 2012). Landscape visualisations are used to communicate both existing conditions and alternative landscape scenarios, past and present. Views of scenarios are important engagement media for communication within the broader context of participatory decision-making. Indeed, the results of the planning and forecasting processes, as well as the representations of the historic landscapes, are often too abstract to give a clear vision of the future for non-specialist public.

Modelling accessibilities

The concept of accessibility is generally measured using accessibility indexes (Talen e Anselin, 1998), but there is not consensus about “accessibility” definition (Lotfi, 2009). It is a concept well known in the field of transport planning since 1950 when it was defined as the ease of getting desirable destinations (Hansen, 1959). More precisely, accessibility is the ease to reach a destination location from a origin place by a certain transport system (Morris et al., 1979; Johnston et al., 2000). Furtermore, accessibility is interpreted also as the ease how a building, a place or a facility can be reach by people and/or goods and services (Cowan, 2005, p. 2). Handy e
Niemeier (1997) suggest that accessibility is defined by the spatial distribution of potential destinations, the ease to reach them as well as the attractiveness, the quality and the characteristic of the activities in the destination place. Accessibility also refers to an individual’s ability to take part in activities (Lau e Chiu, 2003); in other words is the capability to participate to activities considered “normal” for own society. Finally, and more generally, accessibility is defined as the relative closeness or proximity between places (Tsou, et al., 2005). From this summary of accessibility interpretations it is possible to understand that the measures of the accessibility concept depends on own personal way to read the idea of accessibility. In this sense, it seems to be more appropriate to refer to the plural concept of accessibilities.

An essential difference, corresponding to two different fundamental approaches to accessibility measure, is the way to see the fulcrum of the analysis: the space characteristics or the individual capabilities. Measure methods are therefore divided into place-based and people-based. In an objective approach (place-based measure), an accessible space is the one which many people can reach, instead, in a subjective approach (people-based measure), accessibility is relative to different people; this means, different needs, capacity and opportunity. Also, accessibility can mean the freedom or the ability of people to achieve their fundamental needs. In the first case the accessibility for the individual $i$ to the destination $j$ can be interpreted as a function $f$ of the distance $d$ between $i$ and $j$; in the second case, the accessibility is a function of the satisfaction or utility $S$ that the individual derive from the service $j$.

According to Koenig (1980), place-based measures derives from a measure of space characteristics and space distances, or number of opportunity in the space; while people-based measures derives from the idea that people associate an utility to each destination, the total utility is positive if the gross utility is greater than the travel cost. It is a measure that can be based on individual characteristics and the capacity to reach places.

Perception and accessibility are strictly connected. The visual experience has to be considered in the modelling of the accessibility, investigating people perception of space characteristics and estimating the importance of each criterion. Psychometric approaches are adopted to study the relationship between human environment evaluation and its characteristics. This kind of analysis can be conducted by econometric models to estimate how space attributes influence the perception of walkability, or to estimate, from an economics point of views, the willingness to pay to make changes in the landscape. For example, Tempesta, Vecchiato and Girardi (2014) have studied the impact of high voltage overhead transmission lines on landscape quality and the willingness to pay of the Italian population to eliminate the landscape impact. The results demonstrated that the willingness to pay per kilometer of power line eliminated is higher in the mountain and hill natural parks than in the other areas considered. Same procedure is also used in urban contexts, such as Ng et al. (2015) or Muraleetharan et al. (2014) that respectively have studied the impact of tree planting in street canyons and the definition of weight relation of importance between space characteristic of walking needs.

All this examples uses urban space or landscape representations to describe it, using 3D representations, photos and photomontages or video sequences to illustrate the subject of the analysis. Results of the analysis can be used to fine-tune the accessibility models, validating and weighting the indicators according to individual perceptions of the space.

**Methodos and tools for the Visual Landscape mapping**

The 3D digital technologies has been widely applied in the fields of the architectural and urban cultural heritage, because it is an excellent means of giving access to the cultural content as well as being a hub for collecting information (Ippoliti, Menesini 2010). However, on the landscape scale this tools and methods have to be still applied in the field of the enhancement of our cultural landscape heritage.
Actually, visualisation has a long tradition in the communication of design ideas. In past centuries this role was played by the three-dimensional physical models, particularly in the Renaissance with the statement of perspective while, at the landscape scale, visualisation of scenarios was based on freehand sketches or, from the last century, on photomontages. The landscape representations take traditionally a variety of forms like models, drawings photomontages and paintings. Furthermore, in the range of graphic landscape representation can be included diagrams, info-graphics, maps, sections, renderings, models and animations. Since the 1990s, the use of digital techniques for landscape visualisation has increased dramatically (Bishop & Lange, 2005). The possibilities for digital representation have been substantially enhanced by the improved capabilities to link CAD, GIS and landscape visualisation software. The common approach is today to compile information in a CAD or GIS database and then generate outputs of different type like maps, rendered images, animated sequences and real-time models where the user can freely navigate a landscape (Appleton, Lovett, Sünnenberg, & Dockerty, 2002).

The landscape representations are often intended to users without the linguistic tools necessary for their understanding. Generally images are produced regardless of the user’s cultural level, preventing their real involvement in decision-making (Empler, Bianconi, Bagagli 2006). As the members of the public have become more involved in decision making on landscape the need for visualisation have increased, privileging forms of expression more ductile and explicit (Novello, Vitali 2013). An Answer to this need has been given applying computer game technologies to the landscape visualisation. Games offer a familiar context to unfamiliar issues and allow people without special expertise entry into multidisciplinary environments backed by the best available data and modelling (Bishop 2015).

In recent years there has been a growing and renewed interest in the research field of landscape visualisation (Nijhuis et al. 2011, Sheppard 2012, Pettit et al. 2014) suggesting a new area of research within the Visual Sciences (Bertoline 1997) focused on landscape, that it can be defined Visual Landscape Science (Nijhuis, Van Lammeren, Van Der Hoeven 2011). Rooted in the descriptive geometry theories and in the projective methods, it investigates the perception, the representation, and the communication of landscape in relation to the new demands emerging from the territories and from their local populations. Visual Landscape Science is focused on mapping and on visualising the perception of the landscape by means of a wide range of theories, methods and techniques for analysis and visualisation, which reflect different approaches to landscape. Research on landscape is going through the integration of different tools and representations. Coherently, Visual Landscape Sciences involves and integrates several digital tools as GIS, maps, 3D modelling, spatial analysis, geomatics and digital visualisation in order to investigate and represent the landscape perceptions.

Landscapes are considered to be the main resource on which to base the social and economic development policies of the rural and marginal territories in crisis. Therefore, it is necessary to focus the research activities to the exploration of sustainable uses and preserving strategies. The Visual Landscape Sciences can give a contribution to the identification and to the communication of the landscape resources, fostering their accessibility, physical but also visual. Accessibility and visibility are effective knowledge instruments; and knowledge is the most effective strategy for the preservation. What it is accessible, visible and known to the wider public can be more easily preserved. In this way, the representation and communication of resources and knowledge are increasingly configuring important tools for heritage preserving and for socio-economic development of territories.

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Introduction

To upgrade public spaces in terms of accessibility requires a plurality of coherent actions and a series of scheduled interventions according to a plan, which represents at the same time a strategic tool as well as an opportunity to implement socialization experiences and to empower citizens, giving them opportunities to be protagonist. As responsible for management of public spaces and guarantor of freedom in safe movement on city routes, the Municipality plays a crucial role to achieve social inclusion by promoting participation to decision making among several stakeholders (final users including the vulnerable groups, those who perform public services, organizations, institutions, committees). The individual opinions of a complex group of stakeholders objectively contribute to reach shared and effective solutions; providing methodological elements can help local councils to consider needs and requirements in the different project they develop, to ensure accessible and safe places for all. Aiming to expand the concept remarked by the Hamburg declaration, according to which actions should be fostered “to enable people and communities to take control of their destiny and society”, since 2012 the Province of Trieste developed innovative models to manage actions and services addressed to people with disabilities. At the purpose, specific projects were supported with funds under the Regional Law 41/1996.

Accessibility as a shared value of space

Following the project ““Change your idea of possible': living independently” (2011-2012) which explored the dimension of private living spaces, at the end of 2012 the Province of Trieste started the project LabAc – Laboratory of Accessibility. It firstly focused on spaces next to the house, then extended the interests to urban spaces and services which help to experience the outdoor environment, especially by persons with disability. LabAc is a project coordinated by the University of Trieste and integrated into the “Zone Plans on Disability Area”, applied to the whole Province territory.

The LabAc project bases upon the approach developed by Universal Design, that is inclusive when addressing the community the task of bridging the gap between the capabilities provided by the people and the skills required from the living context.

The knowledge of the provided capabilities is critical to an effective project: for this reason, we cannot deny the value of the contribution that the users can give to the result, as real "experts" of their abilities who, day by day, directly experience the consequences of a disabling environment.

These experts should be involved since the beginning of the process, and contribute to it from concept to design validation, in a perspective of full and real participation. The design process has the task to point out all the facilitator elements embodied in the built environment. In this sense, Universal
Design is the process that sets the quality of relationships between people and the living context, basing on the inclusive concept of “user” and on the study of the potentialities held by the context to enable people to use and to enjoy it.

ICF (International Classification of Functioning, Disability and Health) represented the cultural leap to a new awareness of the role that the environment plays into enabling or disabling people, in relation to the action they perform in it (Schneidert, 2003). Assuming disability not as individual condition that concerns a minority of people, but as a fact that affects everyone and that everyone can experience in their lifetime, ICF shifted the focus from disability to the overall functioning of a person in relation to his/her temporarily or permanently state, and to and the interaction with a set of conditions. This interaction creates situations of potential "vulnerability" or "risk" - the different types of barriers - and it may induce discrimination. Planning and designing accessible environments, therefore, is crucial to eliminate the risk potential, but it also calls to move the focus from places to people.

**Perceived accessibility and measured accessibility**

Accessibility plays a role in contributing to community wellbeing, but at the same time is a complex concept. It is difficult to define and more difficult to measure, because it evolved into a multi-dimensional construct, consisting of variables that come from both spatial and non-spatial dimensions (Wang et al., 2013, Bisht et al., 2010) able to capture the complexity of social systems. For these reasons a better understanding on the multi-dimensionality of the accessibility construct and its impacts on open space use behaviour can help the design process to improve qualities of public open spaces and their usability. Moreover, accessibility is a relative and dynamic concept, to consider not as a product but as an ongoing process that starts from an initial conflict between opposing needs and which tends to a mutual adaptation of values and behaviours in the shared environment.

Therefore, we cannot define accessibility in an absolute sense, but in relation to the "synthesis of the levels of satisfaction" referred to different user profiles (Lauria, 1993). Considering the functional profiles of persons allows the setting of a rational and methodologically correct assessment of accessibility of the living spaces, because it refers to the person and to his needs, and it is not expression, in abstract terms, of the built environment's features. Moreover, an integrated model of accessibility of open space contains spatial and non-spatial dimensions, as well as a behavioural model that includes the perceived accessibility construct (Wang et al., 2013)
Methodology

Methodology developed in LabAc project is based on different tools, which apply all the stakeholder and foster different goals. The first phase of the project (2012-2013) aimed to set out the governance of the participative process. The second phase (2014-2015) focused on the pointing out of the involved stakeholders’ panel (those who interfere with the transformation process of public spaces) and the setting of operative tools (aimed to support the survey stage, the following working out of recorded data), to get the assumed final products. Georeferenced maps of criticalities for targeted areas is the product addressed to technical offices from municipalities, to plan resources and to schedule interventions. To allow the drawing of such a map, a data recording and elaboration process was developed, finalized to implement a database that could be exploited from an application dedicated to final users to help their mobility. Operative tools, which supported the data recording, were questionnaires and forms (conceived as checklists). At the same time, officers from municipality who joined the surveys, recorded technical facts and data by means of the same forms, implemented with a special “technical” section. Questionnaires provide useful qualitative data when focusing well-defined problems, recognizing what dimensions and concepts they want to deal with and how to manage the achieved data once developed the survey. Therefore, a big effort was paid to develop the questionnaire and the record forms to deliver to participants when they were involved into the diagnostic of targeted areas. The work focused on how to organize the questionnaire (pointing out identification of relevant elements, coding ID, number of given questions, etc.); on how to code categories of required information to achieve, to make them effective for further steps (that is the drawing up of map of accessibility level of the pilot area). Last but not least, attention was paid on how to formulate questions to let all participant to be able answering (that is a question of precision to let responders to understand questions, simplicity, avoiding complicated words with multiple meanings, and neutrality, to prevent implicit influencing the direction of respondent's answers) (Zeisel, 2006).

Pointing out and assessment of accessibility indicators

Data were collected during the participated surveys, that where developed involving citizens, giving them the opportunity to express their qualitative opinion about perceived accessibility and usability of places. The surveys represented the occasion for identifying problems, observing the surroundings from different standpoint, but also developing concepts and decisions to act and plans for what to do, taking the advantage from the other’s difference to order what to do in a new way. For professionals stakeholders, the participated process represent the occasion to extend their skills to do new things and replace old ways with new options; thus improving the ability to contribute to effective solution by using each the other (Zeisel, 2006). Evaluating accessibility with the eyes of weak users (person with disabilities), therefore considering physical and social-psychological variables in relation to the behavioural process, showed that perceived accessibility influences behavioural intention to use or not to use a specific urban space and its facilitating elements. This represents an important information to address plans and projects to improve living quality in specific urban areas, especially those close to main public services. To assess the accessibility level, at first a set of environmental facilitating elements was fixed in meetings developed before the surveys, where also the process was explained to the stakeholders’ panel. Then, the selection was expanded during the on site assessment; the
pointing out of new elements took place according to the shared choice from the involved stakeholders, based on judgment on the benefits coming from their presence/absence along the path. The list of indicators tried to be as inclusive and detailed as possible, to the point of how many attributes and how much detail could be measured without losing objectivity.

The working out of the recoded data
The aim of the LabAc was not to provide a “right” set of factors influencing accessibility. Instead, to provide an operational process to structure a flexible accessibility assessment that accounts different situation suitable to various users (persons on wheel chair, blinds, and persons with low vision impairments, elderly, children among the others) and that is adaptable to different urban contexts. Therefore, to support the making up of a map of accessibility level (that starts from the knowledge of criticalities), other than selecting the built environment factors featuring accessibility, one cornerstone of the project was weighting the elements that facilitate environment to be actually accessible, also, according to how it is perceived.

To get the level of accessibility of a urban path, generated from the working out of the recorded data, a spreadsheet has been set where scores were assigned to each element, from -1 (not responding to regulation requirements) to 3 (best practice) where 0 is the partial and 1 the full meeting to the current regulation. The final assessment is the output of assigning weights to each element, as a balance among those required as essential for law, needful or desired for an enjoyable fruition.

In a following step, with all the data collected (qualitative and quantitative) a georeferenced map has been drafted, at first for the pilot area and then for a larger area within the border of the historic city of Trieste, which contents the main pathways linking key areas and services. This map can be interrogated in some key points and a set of data and key intervention to upgrade the level of accessibility of that point appears, with the suggested design of solution, according to guidelines that have been elaborated by the LabAc board. One more useful fact that appears is the cost of the intervention, that can help planners to schedule intervention according to the available resources.

Results and discussion
The results of LabAc experience showed that selecting and weighting factors significantly differ among different user groups, according to their needs, and between “expert” and stakeholders perspectives. Distinct users groups also stated different environmental indicators as the most relevant and this helped into address the relative importance of each selected factor, by means of weighting. Of course, an intricate frame of reciprocal influence arose, but this was expected due to the fact that needs from different users, especially among persons with different disabilities, often differ in a conflictual way.

Following the first surveys, reflections were made about some criticisms related to the complexity of the surveys (to manage in terms of time duration and representativeness of the pilot group) and the need to collect technical data beside opinions of participants. The developed experiences also showed the lack of appropriate experience of technicians in the field of participative process and expertise in Universal Design. This affects very much the approach to a new way of thinking (and managing the design or design assessment process) for the redevelopment and revitalization of public spaces, in terms of therapeutic and inclusive environment. Beside the achieved results and products, suggestions came for improvement of the operative tools and implementation of useful applications for users, which could exploit the data
from the surveys. Starting from the service “Comunichiamo” available to the citizens from the Municipality website, and by which they can report problems observed in the territory, the idea arose to exploit the database to give back the users information on the facilitating elements on pathways that they can find in the city, and that can help mobility especially for users with special needs. Then the efforts of the LabAc project focused on one side to improve the database (by a targeted campaign to implement the database) and on the other side to implement an application to help people into choosing the best available path from one spot to the other in the city, according to their condition and level of autonomy while moving along barrier free pathways. The APP, available on desktop (from the municipality website) or on mobile devices is under development and the pilot version will be released at the end of June 2016.

Conclusions

Result from the surveys showed inconsistency between accessibility subjectively measured (perceived accessibility) and objectively measured (accessibility for law), and accessibility assessment developed by users not always equated with quantitative measures. While some studies were developed to asses general accessibility in buildings, even though considering the few elements that should be present for law (as i.e. devices to overcome steps, accessible toilets, adequate width of corridors and doors) and a shared semantics for accessibility evaluation in terms of terminology, classification systems, ontological representation was developed in recent works (Bucciarelli and Simoncello, 2012) as far as we know relatively little research has been devoted to examining the accessibility concept from the perspective of potential users. The developed work aims to give a contribution to the knowledge gaps between real accessibility and accessibility for law, examining the accessibility concept from this perspective. The given experience demonstrates that the human process of evaluating accessibility is the key to better understand the different dimensions of accessibility, its variables and its relationship to open space use behaviour. As LabAc project expires July 2016, the interest of the research group at the University of Trieste is focused to validate the achieved tools and, more in general the pointed process, in other city areas in Trieste as well as in other cities; at the purpose, being Roma Capitale Municipal Office interested to collaborate to the project implementation, a protocol agreement is going to be signed to endorse collaboration.

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Multilevel Infrastructures

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Key-words: Infrastructures, Urban Design, Innovation, Territory, Urban Safety.

Introduction

In psychology, resilience is the ability to cope in a positive way to traumatic events, positively reorganize their lives face of difficulties, to rebuild remaining sensitive to the positive opportunities that life offers, without alienating their identity. Applied to an entire community, the concept of resilience is emerging in the analysis of subsequent social contexts to major natural disasters or due to human action. There are economic and social processes, as a result of trauma consists of a catastrophe, they cease to develop or even collapse, dying; in other cases, on the contrary, they survive and, indeed, precisely as a result of trauma, find the strength and the resources for a new phase of growth and affirmation (Colchado 2013).

When setting the research agenda “Local infrastructure as a lever for urban regeneration in fragile territories” following the earthquake that struck the Abruzzo in 2009, we must ask whether the infrastructure can be considered urban and regional innovation agents. Especially if the innovation can be avoiding the adverse effects that have often affected the effectiveness in the past. In short, if you can work in favor of a new cycle of positive innovations, through which infrastructure contributes to improving the settlements quality into contemporary cities and territories.

The renewed centrality that can take on innovation in the field of infrastructure for the city and the territory is based on the assumption that the design of the networks can be considered at the same time as the infrastructure project and urban or territorial project. The involvement of the proximity context of the infrastructure opens up tempting opportunity to test strategies for urban regeneration that raising the quality of the adjacent spaces may also offer opportunities to mobilize private capital available to the perspective of sustainable urban development and socially cohesive.

Considering some significant experiences in different national and international contexts, the research aims to investigate the possible innovations induced by infrastructure projects with particular reference to three important issues (Di Girolamo, 2014):

a. morphological qualification of local contexts and capacity of the project to act as enzyme of urban transformation (Context Innovation)

b. provision of appropriate financial instruments and procedures to be applied to the process of implementation and management of infrastructure projects to the feasibility of interventions (Process Innovation)

c. evolution of housing practices and use of the city that can be drawn tangible benefits from the works of infrastructure, perceived as a vehicle for new meanings and a new local sense of common (Innovation of relationships).
The focus on these different innovation profiles allows direct way to treat the possible innovation, deepening each time the evaluation of its specific effects, and considering the possible added value from the cumulative interweaving of the profiles in the case studies.

The contribution aims to investigate ‘such infrastructure to such contexts’ assuming the prospect of gaining positive innovations as a result of the specific relationships between infrastructure and frames of reference, even before the invention of new types of infrastructure spaces. The innovations in the study are those capable of producing added value, that is capable of contributing to the improvement of the habitability and the attractiveness of the settlements in the inland areas going beyond the specific functional objectives that usually characterize the infrastructure work forecasts.

They will be dealt with in particular the local infrastructure can act as activators environment for sustainable development of the smaller towns in the inland areas, subjected to processes of depopulation and loss of its central functions.

Moving from learning the most successful experiences in the national and international context, we intend to evaluate the applicability of best practices in the context of Abruzzo, and in particular to membership of the seismic centers crater of L’Aquila in April of 2009.
Methodology

A new hypothesis sees networks for sustainability, flexible convergence of green and gray infrastructure, capable as a whole to contribute to the structuring and dissemination of sustainability processes of the urban spaces (Clementi, 2010). It proposes the construction of a new intervention model from the networks sustainability project not only allows the energy efficiency of the urban portion treated, but it is capable of promoting the value of urban intervention and for the administration municipal, both for network operators, and finally to the end users, offering opportunities to extend the environmental improvement processes around. In summary, the envisaged strategy involves a gradual activation of urban catalysts with side effects spillover to their surroundings, with a view to entrust the sustainability strategy of the existing city to the many interventions that are now implemented without taking into account their possible leverage sustainable development effects. This approach was tested on a regional scale with the Reconstruction Plans following the earthquake that hit the Abruzzo region in 2009, through energy, green and water infrastructures that operate on different scales.

Assuming as qualifying objectives of post-earthquake reconstruction of Abruzzo plans to boost innovation (crater as innovation territory) and sustainable development (such as the reconstruction of the sustainability test), the recognized issues of particular importance are the development of ICT technologies, preventive safety of urban structures, the strengthening of cultural and creative local resources and the development of alternative energies, the strengthening of networks for sustainable mobility, building green networks (Clementi, 2012). In particular, preventive safety of urban structures, substantial aspect of the reconstruction strategies to reduce seismic vulnerability, apply operationally the theoretical directions of the Urban Structure Minima (SUM), allowing you to identify the priorities for action to optimize system performance. For each town we are provided the interventions of consolidation of strategic structures and the safety of escape routes and gathering areas. At the regional scale, the individual local units are connected by a road network that is able to guarantee access even in critical conditions for effect of any catastrophic events.

Results and discussion

The expected results from this study concern the definition of guidelines and intervention models to promote accessibility at various scales to the fragile interior Abruzzo territories, taking the infrastructure as a multifunctional development driver. This concerns the achievement of mountain destinations in the post-earthquake territories by a regional tourism, domestic and international, favoring the permanence processes particularly for towns with high quality of the architectural heritage and surrounding landscape, better connected with major transport networks motorways, railways and airports.

Conclusions

In the historical centers, the role of networks is suitable for multiple functions of local and supra-local level. For example, changes from time to time by the main entrance to the old town public space, plug of evacuation routes in case of natural disasters (escape routes), as an infrastructure for the development of ICT technologies, functional network housing service. A Brittoli, one of the municipalities of seismic crater, the Urban Project associated to networks applies mainly to the
redefinition of the access to the historical path, enhancing the ancient Bourbon street fallen into disuse, and providing the opportunity to establish a new center with mixed public and private functions, all inside the Baron's Palace.

More generally in the area of seismic crater could be introduced and tested virtuous mechanisms of utilization of public resources available for repairing and securing the networks of underground utilities, seizing this opportunity to turn the overall urban redevelopment projects, overcoming practices current division into sectors of public works.

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The built environment as a determinant of the public health. An epidemiological survey of the walking behavior in Sardinia

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Introduction

Current projections indicate that the phenomenon of urbanization could affect over 60% of the world population by the year 2030. The built environment will be the one in which the most of the individuals will live and it will exert different pressures at all levels of health: physical, mental and social.

A significant finding, as an example, points out that since the early 90’s the world’s population with access to safe drinking water has increased, but the estimate of people to whom this still is not guaranteed is about 768 million individuals, corresponding to 4% of the urban population of the entire planet (8). To undermine the public health there are not only hazards in relation to the drinking water supply, but various other risks present in the built urban environment (i.e. disposal of solid and liquid waste or air pollution) (6).

So, as the urban and peri-urban environment is the one in which people spend almost all their life, the scientific community recognizes both the potential adverse effects (the aforementioned risks) and the beneficial ones that it can exert on public health.

All spheres of health are investigated, not only the physical and social but, recently, the psychic. It is from the early years of the century that are published experiences relating mental health aspects to the quality of built environment (12). In particular, epidemiological studies recognize a relationship between the poor quality of the built environment with depression (13). The attention of the scientific community is nevertheless still pointing to more detailed understanding of these issues, as evidenced by very recent publications of studies focusing on the role of the urban structure and the effects on the mental sphere of population health (14, 22). It is also interesting to note a recent study that addresses the challenge of demonstrating the effects of an urban regeneration program on the mental health status of the population. The authors state: "implementing an urban regeneration programme with a wide range of intensive interventions may be effective in promoting good mental health" (3).

If, on the one hand, epidemiological studies on the effects of the built environment on health are still in place, on the other, there are different views regarding the effects - often preventive - it can have on the physical and social spheres. In particular, several observational studies, since the 90s of the last century, have ascertained the role played by the built environment in promoting physical activity in the population. (1, 5, 9, 15, 17, 18, 21, 24, 25, 27).

Today there is a growing scientific evidence that the urban and neighbourhood environment and designs are associated with an increased physical activity and with
beneficial health impacts on the population (20, 26, 28).
Despite the well-known benefits for health, today we know that there is a large proportions of the population in many developed countries physically inactive, with estimates ranging from 33% of adults worldwide (16). In Europe, a sedentary lifestyle is responsible for 600,000 deaths per year. The most worrying evidence is that the physical activity tends to decrease with increasing urbanization (29). In Italy the situation is not different and many epidemiological studies offer a framework of its reality (7, 10, 11, 19). Recently, to emphasize the critical values concerning issues related to the physical activity, the "Osservasalute Report 2015" describes a prevalence of people (aged 18 and over) in overweight condition amounted to 36.2%. Moreover, the prevalence of people aged 18 and over that are obese is 10.2% and the prevalence of those who say they do not practice sports amounted to 39.9% (23).

The priorities that stand out across the panorama described are therefore different and at different scales of action, and are aimed to:

- redefine the role of cooperation between urban planners and operators of Hygiene and Public Health as a top priority, so as to tend to a single, shared vision that has as its main objective the prevention and promotion of health of the population (2);
- integrate the studies and observations conducted on the urban environment (using ad hoc tools) with epidemiological observations (4);
- define new quality indicators (eg for walkability) that are the result of previous observations and may fall within categories related to the wellbeing and public health;
- obtain a framework of the variables (not only of the built environment but also, at this point, of the population) useful to the planning activities.

To achieve these objectives we propose a method based on an epidemiological descriptive observation.
Methodology

The analysis of the physical activity will primarily focus on a phenomenon related to the walking behaviour: the incidence of pedestrian accidents. In particular, the frequencies of pedestrian accidents will first be estimated through an epidemiological descriptive study of accidents occurred in urban or peri-urban areas. Researchers will use the data detected by two official sources: on the one hand, the complaints filed with the communities of interest and stored in the database of the municipal departments; on the other, the complaints filed in the hospital emergency room services. The underestimation of phenomena, proper of descriptive epidemiological studies, will be limited consulting both the sources. Finally, the analysis will lead to calculate the prevalence of the pedestrian’s accident event. This data will follow a process of standardisation with the intensity of the pedestrians’ activity and will be stratified with temporal, individual and environmental variables, resulting from data.

Results and discussion

To date, phases of work are still related to the data collection, so the results will be displayed as the ones we expect. The epidemiological investigation regard the possibility of having a snapshot of the prevalence of injuries in relation to the attitude of walking in the Sardinian population. Furthermore, applying a descriptive study of population opens to the stratification knowledge of the phenomenon (by age, sex, place, temporality). The importance of this evidence lies in the understanding of various phenomena, including, indirectly, a first assumption of the attitude to physical activity and movement of Sardinian pedestrian population in urban and peri-urban areas. These early findings offer potential applicability in planning, especially if they are supported by a subsequent ad hoc investigation.
Finally the comparison to assess the quality of data provided by the officials sources will provide to institutional stakeholders (such as municipal Departments) benchmark indicators to assess the specific situation in which they operate.

Conclusions

The potential effects of the built environment on public health currently require further information from the epidemiological point of view. The ex post evaluation of urban environment planning interventions, however, are not easy to implement and require close cooperation between planners and epidemiologists.
This methodological proposal concerns the ability to implement the tools developed for the assessment of the population walking behavior also with epidemiological observations. This ex ante application, although possibly affected by self-selection bias, would permit to obtain accurate data on the real physical activity attitude and, above all, on the individual variables of the population.
To associate these variables (i.e. age and sex) to a simultaneous physical environment assessment, in the first instance, might provide a framework of indicators of the built environment that are attractive for a certain type of individuals. The analysis of these indicators may provide experimental studies also detectable in other urban contexts.
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Shaping urban pedestrian mobility involving users: the LabAc case study

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Key-words: accessibility, users involvement, open government, participative process, planning tools.

Introduction

In a complex environment like the current one, in which cities try to become more and more smart, working with the open government prospect (that means transparency and direct participation of the citizens in decision-making) is essential. Public administrations must necessarily and constantly innovate by developing new tools and new technologies in order to get closer to the citizens. Institutions should pay attention and be open to experimentation, being able to plan and actually practice in the field of new forms of public policy, in synergy with citizens: a smart city must be a city whose community has learned how to learn, adapt and innovate himself (Coe, Paquet, Roy, 2001).

In urban development the key issue is the attention to the social role: from this point of view the actions to be undertaken concern awareness and education activities, dissemination and divulgation in the perspective of empowerment to increase the skills and the aptitude to participate (Gaffi, Mela, 2013).

The principle of citizen participation in democratic life is directly derived from the fundamental rights of citizenship and popular sovereignty. The development and dissemination of technologies addressed to the citizens can and should be instruments that facilitate this interaction, as confirmed by European guidelines. This principle is reaffirmed by the “European Charter for the rights of the citizen of the information and knowledge society”, that focusing on ICT - Information and communications technology - outlines four basic rights: the right to access, the right to information, the right to education and finally the right to participation. Participation, which then becomes “e-participation”, i.e. the active interaction between citizens and public administrations through the use of ICT, is today one of the most important elements of international government policies (Grion, Antonaglia, Chiarelli, 2016).

Labac (Accessibility Lab), a project coordinated by the University of Trieste and integrated into the so called “Zone Plans on Disability Area”, has been signed by almost all municipalities throughout the Province and has worked on all these issues. Oriented to the development of processes and innovative actions aimed at improving the accessibility of the open spaces, to raise the public awareness on the issues of usability of the city independently and safely, and the spread of a culture of social inclusion, it has been the first case of a participatory process between the municipalities of the Province, and a successful experiment that continues from 2011 with growing interest by municipalities and the multitude of actors involved.
Methodology

The inspiring principles of the project are based on three main considerations:

- adopt policies focused on the accessible enjoyment contributes to the improvement of the welfare and the security of citizens;
- adopt a multi-disciplinary strategic vision that involves the whole community allows for durable and effective results;
- undertake campaigns to educate strengthens the culture of inclusion.

(Orlandini, 2016).

The working method of Labac is designed as a participatory process, in which it is essential to involve all those who have an interest in matter of livability of public spaces and their accessibility considering “wide users”.

This methodological approach puts the Public Administration in direct dialogue with the citizens (the whole community, and in particular the weaker categories of users - i.e. people who have special needs to carry out daily life, such as people with disabilities, elderly, pregnant women, people suffering from trauma and chronic diseases, etc.) and helps them to express their needs and put forward their own proposals. The close interaction and collaboration between representatives of the community - on the one hand - and the municipal administrators and designers - on the other - plays a facilitating role in the understanding of the issues of the first one and the choices of the others, exchanging roles and assuming different points of view within the space of the Laboratory.

Labac activities

There are three phases of project development: in the first phase, which has embraced the period 2011-2013, it was drawn up the drafting of the rules of the Laboratory and the planning of activities: once established the method, the purpose, the actors to be involved and the expected results, it was made a check-up of the available tools, and then a feasibility study of the tools to be developed. The process took different skills, expert knowledge covering many disciplines - architects, engineers, surveyors, physiotherapists, teachers, social workers, social and health professionals - able to talk to each other. They, dealing with associations representing the most vulnerable groups, have worked together to develop operational tools and finally drawing up “guidelines for designing” in the form of performance checklist indicators evaluation criteria of quality of public spaces, especially useful to outline a structured and systematic collection of good practice to be considered for the interventions to be implemented.

During the second phase - 2014-2015 period - the activity was the acquisition of data on specific areas suggested by the Administration; guided surveys, aimed at the detection of critical issues, were field tests of the entire participatory process.

The third phase, currently underway, is focusing on two important aspects:

- an intense activity of divulgation and dissemination addressed to students and technicians with meetings and training courses aimed at an exchange of best practices with other Italian municipalities (Milan, Prato, Rome, Turin, Venice);
- the digitalization of tools in order to improve municipal internal processes and enhance the level of communication between administrators and citizens.
Results and discussion

After five years of the Labac project, decision-makers understood the importance of continuing in the undertaken direction to allow citizens to know their city in terms of space and tools, to enable them to make aware choices in accordance with their capabilities and specific functionalities. In particular through the signing of two important projects the Municipality of Trieste has adopted the modus operandi of Labac to continue its activities taking them as an inheritance from the Province, an institution which is soon going to be closed.

Accessibility Map
Result of a collaboration between the Public Works Area of the Municipality of Trieste, the University of Trieste and the young startup Comunichiama, it is ongoing the acquisition and processing of dimensional data collected over an area chosen by the Labac table, aimed at the construction of a demo of a georeferenced map with barrier-free information. The different colors on the map, result of a series of calculations obtained by the insertion of the data collected in a programmed spreadsheet, will indicate the different levels of the accessibility of the examined streets, marking also the critical issues with information concerning its nature and the required interventions.

Once created, the map is going to become a mean of communication between the public administration and the citizens. It will allow the citizens an active part in the decision-making process, and at the same time it will help the Public Administration to establish and upgrade its relationship with the community, allowing it to optimize the use of its social and economic resources.

Trieste per Tutti / Trieste for All
Thanks to methodology and tools developed by Labac and thanks to synergy between many departments of the Municipality of Trieste – such as Social Policy, Economy and Sport, Urban Planning, Mobility and Communication – the project “Trieste per Tutti” (Trieste for All), a website aimed at giving information for a barrier-free tourism, was born. We talk about not only architectural, but also cultural and ideological barriers, that turn away weaker people from real usability of the city and of its sites of touristic interest.

The project has been realized by an interdisciplinary working group coordinated by the University of Trieste. The website offers detailed information useful in order to plan the journey, the stay and the visit of Trieste, to enjoy as much as possible its attractions.

“Trieste per Tutti” has maps useful to locate the structures/sites that has been analyzed as regards their usability and it has been conceived as an implementable tool, adding in the future other information about touristic itineraries, other typologies of structures for hospitality or restaurants.

All reported information want to encourage aware choices by tourists with disabilities or special needs, according to their capabilities and specific functionality. The tools therefore don’t offer judgments of accessibility but just report information relating to the absence of sensory, perceptual and architectural barriers in urban spaces and public buildings, the presence of facilitator elements and functionality of space and equipment, as well as information about usability of content of sites of historical, cultural and touristic interest. (Trieste per Tutti, 2016).

Conclusions

Ensure the continuity of a project with a social relevance is a crucial milestone: it allows the actions undertaken to continue to have effect.
In particular, the exchange and the direct comparison of experiences among local governments, calling those who have already implemented best practices to share with other authorities who wish to improve the sustainability of their territories, has proved to be a crucial action.

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Spatial image of territories. The case study of Sardinia

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Key-words: territoriality, socio-demographic analysis, smart land.

Introduction

The aim of this research is to analyze the socio-demographic structure of regional Sardinian territory with respect of the reorganization of local government.

The challenge promoted by the Region of Sardinia through Law 2/2016, “Reorganization of the system of local self-government of Sardinia” (http://consiglio.regione.sardegna.it/XV Legislatura/Leggi%20approvate/lr201602.as), can be read in local key starting from the concept of smart territories. A city is defined smart when investing in human capital, social capital, in the traditional and modern infrastructure, economic growth, in the high quality of life with an efficient management of natural resources, through participatory governance.

Contextualizing the idea of smart city, in the territory of Sardinia, characterized mainly by small and medium-sized cities, we need to move from the idea of smart cities subway, to the vision of the smart territory, where intelligence is not necessarily due to the concept of technology.

We should focus on smart solutions that allow the modern territory to develop through the qualitative and quantitative improvement of productivity, providing greater quality of place, thus defining "intelligent territories" that responds to the needs of the population and increases the quality of life, security and social inclusion.

For this reason we need to go beyond the administrative limits and design a smart territorial development, based on participation and local intelligence tools to obtain a more antifragile (Taleb, 2012) and healthy territory.

The Smart Land, is a territory in which to experience widespread and shared policies, useful to increase the competitiveness and attractiveness of the territory with specific attention to social cohesion, the spread of knowledge, the creative growth, accessibility and freedom of movement, environmental accessibility, the quality of the landscape and the lives of citizens. The smart land is the adaptation, in the Italian context of territorial platforms, the concept of smart city, in the perspective of sustainability and the green economy.

If the smart city, as anticipated, is identifiable with the administrative competence boundaries of individual cities and has a political entity deciding, the hypothesis instead of smart land forces or induces the need for homogeneous territorial configurations, willing to unite and then to recompose from the bottom to the will of self-transformation (Bonomi, Masiero, 2014).

One of the requirements that makes a smart area is the presence of a strong sense of citizenship: the community is expressed through and for the territory on defining so the sense of territoriality (Gold, 1982; Klauser, 2012; Sack, 1986, Soja, 1971).

Territoriality is defined as a phenomenon connected to the organization of space into spheres of influence or in defined territories, which take the distinctive features and can be considered exclusive to occupants and who defines them adding that the man is a territorial animal and...
Territoriality affects human behavior at all levels of social activity (Soja, 1971). From these considerations, I have chosen to dedicate a part of the research for the analysis of Sardinia, by introducing, in the study of the local environment, the socio-demographic analysis as a typical feature factor in the formation of supra-municipal organizations (Unions of Municipalities). Communities become an essential element in the reorganization of local authorities, going beyond the simple calculation of the number of inhabitants (minimum 10,000).
Methodology

From these reflections, I wanted to analyze the 377 municipalities of Sardinia, aggregating according to the Union of Municipalities on the territories (34).

As announced, the following paper is the preliminary phase of more thorough analysis that will end with the measurement of the island’s social capital level.

The coordinated use of aggregated data (on Istat data processing - 2011, www.istat.it) and GIS software has made it possible to elaborate the territorial maps that tell the reality Sardinian socio-demographic.

Space images used to understand the territorial dimension of local authorities and the social conformation of the population that lives.

Results and discussion

The reformation of the Sardinian local authorities, fits into the context characterized by a large number of common low-density. Therefore, it’s interesting to show a map that shows the number of inhabitants (Figure 1) per common across different ranges, supported by a map that showing the new organization of the territory: Province of Nuoro, Province of Sassari (which includes the metropolitan network of Sassari), Province of Oristano, Province of South Sardinia and Metropolitan city of Cagliari (Figure 2).

The first image shows the demographic situation in 2011, where the most populated urban centers are mainly 4 (and correspond to the provincial capitals), someone is located along the coast (for example, Olbia and Alghero among the greatest) and the other around Cagliari (Quartu Sant’Elena, Assemini and Monserrato).

Instead, the common center located on the island has, for the most part, a number less than 3000 of inhabitants; these are distributed, mainly, in the Province of Nuoro, Oristano and South Sardinia.

Fig. 1 and 2. Municipalities classification for inhabitants; Organization of territory.
Figure 3 shows the internal organization of each province where there are unions of municipalities. The law provides that every municipality should be part of a Union. Now is 34, but many municipalities have yet to join.

Fig. 3. Union of Municipalities

<table>
<thead>
<tr>
<th>Unions of municipalities</th>
<th>Number of municipalities</th>
<th>Inhabitants</th>
<th>Employment rate</th>
<th>Graduates rate</th>
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<tbody>
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<td>3.2%</td>
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<td>13239</td>
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<td>33258</td>
<td>55.3</td>
<td>8</td>
</tr>
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<td>29906</td>
<td>56.2</td>
<td>7.1</td>
</tr>
<tr>
<td>Ceres</td>
<td>11</td>
<td>33502</td>
<td>51.6</td>
<td>5.5</td>
</tr>
<tr>
<td>Logudoro</td>
<td>7</td>
<td>19931</td>
<td>55</td>
<td>7.4</td>
</tr>
<tr>
<td>Villanova</td>
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<td>4447</td>
<td>52.5</td>
<td>4.5</td>
</tr>
<tr>
<td>Malaspina</td>
<td>13</td>
<td>25599</td>
<td>51</td>
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</tr>
<tr>
<td>Martana</td>
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<td>26726</td>
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<td>6.7</td>
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<tr>
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</tr>
<tr>
<td>Panorpa</td>
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<td>6.6</td>
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<tr>
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<tr>
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<td>Gessi</td>
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<td>5.8</td>
</tr>
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<td>Partelana</td>
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<td>6.1</td>
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<td>53.6</td>
<td>5</td>
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<td>7.3</td>
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<td>Metropolitan city of Cagliari</td>
<td>17</td>
<td>42667</td>
<td>54.8</td>
<td>13</td>
</tr>
</tbody>
</table>

Tab. 1. Unions of municipalities’ analysis
In the Table 1, it’s possible to read the analysis of local authorities, about of rates of employment and graduates. Compared to the Sardinia’s rates (employment 52.7% and graduates 9.3%), few municipalities’ Unions exceed the regional average. Among these, the metropolitan city of Cagliari, the metropolitan city of Sassari and some Unions that are found, mainly, in the coastal territory (3;4;11;12;14; 16;21;29;31). These are the Unions that have a number of inhabitants greater than 15000 and in which, in addition to being more numerous municipalities, there are, also, a large number of services, often territorial level.

The proposed analysis is only a small part of a more detailed study that aims to investigate the territory of Sardinia so that we can define spatial development policies based on the current socio-demographic reality.

The challenge of the reform of local authorities can be read in territorial key to the definition of healthy and intelligent territories. The conformation of settlement (low density) of Sardinian towns allows the application of the concept of smart land and the promotion the development policies of the territory.

Some municipalities, aggregated in the Union are defined, according to their socio-demographic features, policies for the management of student mobility and for the management of services (for example, the library) in common.

The proposed spatial images and the data show, therefore, a heterogeneous reality and a prevalence coastal areas with larger municipalities, compared to Unions of smaller towns. The definition of these, then, in response to the directives of the Law 2/2016 (Art. 7), must be formulated according to of socio-economic characteristics of the municipalities in order to avoid imbalances between coastal and inland territories.

Conclusions

The research presented here is to be a step for the definition of Social Landscape Areas for Sardinia; the purpose of the investigation is to show the regional Sardinian territory under a different key from that offered, for example, by PPR, integrating the vastness of visions offered over the years and promoting the island’s social and cultural idea.

The Social Landscape Areas, try to show the level of social and human capital of Sardinia (measured on the municipal level).

The next phase of research will try to elaborate these spatial images as the address for possible lines of development for the territories.

References


An Empirical Study on Factors of Perceived Walkability

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Key-words: walkability, regression analysis, walkability perception, urban design, walkability audit.

Introduction

We present preliminary results of a pilot empirical study designed to examine factors associated with pedestrians’ perception of walkability, i.e. the perception of the quality, comfort and pleasantness of streets, and their conductivity to walk. This empirical study contributes to the ongoing multidisciplinary effort to pin down factors, their relative importance and their interactions, relevant for pedestrians’ perception of walkability, that is to say, of the quality, comfort and pleasantness of streets, and their conductivity to walk. In attempt to describe and explain people’s propensity and decision to walk, their choices of pedestrian route and the qualitative perception thereof, scholars have examined a series of factors, related to individual characteristics (e.g. age, gender, income, etc.), mobility opportunities (e.g. availability of public transportation), trip types (purpose, frequency, available time, etc.), and features of the walking environment (Mateo-Babiano 2016). Our study focuses on this latter family of factors, related to the physical urban environment, and attempts to determine their correlation with the subjective, qualitative perception of the walking environment.

Scholars have employed a range of experimental designs, sets of dependent and independent variables, survey methods, and analytical tools to tackle this issue.

As dependent variables, one can find measurements of degree of satisfaction with urban environment, such as its quality, its perceived Level of service, its safety or comfort perception. That can be measured both for street segments and intersections, and can be measured in relation to personal characteristics (e.g. children and parents). When attempting to acquire “objective” measures and observed behaviours, rather than declared qualitative perceptions and evaluative judgements, scholars have employed data on physical activity (and inactivity), transport system relationship and route choice.

Among independent variables, assumed as “predictors” of walkability, in literature we encounter three types of variables, along objective-subjective axis: (1) physical, functional and urban design features of space (such as walkway width, number of car lanes, presence of green areas, landmarks and other “attractions”, as well as the degree of maintenance); (2) practices of use of space (frequencies, densities, flows, rates of use, etc.); and finally (3) individual perceptions or reactions to space (such as sense of security, perceived urban quality, “sense of place”, and so on).

Ultimately, the purpose of our study is to provide useful indications both for modelling and evaluating urban walkability (Blečić et al. 2015a, Blečić et al. 2015b), as
well as for suggesting the most effective levelers urban design and planning may pull to encourage walking behaviour by improving the pedestrian friendliness of cities (Guo and Loo 2013).

As for the data collection and survey methods, scholars have been undertaking different routes. Direct, on-street survey methods can be classified (Ling et al. 2014) into: observational methods (observation of pedestrian behaviour), intercept survey (on street pedestrians interview), contingent field survey (involves subjects walking along routes and instructed to grade each crosswalk or street segments immediately after they have passed through), controlled field valuation (same as contingent filed survey but judgment is given without crossing the intersection/street), laboratory/simulation studies (involve subjects observing and evaluating a representation of the pedestrian environment, such as 3D rendering, photomontages or video clips).
### Methodology

We conducted a *contingent field survey* of the entire street network of the city of Alghero (Italy). The purpose of the survey was to collect two separate measures for each street segment of the city: (1) an *analytic* description of the street segment, through 18 observable street attributes; and (2) a *synthetic*, subjective perception of its quality of walkability.

The streets were divided into 408 homogeneous street segments, and the city was subdivided into 10 sectors. The survey was carried out in January 2016 by 24 graduate students split into 12 pairs, each pair assigned (1) to undertake a walkability audit of one urban sector (collecting 18 attributes for each street segment), and (2) to provide their subjective *synthetic* evaluation of the street segments in another sector. The two sectors assigned to each pair were different not to have their previous analytic knowledge influence their synthetic evaluation of streets.

#### Fig. 1. Tile plot of judgments and street characteristics distribution of frequency.

The 18 analytic attributes are: X1 Useful sidewalk width; X2 Objects of architectural, urban and environmental attractions; X3 Density of shops, bars, services, economic activities; X4
Opportunity to sit (benches, etc.); X5 Shelters and shades; X6 Car traffic direction; X7 Car roadway width; X8 Speed limit; X9 Bicycle track (cyclability); X10 Degree of integration with surrounding space; X11 Vehicles-pedestrians separation; X12 Street lighting; X13 Sidewalk degree of maintenance; X14 Street-level parking; X15 Physical car-speed reducers (hump, raised crossings, traffic islands, mini roundabouts); X16 Non-physical car speed reducers (traffic lights density, enclosure); X17 Crossings density (crossing opportunity); X18 Road type.

While some attributes do use qualitative levels, we provided auditors with detailed definitions and exemplifications to limit their interpretative ambiguity. So for example, for the five levels of the attribute "X1 Useful sidewalk width", the levels and their interpretations we provided as instructions to the auditors were: “1. Wide: allows comfortable passage for at least four people without obstacles; 2. Comfortable: allows passage for 3 people, even if with few minor nuisances; 3. Minimal: allows passage for two people, with obstacles that occasionally force to divert; 4. Inadequate: allows passage for only one person, with numerous obstacles along the route and detours; “5. Missing: no sidewalk, or impossible to use”.

As for the synthetic subjective perception of the quality of walk, the auditors were asked to express their overall evaluative judgment about street segments by answering to the following question: "Express a synthetic evaluation of your perception of the quality and walkability of the street, from your point of view as pedestrian. The evaluation must be expressed on a qualitative scale from 1 ("insufficient") to 5 ("excellent"), taking into account the physical features of the pedestrian walkway, the overall qualitative characteristics of the urban space, and in general how you perceive the street to be safe, comfortable, pleasant, attractive and usable.

In order to express your evaluation, you must not take into account the distance from the city centre, nor the temporary sources of disturbance (such as public works, construction in progress, etc.).

Following are the meanings of each evaluation level:

5. Excellent: maximum pedestrian comfort; the street is very pleasant to walk, with particularly attractive and valuable surrounding urban space or landscape where it is interesting to walk, sit and hangout.

4. Very good: the street is comfortable to walk, the pedestrian transit is pleasant and free of obstacles.

3. Good: the street can be walked, the pedestrian transit is without obstacles, but the surrounding urban space or landscape is not attractive.
2. Sufficient: the street is difficult to walk, there are obstacles to the pedestrian transit or the quality of the urban space and landscape is low, unpleasant or very disturbing.
1. Insufficient: the street is impossible to walk or feels very unsafe, the quality of the surrounding space or landscape is very disturbing.”

Results and discussion

After uniformly re-scaling all the evaluations and grades on a scale from 0 to 1, we ran several multivariate linear regressions to explore models of correlation between the synthetic evaluation of walkability (dependent variable) and the street attributes (independent variables).

The first model, using all the available independent variables, yields $R^2=0.60$. (see Model A in Table 1). A subsequent model, using the 9 most significant variables from model A (and excluding ”Street level parking” for low variability in the data) yields $R^2=0.59$ (see Model B in Table 1). These results point at the following nine variables ($X_1, X_2, X_3, X_4, X_5, X_7, X_9, X_{11}, X_{12}$) as jointly most strongly associated with the overall synthetic perception of walkability.

A graphical representation of two-way contingency tables between each of the nine variables and the dependent variable are shown in Figure 1.

For a comparison of relative importance of independent variables, we ran separate monovariate linear regressions for those nine variables. From these results, we further note that the strongest individual effect may be observed on the variables $X_1, X_2, X_9$ and $X_{11}$, each individually yielding $R^2>0.30$. A multivariate linear regression model using only those four variables yields $R^2=0.54$ (See Model C in Table 1).

Using the model with nine variables for prediction (Model B), in Figure 2 we compare the actual and the predicted values of synthetic evaluation of walkability.

The distribution of residuals of this model are shown and reported in Figure 3. From the summary data in the figure, one can note that the Model B predicts approximately 55% of street segments in the correct class, and classifies over 95% of street segments correctly or at most one class off from the actual synthetic evaluation assigned by the auditors.

Conclusions

The purpose of our study was to determine which urban features and design characteristics of the streets are most strongly correlated with a qualitative synthetic perception of the quality and walkability of streets. With respect to other similar studies, we have undertaken walkability
audits to collect comparatively more detailed descriptions of the streets, both in terms of the number of descriptive attributes and in terms of modalities for some of the attributes. Furthermore, we used both qualitative and quantitative descriptors in a way to reduce equivocation and misunderstandings of the meaning of their respective scales of measurement. Contingent filed survey permitted also to reduce estimation errors of "direct" stated preference methods. The results of regression analysis in particular show the following nine attributes to be highly significant and jointly yield a relatively high R-squared of 0.59: “Useful sidewalk width”, “Objects of architectural, urban and environmental attractions”, “Density of shops, bars, services, economic activities”, “Vehicles-pedestrians separation”, “Bicycle track (cyclability)”, “Opportunity to sit”, “Shelters and shades”, “Car roadway width”, and “Street lighting”. These attribute are related to the pleasantness, comfort and safety, and are thus in accordance with Alfonzo’s et al. (2008) hierarchy of walking needs. Out of the nine attributes listed before, the first four in particular are revealed to be jointly most strongly associated with the perceived synthetic walkability (R-squared=0.54). As a prediction tool, the regression model using the above nine most significant attributes shows a fairly high precision of predictions (55% streets classified correctly, 95% classified correctly or at most ±one class off). In future, we will intend to widen the sample and explore different statistical approaches, such as ordinal model, conjoint analysis, and part-worth function models. Also further investigation is needed to explore interactions between variables, which may be undertaken through choice modeling approaches.

References


GPS Tracking and Surveys Analysis of Tourists' Spatio-Temporal Behaviour. The case of Alghero

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b Department of Architecture, Design and Urban Planning, University of Sassari, Italy (dacanu@uniss.it, cecchini@uniss.it, tanjacongiu@uniss.it, trunfio@uniss.it)
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Key-words: Tourist Behaviour, GPS tracking, tourism policy.

Introduction

"Know thy tourists" is a useful maxim for any smart local government official or destination manager responsible for tourism policies. For that, position tracking technologies developed in the last decade are a valuable addition to the traditional toolbox for data collection, as they offer the opportunity to gather a great amount of unprecedented information on tourists behaviour in space and time (Shoval and Isaacson 2007; Shoval et al. 2014).

Until recently the most common way to study tourists’ behaviours in time and space were various methods of diary (re)construction (Shoval et al. 2014). And also, even if methods for surveying and analysing spatio-temporal behaviour are, of course, becoming highly developed in transportation research and in social sciences in general, comparatively little attention was being paid to the spatial and temporal behaviour of tourists, and systematic studies taking advantage of the technological developments offered by the high precision position tracking are still relatively few (Shoval and Isaacson 2007; Shoval et al. 2014, De Cantis et al. 2016, Sacerdotti et al. 2011).

In recent years scholars have started to break ground in this specific domain of applied research, experimenting and exploring advantages and disadvantages of satellite-based positioning technologies for the study of tourists’ spatio-temporal behaviours (Shoval et al 2010). Among the methods for tracking tourist spatio-temporal behaviour Kellner (et al. 2016) lists: the direct observation of tourists’ activities; the time-space budget techniques; the video-based tracking analysis; the smartphones and specialized GPS tracking devices; the land-based tracking systems.

In this study we use the time-space budget techniques (Pearce 1988) which analyse tourists’ activities within destinations by using diaries, questionnaires and interviews combined with GPS tracking devices in the urban and territorial context of Alghero. Many studies report observations on a small scale, focusing on particular urban areas or activities that have a clearly defined entry and exit point, such as natural parks or historical centres (Shoval et al. 2014) In this paper we arise from the methods used by the studies that analyse urban contexts, among which Rome (Calabrese and Ratti 2006), Lago del Garda (Bruno et al. 2010), Torino (Sacerdotti et al 2011), Canberra and Sydney (Edwards 2009), Salzburg (Kellner and Egger 2016).

In conclusion, this study, offers an example of how GPS tracking technologies may be coupled with more traditional survey methods to produce meaningful information and profiling information related to spatio-temporal behaviour of tourists, and in this
e-agorà|e-αγορά for the transition toward resilient communities

way to construct a better and more purposeful knowledge for tourism and territorial policies and development programmes.
Methodology

We hereby present the results of a study we conducted in October-November 2016 in the city of Alghero (Italy), a tourist destination of approximately 40,000 inhabitants in the North-West Sardinia in Italy. The purpose of the study was to explore tourists' movements, expectations and degree of satisfaction with the destination during a period of “low-season”, considering that Alghero’s peak period is the summer season, with highest tourist concentration between July and September. The collected data was thus meant to provide useful information and hints on possible policies to attract tourists outside the summer season. Participants were recruited in five venues in Alghero, both hotels and bed&breakfasts, selected taking into account their geographic distribution. The study combined interviews with GPS movement tracking. Each volunteering tourist was interviewed twice: in the morning for the outgoing interview to collect information on his/her socioeconomic characteristics, preferences, and expectations; in the evening for the return interview to gather information on his/her whereabouts and personal evaluation of the day. During the morning interview, tourists were provided with a small GPS data logger which registered their movements during the entire day. A total of 75 questionnaires and tracks were collected, referred to 225 tourists involved in the survey (205 adults, 17 teenagers and 3 children).

Results and discussion

Exploratory data analysis of interviews and tourists profiling

The tourists were mainly Italian (28%), Swedish (22.67%) and German (16%) (due to the availability at the time of low-cost flights from Stockholm and Göteborg), with a relatively high level of education (12% post-degree level; 64% degree level). Around half of all interviewed tourists travel in couple (46.67%). Frequent are also tourist travelling alone (17.33%), while groups of families, couples with children and groups of friends cover each about 9% share of the sample. Almost all tourists have arrived by plane (90%), confirming the importance of the local low-cost airport for the tourist development of the city and of the whole territory. Only 10% of tourists have chosen to travel by ship or by other means of transportation.

When asked to declare the importance (on a qualitative scale from 1 to 5) of the motives they have chosen Alghero as destination for this vacation, the inter-viewed tourists most frequently grade highly favorable climates, the possibility to relax, the quality of the environment, and food & wine. Despite the low cost of the trip the interviewees did not put this among the principal reasons to choose Alghero. These grading were confirmed by their travel plans. Tourists in Alghero would like, above all, to explore environmental resources and to discover the territory and the villages near Alghero city. The analysis of expectations with respect to actual activities carried out that tourists did reveal interesting information: of the 20% of tourists interested in tourist services and leisure activities, only 1% had effectively enjoyed these during the day; but, above all, 61% of tourists declared they would like to enjoy food & wine, but only the 4.3% declared to have done that.

Comparing expectations (outgoing interview) to the declared (return interview) use of means of transportation during the day, we observe that 20% of tourists intended to move in the territory by public transports, but only 6.67% actually used it. This points at (and confirms previous concerns about) the inadequacy of the public transportation system to serve tourists well.

With regard to expenditures (Table 1), the comparison shows that tourists frequently expected and planned to spend more than they actually did, which raises the question whether there is a
mismatch between the supply and tourists’ demand for goods and services (another matter deserving further examination).

Tab. 1. Spending: expected (a) vs. declared (b).

<table>
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<tr>
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<th>Expected daily expenditures* (outgoing interview)</th>
<th>Effective (declared) daily expenditures* (return interview)</th>
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<td>€3.00</td>
<td>€3.00</td>
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<tr>
<td>1st quartile</td>
<td>€200.00</td>
<td>€50.00</td>
<td>€29.25</td>
</tr>
<tr>
<td>Median</td>
<td>€300.00</td>
<td>€80.00</td>
<td>€49.00</td>
</tr>
<tr>
<td>Mean</td>
<td>€503.30</td>
<td>€89.97</td>
<td>€64.95</td>
</tr>
<tr>
<td>3rd quartile</td>
<td>€500.00</td>
<td>€100.00</td>
<td>€80.25</td>
</tr>
<tr>
<td>Max.</td>
<td></td>
<td></td>
<td>€295.00</td>
</tr>
</tbody>
</table>

* Accommodation and incoming/outgoing travel excluded

Tourists’ spatial behaviour

In this subsection we present summary analysis of the GPS tracking of tourists. Their daily spatio-temporal schedules may be subdivided into three types: “Alghero - town”, “Alghero - surrounding territory”, and “outside Alghero”. The shares of GPS tracks of each type of schedule are shown in Errore. L’origine riferimento non è stata trovata. Having the sea swimming season ended, the tracks within the town area rarely include beaches, as tourists show to be more focused on the historical centre, the harbour and the waterfront.

In addition to classifying the tracks, we analysed the totality of points marked by the GPS data loggers to represent the daily distribution of tourists in space (Figure 1). The GPS data loggers register individual position in space each 20 seconds during entire day. This permits to observe the spatial distribution of tourists in space in relation to the geography of activities, resources and services that are known touristic attractors in the Alghero’s territory.

Tab. 2. Shares (time) of daily spatio-temporal schedules among different areas/zones

<table>
<thead>
<tr>
<th>Macro-area</th>
<th>Area</th>
<th>Zone</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alghero and its territory</td>
<td>Town</td>
<td>Historical centre</td>
<td>37.74%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Garibaldi and Lido waterfront</td>
<td>30.34%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dante/Valencia waterfront</td>
<td>7.82%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other</td>
<td>24.10%</td>
</tr>
<tr>
<td>Surrounding territory</td>
<td>Park and marine area</td>
<td>43.26%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bombarde-Lazzaretto</td>
<td>25.59%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maria Pia beaches</td>
<td>22.26%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fertilia</td>
<td>8.89%</td>
<td></td>
</tr>
<tr>
<td>Outside Alghero</td>
<td></td>
<td></td>
<td>19.71%</td>
</tr>
</tbody>
</table>
Fig. 1. GPS tracking data for Alghero and its surrounding territory (points, routes, kernel density estimation): (A) Alghero – town; (B) Historical centre; (C) Alghero surrounding territory.

For example Figure 1-A shows the distribution of tourists within the town of Alghero. The point representation and the kernel density estimations emphasise main places of interest, concentrated between the historical centre and the waterfront, while the route representation shows the flows and the main ways of communications used by tourists.

**Time use by tourist profiles**

A further possible analysis is to explore behaviour by different profiles of tourists. We propose a preliminary study at the city scale with respect to tourists segmented by company, age and expenditures. An example of spatialisation of this information is represented in Figure 2 and reveals that those who spend more also spend more time in the city centre (and are more concentrated in fewer places), while those who spend less are also relatively less concentrated in the space and spend more of their time in different parts of the city.
Conclusions

In this paper we have presented and explored tourists’ spatio-temporal behaviour in urban and territorial context of the city of Alghero. The analysis of tourist populations in general pointed at some weaknesses and lack of urban and territorial opportunities which appear to limit the “urban capabilities” of tourists (Blečić et al. 2015) and that must be considered in a territorial policy aimed to develop not only the tourist economy and services but also tourists’ urban quality of life. Among these, two types of urban opportunities seem to stand out among those in need of greater improvements: leisure-time activities/services and public transportation. Furthermore, a relatively low degree of loyalty of tourists requires specific attention by marketing and destination management policies. Furthermore, we experienced difficulties with including in the survey accommodation facilities located in rural areas because they were at the time largely lacking tourists. This is indicative of a reduced attendance in these areas in this period of the year, even if the interviewed tourists frequently declared individual preference for relax, enjoyment of the environment, wine & food traditions, all opportunities possible to develop in rural areas.

In conclusion, tourism policies are foremost territorial policies, so such information, if wisely used, may become of particular relevance when investigating the relationship between tourists’ behaviour, their individual characteristics and interests (Kellner and Egger 2016), and spatial distribution and accessibility of urban and territorial attractors and activities (Blečić et al. 2015). These results serve moreover to better understand preferences and choices of different populations of tourists, in order to put in place policies for tourism deseasoning or to more efficiently coordinate activities, attractions and transportation services; or to build tourist fidelity. In general, to better understand tourists’ behaviours in space and time and to have useful information for public policies which aim at development and governing of tourism.
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Triggers of urban innovation. The Case of Cavallerizza Reale in Turin

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Key-words: Right to the City, Urban Innovation, Commons, Urban Movements, Planning Law.

Introduction

The crisis of the old planning paradigms is an incontrovertible fact (Jacobs, 1961, Sennett, 2003, Hall 2012).

A growing demand for mechanisms to manage the urban transformation is raised by the institutions, driven by the claims of those who live the city to exercise rights that derive from it. The available tools show indeed their inadequacy and deficiency in not taking in sufficient account the characters of what they are intended to govern.

The city represents a powerful place to identify emerging processes and where to observe spontaneous transformation processes (Jacobs, 1961, 1969, Secchi 2013, Sennett, 2003, 2012), showing an internal capacity to regenerate continuously, despite the changes and unpredictable challenges.

The city supports its dwellers in their projects, in dreams and ambitions. Such a nature has an obvious implication: it is in the city that strong objections arise and insurgent citizenship develop.

Often these collective actions, while opposed to the existing city, build urban spaces and produce works that contribute to triggering the first devices of an alternative and change of the city.

The case of the urban movement taking place around the Cavallerizza Reale (belonging to the Royal House Compendium of Savoy in Turin and recognized as a World Heritage Site by UNESCO) offers an opportunity to study the role of collective processes in urban innovation trigger. This also is the occasion of an investigation into the determination and production process of decision systems related to goods that are in collective enjoyment and belonging – “beni in appartenenza e fruizione collettiva” (Maddalena, 2014).

This paper is intended to verify what are the criteria to identify spatial and legal dispositifs and tactics of intervention that consider:

1) the character of the city in determining a claim for a specific quality of the urban including access to the resources of the city and a chance to experience an alternative urban life (Lefebvre, 1968);

2) the generative character of the city of urban innovations as a product of the collective work and the rights arising from their use, acknowledged all those who were involved in their production;

3) the collective nature of urban processes;

4) the role of collective artistic processes.

In 1961 Jane Jacobs introduced her book The Death and Life of Great American Cities presenting it as “an attack on current city planning and rebuilding”.

In more recent times several eminent authors such as Richard Sennett, Peter Hall or Luigi Mazza solidly criticised existing urban planning as at the present time implemented.

They showed and demonstrated indeed, with different perspectives and methods, the crisis and the failure of old planning paradigms, promoting a critical debate over the current role of spatial governance in

In this context, a growing question of mechanisms to manage transformations raises both from institutions and from people (Berdini, 2014). Institutions and authorities that deal with planning are indeed more and more pushed by dwellers that claim rights connected with their places of life, their milieu, laying claim to the exercise of rights deriving from the city.

This paper considers some contemporary urban processes and dynamics of designing urban innovation, in order to highlight their possible contributions to improve planning tools and norms, aiming to wide contemporary urban studies and planning debates.

The paper is intended to identify what are the criteria to identify spatial and legal dispositifs (à la Foucault) and tactics (à la Jacobs) of intervention.

It considers the character of the city in determining a claim for a specific urban quality including access to the resources of the city and a chance to experience an alternative urban life (Lefebvre, 1968).

Starting from the case of the urban movement taking place around the Cavallerizza Reale, it looks at a new reading key that comes from the generative character of cities both of innovation as a product of the collective work and the rights arising from collective use, acknowledged all those involved in its production. Finally, the paper suggests some issues and reflections to foster new insights and suggestions for further research.
Methodology


As a living system, the city shows in fact an internal ability to regenerate continuously despite unpredictable changes and challenges. Jane Jacobs offered a visionary prospect, highlighting the extraordinary potentials of urban living in terms of social, economic and cultural interaction within vibrant and dynamic environments (Jacobs, 1961,1969, Ikeda, 2010).

The case of the urban movement taking place around the Cavallerizza Reale in Turin represents an interesting opportunity to verify some of the factors that can trigger urban innovation. This site belongs to the Savoy Royal Compendium – it is in fact located in the city center of Turin - and it has been recognized as a World Heritage Site by UNESCO since 1997. In recent times, this place, protected by the restriction of the Authority of the Sovrintendenza and those deriving from the declaration of UNESCO Heritage, increased its importance for the consequences of a series of political decisions regarding its future.

This site was in fact the subject of a number of financial transactions carried out by the City of Turin, which first acquired it in 2003 in order to allocate it to own institutional needs, then it sold this asset to the Società di Cartolarizzazione Città di Torino (CCT srl), a company completely owned by the Municipality.

In 2010, the City Council approved the Variante 217, which provided for the possibility of creating residences a share of 50-80%, as well as accommodation and commercial activities within the Complex. The share of 50% is considered to be flexible on the rise and this is confirmed by two successive municipal resolutions of 2012 and 2013.

In the meanwhile, the Cavallerizza lies in a state of deterioration and abandonment. The news of this state and the danger that citizenship could have deprived of such a good provokes a strong reaction. A group of artists and theater companies disclosed an appeal for an assembly to be held in front of the stable shareholders on the 23rd May of 2014.

The message of the informal call is well acknowledged and the assembly is attended by about three hundred people. Someone in the audience proposes to call the meeting as the clock of the Cavallerizza, firm on 14:45. The proposal is approved and the Assemblea Cavallerizza 14:45 born with the intent of restarting the clock: the Assembly decided then to occupy the building in order to give it a new life.

Since then, the artists together with citizens, temporary dwellers such as students, researchers, curious, started to create a open, rich and dense program of cultural meetings and debates. They in particular met to reflect on the nature and role of the commons for citizenship rights. The artists began to come from all over Europe and beyond, attracted by such a new place where to create and to contribute to a higher aim of definition of commons and city rights.

In April 2015, the Regional Council approved a Memorandum of Understanding between Piedmont Region, City of Turin, the Superintendent, the State Archive, the University, Edisu (the institution that promotes the right to studies), Compagnia di San Paolo (the major bank Foundation), Fondazione Teatro Stabile, Teatro Regio Foundation, the Academy of Fine Arts and CCT srl, for the exploitation of the portion of the former Cavallerizza Reale complex and former Zecca building.

Such a news pushed occupants and people involved to reflect more intensively on the future of the Cavallerizza, so that they started to organise a serious process of participation in order to imagine how to continue the experience with a solid project to counterpose to the cited MoU. At the same time, it grew a great movement to support Cavallerizza, allowing the issue to rise to the national level. Tommaso Montanari, Gustavo Zagrebelski, Salvatore Settis, Paolo Maddalena lined up with the occupant movement; but, above all, ten thousand signatures of citizens are
collected in favor of Cavallerizza and against the process of privatization of a public good and its sale to private companies.

In particular, the movement wants to remove the danger of a transformation of such a become commons (Paolo Maddalena defines it as goods that are in collective enjoyment and belonging – “beni in appartenenza e fruizione collettiva”, 2014) in an elitist good, since it emerges the concrete possibility of division of the buildings and of a sell it for a top luxury hotel and residencies. In addition, such operation appears incoherent with the declaration of UNESCO and in fact, after a formal communication to Paris arguing the process of privatization, a series of controls are made by UNESCO in order to verify the situation in the Municipality. Furthermore, part of the movement chose also to constitute an Association “Salviamo Cavallerizza” with the purpose to carry on legal lawsuit or people’s action in order to preserve it and its free enjoyment, promoting its public property and function, its accessibility and its cultural and collective use, decided together with the citizens through participatory processes.

The Municipality, after the visit of UNESCO inspectors and now involved in the pre-election phase, decided to re-achieve part of the Compendium from the CCT, but any kind of information regarding the future destination and property of Cavallerizza is given. While even a large number of intellectuals signed an appeal, promoted by Gustavo Zagrebelsky and Paolo Maddalena, to ask engagement of residents in decisions on the fate of the Cavallerizza.

**Results and discussion**

The briefly cited case offers an opportunity to study the role of collective processes in urban innovation trigger. From the analysis of the process of Cavallerizza emerged a clear quality of the city that is in favor of change. Indeed it allows the possibility to express not only the claim for essential needs, but it represents a specific quality of the urban that includes the access to the resources of the city and a chance to experience an alternative urban life. So that the right to the city shows itself as an appeal, a demand (Lefebvre, 1968). It therefore turns out to be as a device, a tactic of intervention (a new tactic of intervention as Jane Jacobs asked for in 1961) on processes of urbanisation of our cities (Harvey, 2003).

In addition, the process of Assemblea Cavallerizza 14:45 shows the generative character of the city of urban innovations. They are the product of a collective work. As a consequence, also the rights deriving from them are collective. They arise from their production or come from their use. That quality gives a an important legal dispositif, providing for an higher form of rights : the right to the oeuvre, to the participant activity and a right to the enjoyment (Lefebvre underlines that they are implicit in the right to the city and the difference to the right of property, 1968).

If one consider the spontaneity of the city (Moroni, 2005, Ikeda, 2010), this character does not mean illegal or informal, but it may better describe an unpredictable social and physical emergent order coming from the bottom (Hayek, 1967).

Plans or urban rules often seek to achieve a predetermined order, thus a predetermined idea of city, through the assistance of behavioral rules that discipline people's actions in space in order to pursue collective efficiency (Buitelaar&Sorel, 2010, Moroni 2010). Notwithstanding, rules cannot determine all people's actions and, consequently, asserting that planning can perfectly prefigure a particular future territorial structure is worthless (Moroni, 1999).

City is the living system that assist their inhabitants with their own personal plans, dreams and ambitions, and to live close to each other in a complex system. Such nature has a evident implication: city is where high contestations arise and spaces of insurgent citizenship (Holston, 1999) develop. These are the territories that make visible efforts to claim vacant or abandoned urban land and structures for affordable housing, the occupation and reclamation of formally
public and private cultural institutions, the rise of informal housing settlements on the peripheries. Nevertheless, insurgent planning practises, while opposing the existing city, with its institutional asset and organization, build the first devices of an alternative and changing city (Sandercock, 1998), enlarging the spaces of democracy and citizenship (Friedmann, 2000). Social insurgents practises are the result of collective intentionality, that, as seen above, has a positive and planning, and thus a designing and governing, requisite.

Conclusions

As it has been seen, city is a powerful place to identify emerging processes and where to observe spontaneous transformation processes (Jacobs, 1961, 1969, Secchi 2013, Sennett, 2003, 2012), showing an internal capacity to regenerate continuously, despite the changes and unpredictable challenges. The city supports its dwellers in their projects, in dreams and ambitions. Such a nature has an obvious implication: it is in the city that strong objections arise and insurgent citizenship develop. Actually, they often represent the way how to respond to deprivation of rights and security and to the advancing precariousness of situations and relationships. Individuals and groups, both organised or not belonging to any juridical recognition, act through self-organisations to find solutions to their needs. Effectively, trying to define the nature of these practises, they can be considered public whether they promote the accessibility of different audiences and if their trials are open to external uses and usability and not the only to the community that produced them. Therefore, sharing practises produce public only if the share is a result of the interaction that builds a community of practise (Savoldi, 2006). Only whether they are able to produce goods and services for those who did not directly activated such testing, then they are public practises.

These practises and processes have also to be examined considering the perspective of people that implement them. Processes of empowerment and creation of new skills of people in response to their needs, according to the capability approach, promote the development of society (Sen, 1999).

In a parallel way, outlined processes can be seen as tools for institutions to learn and develop the ability to embrace changes, to make them visible, then public, translating it into a path provided with norms that can guarantee universalism of possibilities to citizens (Donolo, 1997). Often these collective actions, while opposed to the existing city, build urban spaces and produce works that contribute to triggering the first devices of an alternative and change of the city. The case of the urban movement taking place around the Cavallerizza Reale offered an opportunity to study the role of collective processes in urban innovation trigger. It allowed to verify some of the criteria to identify spatial and legal dispositifs and tactics of intervention considering juridical and operational requisites of the right to the city as a innovation trigger.

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e-agorà|e-αγόρα for the transition toward resilient communities


No more build, but regenerate and reuse

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Key-words: real estate derelict; regeneration process; recovery and reuse; inhabitants involvement; territorial embodied energy.

Introduction

After the uncontrolled growth of cities during the last thirty years, today we can observe several buildings and places abandoned and disused. Within this scenario of neglect there are different buildings (both public and private): historical or single buildings (palaces; castles; old factories; cinemas and theatres; etc); industrial real estate; former military buildings; buildings uncompleted or if completed, unused. Particularly, the "interrupted" buildings emerge (Filpa and La Magna, 2013, 19) like constructions without users and clear functions. The causes of the abandonment depend on many factors such as the economic crisis or the lack of maintenance; or the functional obsolescence or the production standstill or still the bad investments (Filpa and La Magna, 2013, 23-29). Among many causes, it especially emerges and affects the abandonment of places and buildings constructed without taking into account the inhabitants needs. So, «the task of architecture is creating the emotional scene whereas the task of planning is establishing a close link between planning and real estate development, strengthening a feeling of adequacy between places and people» (Contin 2010, 186). On the other hand, the numerous examples of re-appropriation of places by inhabitants recall public administrators to a change of perspective because «traditional development methods have failed (...) and most of all low or shrinking investments in many cities have left numerous spaces vacant» (Christiaanse 2013, 5). Even we remember *Spontaneous Interventions*, the exhibition of the U.S. Pavilion at the 2012 Venice Architecture Biennale. The curators decided to show a few of hundreds examples burgeoning around the world «to describe a type of interventionist urbanism sweeping through cities (...) as alternative recession-era approaches to urban revitalization, and with “social impact design”» (Lang Ho 2012). This shows that we are really at the "tipping point" thesis of Malcolm Gladwell (Gladwell 2006), so that Public Administrators and designers are no longer the only makers of the transformations of the environment but now is fundamental taking into account the inhabitants needs to an effective governance of the cities. *Spontaneous Interventions: Design Actions for the Common Good* also shows (for designers) «that moving ideas off the drawing board and into the world is the tricky part» and «celebrates those who act, who take the initiative to transform problematic urban situations into new opportunities» (Lang Ho 2012). In this work, the curators address the "common good" like a resource for everyone, also representing a form of common wealth and recalling the broader concept of "healthy city" because: «spontaneous interventions embody innumerable ways of rethinking our collective well-being, both physical and emotional».

This involved a gradual change of the point of view of administrators, designers and experts, calling into question disciplines until then unconsidered (as environmental
psychology, urban sociology or environmental design). Today, based on the carried out experiences of re-appropriation of places, widespread in the world (we also remember important interventions like tactical urbanism), to reverse the trend, we should develop a new methodology starting to the social needs to translate them into reuse building process. In this way, urban regeneration should take on a social programming character to be sustainable at different scales intervention process. Doing this, we must enable a new relationship between designers and community to express their own habitat (Paolella 2014, 260) imaging new ways to transfer these visions into the project.
Methodology

Today, most derelict places are “empty container” that have been generated overlooking community’s wishes. According to P.C. Palermo, we can affirm that the “critical pragmatism” have been away in the foundation of new models of territorial government. Potentially, the derelict landscapes seem “areas in which should be placed the regeneration projects, in some way representative of the city” and also they are “unrepresentative places of power that become new icons and symbols in which the community place our identity” (Derossi 1997, 49-51). So, the recovery and regeneration process must take into account the new function rightly suggested by the community, based on socio-cultural and economical context. Consequently, the Public Administrators should first learn to listen to the community, then acting and interacting with it because “the knowledge is formed by interacting and it is confirmed by active use” (Palermo 2009, 138). In addition, to completely define useful functions and meanings based on needs and expectations of local communities, «it is necessary to re-examine the regulation both of government levels that of interests aggregates of civil society» to discovery «originally territorial dimensions» (Cortese 2013, 34). When, planning and programming should be based on multidisciplinary skills while design become «the ideal forum of public deed to synthesize different work tools and codes in relation to pre-existing planners and designers» (Cortese 2013, 36).

Starting from these considerations, over the past months, we have carried out a search in a vast territory in the north of Sardinia, called Nurra. Historically, this was an unhealthy territory that has been reclaimed from the end of the nineteenth century and up to the 50s. Today, it is characterized by “several interruptions” due to: the reclamation (that has not completed the agricultural conversion of this area); the industrial settlements (now mostly abandoned); the tourism industry (which has been not developed in a consistent and continuous way). Many places and buildings have been abandoned, some of which were never put into operation (especially factories for processing of agricultural and herding products). In addition, according to the rules of the reclamation areas, still today the settlement is characterized by both farmhouses scattered in the territory and small town (one from agriculture service, named Santa Maria La Palma; the other as the administrative reclamation branch, named Fertilia). Moreover, this area has great environmental and landscape values. However, these interruptions have caused an intermittent territorial development that is at the root of the difficult living conditions complained by residents. It showed that these difficulties are due to the lack of social services; to the inability to expand productive activities for local administrative restrictions; to the incapability of public administrators to develop effective tools of government land. The research aimed -first of all- to identify the real problems (interviewing the inhabitants), then to look for possible solutions arranging the land resources, human and material, within a multi-years regeneration plan like a complex territorial system. The first analytical step included both the interview of the inhabitants and the mapping of buildings, places and construction materials abandoned; we also surveyed farms and producers, identifying both the number of actives companies and the territorial surface currently productive.
Later, we organized a meeting between the inhabitants and public administrators (the city of Alghero and Porto Conte Natural Park), to understand the needs and the administrative constraints. This operating scenario refers to the «pluralism collaborative (or programming involving communities) and the conflicting pluralism (or programming taking into account the diverging interests of the groups)» (Siza 2003, 49, 51). When some socio-cultural factors have emerged from the analysis carried out, then we have suggested a territorial regeneration plan developed as an instrument of social programming.

Meetings highlighted both the problems and the potentials of an area with a strong agricultural vocation. On one side (has made its way on) the idea of a naturalistic Park brand-sponsored agricultural production chain (proposed by president of the Park); on the other, (emerged) the need to improve tourism offering an integrated system of residence and fruition of the territory (proposal by the inhabitants of the closest seaside villages). From interviews to inhabitants of the villages, emerged more common needs (listed not in order of importance) such as: improvement of the mobility system; maintenance of roads and public greenery; improvement of waste collection service; strengthening the health care system; recovery of public buildings (closed or abandoned) and reuse for social and cultural purposes; building a common market for direct sales of local products.

In the second phase, the work group became an enabler between public administrators, stakeholders and inhabitants. Processing the data emerged from the analysis, we are convinced that the designer must «reflect on himself in the act of design, evaluating effects, knowing and checking the effectiveness and precision of its design objectives» (Amendola 2009, 84). So, the multi-years plan has been drawn up based on: 1) inhabitants needs; 2) recovery and reuse of pre-existing places and builds neglected; 3) recovery and reuse of existing construction materials scattered; 4) taking into account different wishes and point of view among different inhabitants groups; 5) involving public administrators and other public authority.
In the third step was articulated a multi-years program of interventions, like a regeneration strategy planning starting from recovery of the former mechanic's workshop agrarian reform (built in 1942) to be reused as a common market for products of the territory. Building a common market has been the most recurring request of the inhabitants, then it was considered to be a project with a strong identity, able to create community. At the same time, the common market could become a place of encounter and confrontation between the inhabitants and administrators to build a shared vision of the future of this territory, a place like a “common good”, a core to put back together this “interrupted territory”. The market was imagined to be a place for commerce able to promote the meeting between the residents: a place where they could develop ideas for new production chains linked to the region (local and environmentally friendly); even a place equipped with function rooms and a small information centre and tourist promotion of the territory.

The market could be a place to promote a new low environmental impact culture. In fact, in the later phases (from 2018 to 2022) the multi-years regeneration program will enhance the historical productive chains of oil, wine, milk (by dairy products) and agricultural products on which was based the reclamation of the years '30. Finally, (from 2022) to complete the regeneration strategy towards low environmental impact and active the local synergies, it involves the start up of processing chain of derived wastes of above-mentioned productive chains. In fact, a study carried out on the potential types of wastes showed the chance to produce fuels; bioplastics; paper and cardboard. This latter step would transform this territory according to innovative criteria of “circular economy” and “zero waste” also promoted in the last years by European Community.
Results and discussion

This territorial regeneration plan has been shown at the meeting promoted by the inhabitants, who have appreciated the proposal and adopted it for their subsequent proposals to public administrators of Alghero. The methodology has highlighted the inhabitants capability to imagine possible solutions to real problems, confirming (as already known) their fundamental role in design and planning process. It also emerged that:

- it is not possible to design without listening to the inhabitants;
- the design process must take into account these capabilities;
- the functions must match the real needs of end users;
- the project is a fundamental instrument of social programming.

On the other hand, the methodology:

- has confirmed the social role of the designer, which must return to interpret people before designing;
- has highlighted the need to refine the tools and methods of analysis to bring out more clearly the inhabitants requests to be put behind the project (using a multidisciplinary approach to the urban and social issues).

Finally, the project (like a prevision with time frame) must envisage a progressive implementation margins to be able to adapt to changing social and economic conditions. So, to be more flexible by reducing the likelihood of abandonment and its reliability over time.

Conclusions

The methodology has been based on data derived from direct analysis of social, economic and cultural context. This has allowed to elaborate a coherent instrument with current operational constraints and regulatory requirements. The project has been in response to inhabitants requests by reusing existing materials and derelict places. It was made a territorial georeferenced map, which shows the abandoned places, buildings and construction materials. Therefore, we believe that this methodology has great potential because immediately usable, especially by a public authority that wants to implement a regeneration plan starting from energy embodied of its territory, at the same time taking into account environmental, economic and social issue. This is the requirement that permitted us to affirm that is better no more build but regenerate and reuse.

References


e-agorâ|e-αγορά for the transition toward resilient communities


A Reflection on Smart Governance in the new Metropolitan City of Cagliari

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Keywords: smart governance, smart territory, georesources planning, strategic planning, metropolitan cities.

Introduction

Italy’s recent adoption of Law 56/2014 (known as the Delrio law) launched an ambitious organizational and institutional adaptation of metropolitan cities. This law is framed in the draft constitutional reform of the important and strategic-operational issues related to more extensive place-based functions (such as protection and enhancement of the environment, planning transport services, and the construction and management of roads). It is also intended to simplify the State-Regions skills system, from a hyper-structured model (regions and provinces), to one that is more sustainable, both financially and functionally (Gulli, 2011; Longo & Cicirello, 2016). In Sardinia, the Regional law 2/2016 “Reform of the system of local autonomy of Sardinia” (from the Italian Riordino del sistema delle autonomie locali della Sardegna) establishes the Metropolitan City of Cagliari with seventeen municipalities—with Cagliari as leader. The other municipalities are Assemini, Capoterra, Elmas, Decimomannu, Maracalagonis, Monserrato, Pula, Quartu, Quartucciu, Sarroch, Selargius, Sestu, Settimo, Sinnai, Villa San Pietro, and Uta. They include about 431,000 inhabitants, in an area of 1,250 square kilometres (ISTAT, 2015). Different urban planning tools—from those that are strategic to urban master plans or sector plans—continue to be used at various levels.

An analysis of these urban planning tools reveals that only weak attention has been given to the environmental aspect of georesources, and this is particularly true of the treatment given to aggregates in Metropolitan City of Cagliari. A territory requires aggregates mainly for private building activities and public works. The construction industry is the largest user of aggregates, according to a report that analysed territories’ demands for aggregates after the Second World War (Balletto, 2005). This paper, after framing the Metropolitan City of Cagliari, evaluates environmental aspects of the quantification-procurement of construction materials such as aggregates that are essential for development and urban renewal. Doing so allows the authors to interpret key aspects of the smart region paradigm. In other words, the focus of this paper is on understanding whether the activities of development and urban regeneration are consistent with a that encompasses the smart cities concept, but also fit into the smart region paradigm.
The Context of the Metropolitan City of Cagliari

All seventeen municipalities, with the exception of Uta, have a municipal strategic plan (MSP). Only two (Assemini and Sestu) have Urban Masterplans (UPM) adapted to the Regional Landscape Plan (RLP) of 2006; the remaining municipalities have a previous-generation UPM. A detailed analysis of all urban planning tools, as mentioned in the previous section, has also highlighted the Metropolitan City of Cagliari’s strategic functions and objectives, as they relate to its protection and territorial-environmental planning. They are synoptically represented in Table 1.

<table>
<thead>
<tr>
<th>Functions</th>
<th>Tools and / or results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spatial planning</td>
<td>The Territorial Outline Plan for Coordination (<em>Piano Territoriale di Coordinamento</em>) will contain not only the contents of the Provincial Urban Plan (<em>Piano Urbanistico Provinciale</em>), but also forecasts of border contexts among urbanized settlements, in order to ensure good coordination between the Urban Masterplans (<em>UMPs</em>) of the municipalities involved.</td>
</tr>
<tr>
<td></td>
<td>The Metropolitan Urban Masterplan (<em>Piano Urbanistico Metropolitano</em>) will contain the contents of the <em>UMPs</em>.</td>
</tr>
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<td></td>
<td>Multi-Year Implementation Programme (programma pluriennale di attuazione)</td>
</tr>
<tr>
<td>Protection and enhancement of cultural and environmental heritage</td>
<td>Ensures that tasks are related to the census, cataloging, documentation, recovering, conservation, and enhancement of the historical, monumental, archaeological, and environmental metropolitan goods</td>
</tr>
<tr>
<td></td>
<td>Manages cultural facilities of high quality and importance, and major works and institutions aimed at protecting and enhancing the metropolitan ecosystem</td>
</tr>
<tr>
<td></td>
<td>Verifying that the protection areas are identified in regional laws</td>
</tr>
<tr>
<td></td>
<td>Plans measures needed to protect the land and water, and reduce air pollution</td>
</tr>
<tr>
<td></td>
<td>Participates in the preparation and implementation of the Regional Plan of Civil Protection</td>
</tr>
<tr>
<td>Soil conservation, hydrogeological protection, protection and enhancement of water resources, waste disposal</td>
<td>Programming and management of (i) interventions for hydrogeological protection within the metropolitan city, and, (ii) tasks related to the enhancement of water resources</td>
</tr>
<tr>
<td></td>
<td>Regulates and controls discharges of water, and regulates and exercises the collection and disposal of waste within the metropolitan city, including the implementation of related management systems</td>
</tr>
<tr>
<td></td>
<td>Designs the construction and management of sewage wastewater at the metropolitan level</td>
</tr>
<tr>
<td></td>
<td>Provides effective assistance by implementing the Regional Plan for the disposal of solid waste</td>
</tr>
</tbody>
</table>

Table 1 shows how the georesources planning that is closely linked to urban spatial planning is not explicit. A territory’s demand for aggregates is primarily used for private building activities and public works, and the construction sector is the largest user of aggregates, according to a well-established report of direct proportionality in the second post-war (Druker et al., 1996). Nonetheless, local planning does not accommodate any variations attributable to georesources planning, either in terms of needs assessments in urban areas, or in relation to its ecological footprint. In fact, the important role of georesources in economic and environmental terms (Rapporto Cave, 2014; Krehbiel, 2016) requires high levels of attention when drafting and / or reviewing the *UMP*, and this is especially true in island areas, which is the region of Sardinia’s context. Balletto, Mei, and Garau (2015) and Badino, Blengini, and Garbarino (2006) identify various approaches, from which we have chosen to adopt the needs assessment of aggregates, with reference to the provision of local planning tools for this study.

In the Metropolitan City of Cagliari, the hypothesis that soil consumption is equivalent to the demand for aggregates appears to be supported. In fact, the distance of Sardinia (region-island)
from the mainland exceeds sixty-five kilometres. For this reason, it can only rely on its own resources, because of the low market value of aggregates and the high transportation costs of moving things to and from the island (Wackernagel et al., 1999). Therefore, because the aggregate market refers to a local dimension of an insular type, we can easily deduce that its consumption is closely linked to forecasts in the Urban Masterplans (UPMs).

Optimizing the removal of materials and the impacts of the quarries on the landscape is even more urgent and possible today. This is demonstrated by data from other European countries that have reduced the amount of materials extracted through waste reuse policies drafted by the construction industry. This is the only possible way to enable a future for many areas that are otherwise condemned to a progressively degraded identity and landscape quality (Al-Awadhi, 2001). Virtuous international cases (such as England and Denmark) show that it is possible to promote innovation and accommodate the mining industry as an interdisciplinary forefront sector, due to the strong correlation between planning tools (Rapporto Cave, 2014; Balletto, Mei, & Garau, 2015).

The Metropolitan City of Cagliari therefore has an opportunity to assess the relationship between urban planning and its use of georesources. This relationship is associated with the territorial government’s planning tools, according to a smart-region paradigm (Huang & Hsu, 2003), where the use of combined natural aggregates (NA) and recovered aggregates (RA) offers the best solution for meeting demands created by the territorial government's tools (Balletto, Mei, & Garau, 2015).

Methodology

To assess the ten-year requirement stipulated by Balletto, Mei, and Garau (2005) the authors referred to the Metropolitan City of Cagliari, and selected from this one, six municipalities as case studies (Figure 1)—Cagliari, Decimomannu, Maracalagonis, Quartucciu, Quartu Sant’Elena, and Sarroch—based on the following criteria:

- Cagliari and Quartu Sant’Elena represent the most populous municipalities of Sardinia
- Sarroch is affected by a wider regional-scale industrial zone
- Decimomannu, Maracalagonis, and Quartucciu are characterized by an average rate of population increase (equal to 15.15%)

The assessment of aggregate demand (Balletto et al., 2005) has been derived from planned volumes in the UMP planning tool. The innovative aspect of this study is its introduction of a vision of the metropolitan city that has a more sustainable connotation, by assessing the needs for georesources for urban purposes that result from the UMP, following the smart region approach (Louman et al., 2015; Garau, 2014).
Results and discussion

The results of this paper, shown below in brief, highlight that the lack of attention given to the spatial planning of georesources for the city is not consistent with the paradigm of smart regions. In particular, Figure 2 shows the trend of the remaining buildable volumes of the six municipalities selected as case studies from the Metropolitan City of Cagliari. These six municipalities are equipped with a UMP. The urban zones that allow a meaningful analysis of the remaining buildable volume and of the use of aggregates are the following: the historic center zone (“A” zone); the residential completion zone (“B” zone); the residential expansion zone (“C” zone); and the tourism zone (“F” zone). Figure 2 also highlights that the residual volume is mainly evident in the municipalities of Cagliari and Quartu Sant’Elena—the most populated urban areas of the Metropolitan City of Cagliari. This area has a multipolar structure, with different degrees of hierarchy and urban forms characterized by compact (Cagliari) and dispersed urban portions (Quartu Sant’Elena, Decimomannu etc.). Figure 3 shows that the City of Decimomannu has a higher per-capita consumption, which reveals the degree of urban sprawl.
In contrast, Figure 4 highlights and confirms what was previously reported: Cagliari, Quartu Sant’Elena, and Decimomannu will grow, and Cagliari and Quartu Sant’Elena will be most active in conducting maintenance activities (in relation to buildings and roads).

Figure 5 illustrates that the higher demand for aggregates is attributable to the implementation of the C zones, and to maintenance of the A zones. The B and F zones do not have a high need for...
materials, because their infrastructure is in a good state of preservation, and therefore not subject to extraordinary maintenance. However, this assessment is only partially true. Progressive legal tools adopted in 2009, and best known in Italy as Piano casa (regional law [RL] no. 4/2009), are de facto no longer in use, and an unquantifiable demand has been created for the UMP. In fact, urban planning has been conducted at a frequency of about ten years, and since the eighties it has been subjected to the regulatory provisions in the Deregulation (Robinson, 2011), first called Condoni Edilizi (47/85 L, L 724/94 and 326/2003), and then Piano Casa. In Sardinia, the latter became law with RL no. 8, 23 April 2015. This situation, besides generating discontinuities in the implementation of the UPM, does not allow harmonious planning for the use of georesources in urban areas.

![Figure 5. Average demand per capita for homogeneous areas.](image)

**Conclusions**

The formation of new Metropolitan city of Cagliari can and should lead to renewed urban development; this will occur in smart regions that fully include georesource planning. Considering the results of this paper, the UMP is the starting point for forecasting the demand for aggregates, but it is no longer sufficient for fully evaluating the requirements for georesources associated with development and urban renewal. In this context, the authors refer to the balance of research conducted for NA and RA for the Metropolitan City of Cagliari, by reducing the tax burden linked to Leadership in Energy and Environmental Design (LEED) certification (Balletto, Mei, Desogus, & Garau, 2015), for the redevelopment and expansion of buildings. Using RA in the construction sector is the only way of containing the consumption of natural resources. Its systematic use, however, requires incentives, such as reducing the tax burden with respect to specific environmental certifications such as LEED. In particular, the combined actions of the needs assessment, associated with the UPM, and, more generally with the metropolitan urban masterplan (MUMP)—in which the reduction of the tax burden is considered at the time of LEED certification, following the use of RA—directs urban planning towards a smart region vision, that otherwise would be omitted due to the indirect effects of the deregulation of regulatory tools such as the recent Piano Casa.
Acknowledgements

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R&S.U.E Resilient & Safe Urban Environment

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Key-words: resilience, safety, project.

Introduction

The Pilot Project Resilient & Safe Urban Environment for Ferrara will serve as a testing ground for the proposed strategy of using the need to increase safety against earthquakes as an occasion to promote the Urban Project with strategic importance, the reason and utility of which will go far beyond the mere safeguarding against seismic risk. It will generate added value of urban requalification and the valorization of the existing architectural heritage. This project tends in particular to incorporate safety functions with other functions of common interest, creating a multitasking strategy which will associate the primary objectives of reducing the vulnerability of urban centres with the complimentary objectives of offering new opportunities and services to cities. These latter can immediately be incorporated into the normal services of the city until suddenly they are converted into emergency resources to cope with a calamity. This methodology which has inspired the project is targeted directly at the intervention, rather than at analytic recognition and preventative evaluation of the urban risk. In particular it starts from a preliminary identification of the two buildings empirically proposed by the municipal offices based on the conditions of the real feasibility of the interventions.
Methodology

*Guidelines for the Intervention*

The process moves from a consideration of the conditions of the context that are to steer the approach to be followed. Whenever possible one should use the results of preventative research carried out using CLE (Condizione Limite per l’Emergenza – Minimal Emergency Conditions) or even better SUM (Structura Urbana Minima – Minimal Urban Structure) protocols facilitating considerably the procedure, being able to identify right from the beginning buildings with strategic priority and their contribution to the minimalizing the effects of a seismic event.

If instead no previously elaborated data are available it is better to adopt the expeditious methodology, it is best in fact to hypothesize initially the availability of existing buildings that can host the necessary strategic functions in the event of an earthquake, and consider the methodology to make them safe in its inverse order, considering it as a specific Urban Project to construct to improve the performance following an earthquake but also to valorise the city's potential and develop.

The buildings should be identified quickly and beforehand using the sectorial technicians’ knowledge of the contexts of the municipal administration assisted perhaps by external experts and in particular from a local university. Any verification to be carried out concern in general their contribution to urban resilience, feasibility (technical, economic, administrative and social) and their upgrading to strategic buildings, and the marginal utility of their preventative transformation, also considering the added value in terms of the new opportunities this offers the city and to possible private owners (attempting though to use public property wherever possible as this will facilitate access by municipal authorities).

Naturally the verifications should be extended to the system of routes that connect the other urban centralities and to the system of escape routes that should be set up to guarantee their practicability even after a relative seismic event.

In this phase technical verifications, regarding the adaptability of existent buildings to the strategic functions they will carry out in the event of a seismic event, should be accompanied with an evaluation aimed at choosing of the most suitable governance system, to carry out and manage the Urban Project through which the necessary transformation is to take place. Undoubtedly each time will be different because of the size of the work to be carried out, but also because of the particular conditions of the context (administrative, technical, economic-financial, social and political) all of which must be kept in mind and a specific model must be put in place to insure the governance of the project in its various phases, from the programming to execution and then into its management when in operation.

Having a deep understanding of the strategic role of the example chosen as a reference will be very useful, on the base of the experiences which occurred during earlier earthquakes. The forms found in the, may show themselves to be equally useful. They allow one to measure the priorities of the individual interventions, the inversion points of their cost-effective curves. These calculation models do however presuppose specific in depth analyses and though not costly they do require the city administration spending further economic resources.

Having reached this point, basing your plans on the knowledge acquired and the guiding principles formulated previously, it becomes possible to set up the Urban Project using the R&S.U.E research as was done in the example of the application in the Pilot Project.

More in detail the components that characterise it are as follows:

1. **Mobility and accessibility systems**, that keep in mind in particular:
   - Position of the settlement system (territorial level)
   - Configuration (also as regards the urban morphology)
e-agorà|e-αγορά for the transition toward resilient communities

- Degree of complexity (presence of widenings of roads, squares, parking lots, including the configuration of road axes)
- Thoroughfares with the primary and secondary systems (intended as hubs among the networks belonging to several levels)

2. **Strategic buildings and safe open spaces**, for which the pilot project will consider principally:

- Position of the centre as respects the territorial context, both from a geomorphological point of view (synthetic description of the centre as respects the morphology: summit, crest, valley floor, open plain) and functional (degree of belonging, relations with nearby urban centres, specialised functions for the territory);
- Type of centre (mainly urban residential, rural, industrial, services, second homes);
- Dimensions of the urban centre (overall surface area, population density and density of buildings, square metres built up, ratio built:empty);
- Urban structure and morphology (closed, open, compact, fragmented, dense, dispersed);
- Internal organisation and how it functions (single or many-centred urban centre, concentrated or diffuse, with functions and spaces strategically located in one or more points, or rather along a single road, or perhaps in several parts of the settlement).

The strategic buildings and structures whose operation and access should be guaranteed immediately already during the emergency, are the former military barracks Bevilacqua in the historic centre and the complex of buildings in the Fairgrounds in the outskirts. These are to be taken as the structural nuclei, the Primary poles (concentration of the strategic functions that are to be safeguarded). To these two strategic buildings there must be added some public or publicly used private buildings (schools, private schools, sports complexes, hotels, parish buildings and monasteries, barracks, town hall and the main administrative buildings, main health structures) making up together the primary pole and the secondary poles that concentrate the functionality of the second level.

The Municipal Stadium Paolo Mazza, the Sports Centre in Via Don Enrico Tazzoli (Monastery of San Benedetto), Piazza Ariostea, the park in front of the Bevilacqua Barracks and the park in front of the Scientific High School A. Roiti near Via Giacomo Leopardi are identified as strategically important safe, open spaces.

Essentially the proposed strategy aims to assign a primary value to the entire system of the open spaces in the historic centre of Ferrara, identifying in particular a type of urban network anchored to the two primary poles (strategic poles), the building at the Ferrara Fairgrounds and former Bevilacqua Barracks today occupied by the Police Station.

The first, a large open structure for stands which can easily be converted in case of need, could offer hospitality to heterogeneous functions that would allow the authorities to quickly get control of an emergency caused by a natural calamity (from organising aid to managing logistics and temporary hospitality to those who cannot or will not return to their homes).

In the second building, one of great historical importance, unfortunately today in poor condition and partially occupied by the offices of the local police, would go the functions of the coordination and management of the reconstruction, fundamentally hinging on a Smart Centre directing the several needs, integrated by transitory lodging that could host displaced persons until their homes in the city centre were once again safe.

The proposed solution allows for a continued functioning of the Police Station, with a partial reconversion of the under-used spaces into innovative touristic residences. Then the setting up of a centre for smart innovation in the city supplied with a nucleus of hardware and devices, wide
band digital networks, promoting operative and training activities aimed at consolidating its new prefigured vocation. The smart centre should have dedicated Communitary financing available, functioning as the embryo for a future platform, in synergy with the one the Province has already set up not far away.

In this sense the urban project to strengthen the strategic buildings will also become the occasion to restore a heritage site of great value, and then use it to function as a market that can compete both in repaying public investments and in offering new possibilities for employment and in improving Ferrara’s attractiveness.

In the event of a natural disaster, the smart centre is programmed to be able to expand even outside. A large tent can multiply the usable space. Further, even the tourist lodging can be immediately converted in emergency housing, perhaps even taking over spaces now occupied by the offices of the police.

The primary pole anchored on the former Bevilacqua Barracks is completed by its functional integration with the school structures standing in front of it and by exploiting the nearby open spaces, sufficiently large to set up a centre to coordinate the reconstruction. Other secondary poles centred on pre-existing buildings used for health and religious services are connected to the primary poles by routes which would be previously made safe for transit.

The attached figures present a succinct explanation of the indications. Their sequence refers to the various phases of the PescaraHolistic process to progressively guarantee safety against earthquakes.

Phase 1. Strategic Connections
In the first figure of the Pilot Project we can see the main axes that are planned to connect the two strategic poles the former Bevilacqua Barracks in the historic centre and the Fair Grounds in the outskirts. The main urban and territorial connections such as Via Camillo Benso Conte di Cavour, Corso della Giudecca, Corso Ercole I d’Este, this last is to become the axis along which will be located some strategic services and will be used to integrate the parking areas and green areas in the system to gather people. Its strategic importance is connected to the fact that it is the access route to the historic centre connecting the Train Station with the City Hall and the Emergency Health Services (ex-Hospital).

Phase 2. The primary strategic poles are identified successively: Polo St-1 (Police Station, Parking Lot, Scientific High School, Centro Smart, Supermarket); Polo St-2 (Ferrara Fair Grounds, Emergency Health Service) and the main connections between the two poles. In this case the best escape routes are Via Camillo Benso Conte di Cavour, Corso della Giudecca and Corso Ercole I d’Este.

Phase 3. Strategic buildings and secondary strategic poles
Here we show the system of the strategic functions and of the secondary poles. In particular:

- Primary strategic buildings (City Hall and administrative buildings), former Bevilacqua Barracks as the Smart Operative Centre and the Centre for Emergencies (Strategic Pole 1);
- Auxiliary strategic public buildings, Scientific High School, Grisù Space, Church of San Benedetto Abate and private buildings (hospitality facilities); Buildings with critical functions, Emergency Health Services, ex-Hospital;
- System of emergency areas and safe spaces that include the open, green and sports areas which can be used as spaces for temporary staging areas: the Municipal Stadium Paolo Mazza; the sports area in Via Don Enrico Tazzoli (San Benedetto Monastery); Piazza Ariostea; the park in front of the Former Bevilacqua Barracks and the park in front of the Scientific High School A. Rioli which are along Via Giacomo Leopardi.
Phase 4. Integrated routes and gathering areas

4a gathering areas
One identifies the main gathering areas, the emergency areas and safe open spaces which include the open, green and sports areas which can be used as spaces for temporary gathering points. These are the Municipal Stadium Paolo Mazza; the sports area in Via Don Enrico Tazzoli (San Benedetto Monastery); Piazza Ariostea; the park in front of the Former Bevilacqua Barracks and the park in front of the Scientific High School A. Rioli which are along Via Giacomo Leopardi.

4b. the figure shows a possible integration of the routes among the various secondary gathering areas. In particular we have shown the system of emergency areas and safe spaces that include the covered Cofed Market and all the parking areas and public green areas and the secondary escape routes that include Corso Martiri della Libertà, Via Piangipane, Corso Isonzo. Via della Cittadella, Via Montebello, Via Palestro and Via Mortara.

Phase 5. Pilot Project
The last figure of the Pilot Project, though with an element of hypothesis awaiting a more careful verification of the real condition of current buildings and of the confrontation with the first level seismic microzonation map, shows some possible prefectural solutions.

The figures shows the whole set of routes, strategic buildings and spaces considered essential so that the city can resist the effects of a possible seismic event, or rather the relations among the structures that must be able to resist the earthquake and at the same time maintain the historic centre vital. These structures are indispensable to efforts to trigger generalised recovery.

Here we find the main territorial connections confirmed, maintaining the role of Via Camillo Benso Conte di Cavour, Corso della Giudecca and Corso Ercole I d’Este which is to become the fundamental backbone of the system hosting some of the strategic services and will systemize the parking lots and green areas as gathering points and its strategic importance derives from the fact that it is also the main access route to the historic centre that connects the Train Station and emergency health services (Ex-Hospital).

The system of buildings and their strategic functions reiterates what we found in previous figures.

Guidelines for the Intervention
The process moves from a consideration of the conditions of the context that are to steer the approach to be followed.

Whenever possible one should use the results of preventative research carried out using CLE (Condizione Limite per l’Emergenza – Minimal Emergency Conditions) or even better SUM (Structura Urbana Minima – Minimal Urban Structure) protocols facilitating considerably the procedure, being able to identify right from the beginning buildings with strategic priority and their contribution to the minimalizing the effects of a seismic event.

In this case it is best in fact to hypothesize initially the availability of existing buildings that can host the necessary strategic functions in the event of an earthquake, and consider the methodology to make them safe in its inverse order, considering it as a specific Urban Project to construct to improve the performance following an earthquake but also to valorise the city’s potential and develop.

As described more completely in the above mentioned chapter, the buildings should be identified quickly and beforehand using the sectorial technicians’ knowledge of the contexts of the municipal administration assisted perhaps by external experts and in particular from a local university. Any verification to be carried out concern in general their contribution to urban resilience, feasibility (technical, economic, administrative and social) and their upgrading to strategic buildings, and the marginal utility of their preventative transformation, also considering the added value in terms of the new opportunities this offers the city and to possible private
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In this phase technical verifications, regarding the adaptability of existent buildings to the strategic functions they will carry out in the event of a seismic event, should be accompanied with an evaluation aimed at choosing of the most suitable governance system, to carry out and manage the Urban Project through which the necessary transformation is to take place. This is the role of form M2 (Form of governance under exam) that sets the case of Abruzzo as the case to use in designing the institutional system to follow and guide an Urban Project to its conclusion.

Undoubtedly each time will be different because of the size of the work to be carried out, but also because of the particular conditions of the context (administrative, technical, economic-financial, social and political) all of which must be kept in mind and a specific model must be put in place to insure the governance of the project in its various phases, from the programming to execution and then into its management when in operation.

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Having reached this point, basing your plans on the knowledge acquired and the guiding principles formulated previously, it becomes possible to set up the Urban Project using the PescaraHolistic research as was done in the example of the application in the Pilot Project.
Results and discussion

An Urban Project that improves safety against seismic risk can also become a useful opportunity to improve the level of environmental awareness in the city, for example by considering subjects such as clean energy, slow mobility, water conservation and green and public spaces. The strategic buildings and the escape routes in particular should be conceived as self-sufficient entities as regards energy production, lighting, telecommunications and water management. It would be still better to move toward urban sustainability, presupposing a strategy to mitigate risks “at the source” which is quite difficult to do during a seismic event, giving way to urban resilience, on other words the possibility of adapting the several levels of the urban system (city, buildings, infrastructure) to foreseen risks. An approach directed toward resilience would favour as is known a study of the capacity of a living system to “continue and to recover following changes” even if traumatic in nature (Zolly-Healy, 2010). Above all it appears particularly well suited if – as in the case of strategic public buildings – it proposes “preserving their capacity to adapt”, or rather their capacity to adapt to new circumstances though they maintain their main function (Beisner et al 2003).

R&S.U.E research intends to move from the approach of urban resilience, looking at operative implications to the preparing of intervention strategies aimed at guaranteeing safety and preventive adaptation of strategically relevant public buildings.
Conclusions

The project, rather than being a technocratic imposition based mainly on evaluations by risk specialists (mainly seismic engineers and geologists) and then a ratification by local government organs, tends rather to the strategic framework of a process with the active participation of citizens, or at least of the owners of buildings and of the actors of the development included by the planned solutions, to raise the level of safety to those required by current legislation. In this way it contributes to increasing not only the social awareness of, but above all, the value of safety involving citizens actively in the process of choosing what is to be done, after they have been informed on the real issues and the concrete measures that are to be taken to cope with possible risks.

Finally the R&S.U.E approach would restore the question of necessary interventions to reduce the vulnerability of the city to those initiatives and social practices that substantiate projects of strategic valence for the city’s future and encourage research into new instruments of governance that are essential in diluting the technocratic approach which tends to eliminate responsibility. This approach favours the adoption of solutions which are those most widely approved of in the community and its local institutions.

References


Planning for S.M.A.R.T. (Specific, Measurable, Achievable, Resilient, Time-bound) development: a bottom up approach to lead knowledge-based tourism development in low density rural districts

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Key-words: Sustainable Mobility Development; Smart Specialization Strategy; Decision support; E-participation; Smart Mobility indicators.

Introduction

The tourism potential of a region is linked to the possibilities to access, to learn and engage and to benefit from the broad use of places as primary opportunities to attract different categories of users. The development of low-density rural areas, affected by structural limitations in terms of accessibility, loss of population and public services and thus considered in isolation, is mainly related to their spatial configuration and to the organization of urban infrastructure and services.

The authors present a work-in-progress for the Nurra region in the north west Sardinia: this is both a methodological approach that rewards co-operative capacity of stakeholders and an open government model to raise bottom-up sustainable mobility planning. The purpose of the paper is, at one hand, to represent and maximize the knowledge-based development potential of rural territories and their existing networks, and, on the other hand, to outline possible ways to enhance accessibility to information and services, both for residents and visitors, according to a permanent and replicable program. The first operative goal is the systematization of knowledge and access to material and immaterial networks, bringing together basic and different information for systematizing the tourism supply and the rational channeling of generated information to the private sector; the second goal is to structure a “territorial” sustainable mobility Plan through an organized system of links and information in order to connect and make accessible the rural and the coastal areas of Nurra, by identifying place-based areas of greatest strategic potential and available operators. Nevertheless, with reference to the operative goals, the involvement of small and medium enterprises, offering supply for services in the field of social care, tourism, mobility and receptivity, is the basis of the project and an essential contribution to the enhancement of the tangible and intangible heritage of the region. We think that open government and wiki policymaking (Cottica 2010) should be used in parallel with more traditional planning tools for policymaking. Our emphasis is on several alternative scenarios through the definition of S.M.A.R.T. (Specific, Measurable, Achievable, Resilient, Time-bound) targets and indicators, strongly tailored to the context and able to identify and measure the elements that hinder or limit mobility and to reveal the possibilities of linking and reaching places, innovating the organization of services and the use of public spaces making them effectively available for different city users.
Background trends

There is a vast literature about initiatives to be pursued to increase competitiveness and attractiveness of a territory. In 2013 Italy’s Strategic Tourism Plan (Italy Tourism Report 2020) reported the fluctuating trends on tourist numbers to a lack of attention to the close relationship that bind the individual components of cultural tourism infrastructure (cognitive, organizational, social, institutional and geographical proximity) to the territory. Recent years have seen the emergence of a new vision in which the technology-based “smart city” paradigm is overtaken by the most contextualized “smart land” paradigm (Bonomi and Masiero 2014). Furthermore, concepts such as new technologies, sustainability, intelligence, competitiveness, inclusiveness, place-based promotion and efficiency keep pace with social cohesion, the spread of knowledge, the creative growth, accessibility and freedom of movement, usability of the environment (at the natural, historical, architectural, urban/peri-urban/rural dimensions) and the quality of the life of the inhabitants. For this reason, the assessment models supporting tourism and cultural policies are now better geared to the recognition of local resources with a real economic potential and the development of mechanisms for their activation by enhancing existing networks. At the same time, beyond to be a problem for the development of the whole territory, the lack of a planned system of mobility affects the development of opportunities for the inhabitants, especially in low density residential rural areas. The development perspectives of a region are however linked to the physical configuration of space, to the organization of urban and infrastructural systems and services, and to the characteristics and the knowledge of communities: it depends on the possibility to access, to act and transform the places and on the mobility capacity across territorial opportunities according to expressed needs.

Since internet has become a place of content production, the Web opens new forms of participatory governance, that can be summarized in the concept of wiki-policymaking. For instance, social interactions aren’t necessarily conditioned by constraints in terms of space, distance, residence, or time, which was the case in the past and the asynchronous of the response allows us to take part in processes as informed persons, and then participate by expressing our opinion. Furthermore, the principle of transparency enables shared access to Open Data among administrative organizations. Open government and wiki policymaking should be used in parallel with more traditional strategies for sustainable mobility policymaking with the latter being not entirely abandoned. Various group-management techniques can operate together with computerized tools to represent knowledge and to explore interactively the space of opportunities. Our emphasis is not so much on informational support but on the development of a mix of techniques and tools, targets and services more or less innovative, tailored directly to the contexts. To come full circle, the combination of Artificial Intelligence/Web based knowledge can facilitate both the access and the use of local resources for different types of users. In fact, on the one hand, the presence on the Web of cultural and natural heritage in digital form allows the spread on a wide scale and distance, and, on the other hand, the artificial intelligence tools increasingly allow broad categories of users a fruition that takes into account their personal needs. However, the recourse to effective tools of analysis, communication and data sharing facilitates knowledge learning and more aware employment of local resources and services, including the optimization of the economic aspects. Nevertheless, the possibility to pinpoint the information on free editable maps, by experiences of the users, can support policymakers and urban and transport planners to arrange a territorial Sustainable Mobility Plan in a participatory manner and at lower costs.
Toward a digital hamlets network: a case study in North-western Sardinia

To make the point about policymaking in a low density rural areas, we consider a geographical region in the north western Sardinia (Italy), named Nurra. It is the second largest plain of the island, that covers a surface of about 800 km², located between the city of Sassari, and the towns of Porto Torres and Alghero. The population density (5 inhabitants/km²), one of the lowest in Italy, entails problems such as: lack of primary and neighborhood services; lack of an efficient transport system; lack of people involvement in policymaking. Close to Alghero(40000 inhabitants and a touristic tradition), in the countryside marked by soil drainage canals, there are several rural hamlets: Santa Maria la Palma (1059 inhabitants), Guardia Grande (270), Maristella (424), Tramariglio (8), Sa Segada (395) and Villassunta (20) and Fertilia (1703). These hamlets are poorly managed and marginal with respect to the town of Alghero. As for public transport system, the bus routes are dispersive, unclear and badly managed for lack of information and communication. Although the distances between hamlets are not large, the total absence of alternative transport systems (i.e. cycle paths) brings people to prefer moving by car. The main county roads links Alghero and the greater hamlets leaving the smaller ones almost completely isolated. However the existing dense mesh date back to Nurra land reclamation, still guarantees widespread connections among scattered settlements by use of secondary roads, with their discreet state of maintenance hinting the potential for alternative non motorized transports. Territorial potentialities for off-season tourism are high: questionnaires to tourists report a demand for environmental resources, food and wine culture, local traditions etc. (DADU 2014), however at this time there are no organized systems of mobility nor of information able to lure these populations. Nevertheless, the lack of primary and district services in hamlets is crucial: de facto these low density residential areas are detached from the town of Alghero, the few services have unpractical locations with public spaces often neglected. According to this framework, with the support of e-participation technologies, we propose the Nurra region as the test field for developing multi-stakeholder governance mechanisms, setting strategic priorities and using smart instruments and policies of the different sectors, levels of government and neighboring authorities to maximize the knowledge-based development potential of the region and to set up an integrated land use and transport planning method which attempts to meet the needs and aspiration of different categories of users. The planning process is based on an accessibility network able to unveil and to strength the structure of connections (tangible and intangible) with a leading role in the organization of the whole urban system. The proposed network consist of two components: 1. the physical connections which grasps on the myriad of primary and secondary paths of the above mentioned original mesh of the land reform of Nurra region, including roads accessible for vehicles as well as those exclusively devoted for pedestrians or other users; 2. the social connections which concerns the existing network of relationships and commitments between local actors and potential ones.

Defining a “regional” sustainable mobility plan

According to the official document by the EU Commission (ELTISplus 2014) the process of the sustainable mobility planning strategy is articulated in 4 phases: 1. Preparing well; 2. Rational and transparent target setting; 3. Elaborating the plan; 4. Implementing the plan. Our research refers to the 1th and 2nd phase of the process as necessary steps to create the condition for the elaboration (3th phase) and the implementation (4th phase) of a territorial Sustainable Mobility Plan.

The 1st phase of the planning process provides for the following 5 activities. 1. Desk analysis on current policies and practices. The first analysis aims to assess the impact of
EU/national/regional framework on current local/regional policies and practices in order to understand to what extent sustainability principles are already part of the territorial policy at all level of government. 2. Analysis on drivers and barriers to the project development process and on perceived needs of the whole community. The rehabilitation perspectives of each hamlet or district will depend on the specific role it can play in the system according to the distinctive attributes and resources owned. Specific e-participation tools, such as crowdsourcing platforms and public noticeboard for collecting ideas and opinions (e.g. “Ideastorm”, “UserVoice”, “Ideascale”) will allow to gather and give information about perceived needs of permanent and fluctuating inhabitants, underway environmental and urban functionalities and spatial and social relationships. Web analysis can support in investigating platforms that manage specific information related to tourism or daily life, such as specialized sites containing information of interest (natural and historical heritage, accommodation or cultural content) and the UGC (User-Generated Content) as well as information about public utilities (transport network, security, health, banking and postal services, tourist information points, etc.). 3. Identification of local key actors and stakeholders. In order to launch the planning program it is important to clearly outline the core skill requirements and available financial, human and social resources (i.e. available staff and skills, financial funds, as well as the vitality of local communities expressed by self-organised, volunteer or cooperative forms of production and service supply). 4. Definition of the operating area. In order to pinpoint the “functional city”, that is the geographic context to be involved in the experimentation of the integrated planning approach, the analysis of the present mobility patterns and practices turns out to be very useful as a cognitive key for understanding socio-spatial relationships of the context and their extent (Pucci and Colleoni 2015). Daily travel itineraries provide a tracking of the rhythms of usage of the territory, thus unveiling physical and functional correspondences between people and places. The representation of movements in space and time is an important descriptor of changes in the organization of everyday life. It offers planners original insights into the formulation of policies coherent with the emerging demands by urban populations (residents, commuters, city users, tourists). Hence, with respect to the level of accessibility and coordination, other important interlinked information concern the location of natural ecosystems, their ecological quality, functional value and resulting attractiveness, the distribution of dwellings, goods, services, facilities and other urban opportunities across the area, the multiplicity of uses by different populations, economic activities and spontaneous initiatives. The frame of urban dynamics of a rural area supports identifying and prioritising key problems to be addresses as well as strengths and vitality clues to be endorsed. One tangible outputs of this phase is the construction of a set of indicators measured directly in the context, to detect and evaluate the elements that hinder or limit the access to opportunities and their real operation and to reveal the possibilities of link, use and manage urban and rural places, public spaces, services and local operators paying more attention to the needs of different users. 5. Construction of alternative scenarios for sustainable mobility. The frame of interdependencies addresses the formulation of "evolution trajectories" to be preferred for the context. Such a task requires a coordination between sectors and tiers (coherence of options related to transportation functionalities, land use measures, environmental concerns, etc.). The definition of an integrated system of transport combines the outcomes of the previous analysis of accessibility and mobility patterns on territorial level, with the requirement of sustainable mobility management strategies whose potential is increasingly augmented by introduction of ICT and telematics (e-ticketing, systems of travel and passenger information, apps for promoting, monitoring and rewarding the use of public transport and other sustainable mobility options, new alternatives of collective passenger transport services, access assistance services for elderly and disabled passengers, etc.). This activity can be effectively supported by the use of free editable maps (e.g. OpenStreetMap) which pinpoint the information edited by experiences of the users, together with a set of modelling techniques and tools to address policy measures such as models to assess whether and how the context is conducive to adopt sustainable mobility behaviours (e.g. Walkability Explorer, Blečić
The 2nd phase includes the development of a common vision about mobility in a wider framework, e.g. quality of life, services and use of public space. Citizens and stakeholders, especially enterprises and tourism operators, are pro-actively informed and involved in the development of a common vision in different ways (e.g. questionnaires; interviews, meetings, citizen's juries, etc.). A set of priority and measurable S.M.A.R.T. targets tailored to selected areas by indicators will be defined, by specifying what social, environmental or economic improvements are required, saying exactly what needs to be "reduced", "increased" or "maintained". In regard to indicators they will be selected according to the following requisites: efficiency (how much paths and features affect the possibility to exchange information, resources and connect people efficiently); pleasantness (how people reacts to the configuration of places and possible changes, whether physical and functional); comfort, safety and security (how conducive is the space to move around by use of multiple integrated forms of mobility according to different users' requirements); attractiveness (e.g. the possibility to have access to primary services); private-public support systems for mobility (self-organised mobility supply and services promoted by local actors in terms of sharing economy); etc. All these activities lead to the development of an effective package of guide lines which include suitable measures specific for context, checked with attention to the combination of urban and rural practices (new functional value to open space and innovative operative models of services) and to usability by different users. Guide lines intend to be the result of the discussion with key stakeholders, they are drawn by considering similar processes and policies experienced in other places, and exploit as much as possible synergies between measures.

**Conclusions**

The paper introduces an ongoing planning method for the Nurra region of Alghero (SS), a low density rural territory, aiming at connecting and including the area in the present and future development trajectories of the city of Alghero. The strategy is founded on the construction of an accessibility network connecting both physical and social components of the territory. An open government model to raise bottom-up sustainable planning initiatives is discussed. The construction of a growing co-operative capacity of stakeholders and the organization of an integrated transport system which involve in a coordinated way different travel modes and services are two basic precondition to give the region a renovated proactive role in the organization of the whole urban system. The article describes the methodological approach and a step-wise program for the activation of the process.

**References**


Urban intersections effect on pedestrian accessibility

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Key-words: urban intersections, pedestrian accessibility, walkability, evaluation, multicriteria decision aiding methods.

Introduction

Do intersections affect the convenience, pleasantness and quality of walk across the city? The study investigates the effect of spatial and operational configuration of street junctions on walking. A method for analyzing and evaluating urban intersections from the point of view of pedestrians and its operative application in the town of Alghero (Italy) is presented. An ELECTRE TRI rating/classification procedure was used to classify intersections according to their level of impedance for walking. Since the proposed method is reasonable simple to implement and its results have proven to be easily communicable, we believe it can be a useful planning support tool for the development of transportation policies aimed at enhancing pedestrian mobility and a practicable support aid for decision makers interested in prioritize interventions in cities. Furthermore, the proposed evaluation procedure may be incorporated into other evaluation models of urban walkability, which frequently put minor attention on (when not entirely ignoring) the effects of intersections on the overall walkability of places.
Background trends

Despite a growing attention of urban and transportation scholars on how built environment characteristics affect walking, most measures and models of pedestrian behavior are focused on street edges with less attention given to intersections. The character of punctual constructs which interrupt the continuity of the transport network and the related high potential of conflict between vehicles and pedestrian suggest to include these structural elements in evaluation models of walking accessibility. Safety concerns and spatial conditions such as the distance between origin and destination, the directness and the continuity of paths are overwhelmingly considered by the literature the main determinants of the decision to walk. Walkability indicators such as street connectivity account for intersections in the form of density (number of intersections per unit area), typology (number of approaches for each node) or connected node ratio, etc. (Dill 2004, Schlossberg et al. 2015). However, such indicators often reveal not to be adequate for measuring the effects of intersections on walking, being the level of observation excessively general and the spatial and operational characteristics of single crossings often overlooked. A more detailed evaluation method of road and crossing performances with respect to pedestrian accessibility is given by Pedestrian Level of Service measures - PLOS (Transportation Research Board 2000) which rank roads or intersections into classes based on the conducivity to walk associated to their spatial configuration including traffic volumes, car speed, visibility, presence of physical barriers, facilities for impaired. More recent studies on combine objective variables with behavioral features in a attempt to include the pedestrian experience of crossing in the evaluation (Muraleetharan et al. 2005, Abley and Tuner 2011).

As we already argued safety conditions, comfort and convenience of pedestrian seem to be the most important issues to consider in the analysis of urban intersections influence on walkability. Safety is mainly associated with traffic. The barrier effect produced by traffic volume and speed entails delays or extensions of the itinerary, steering the choice of travel mode towards motorized conveyances (Jacobsen and Rutter 2009). According to Litman (2000) it is an indirect cost people bear when changing route or travel mode to avoid crash risk and disturbance. Above all it becomes an important constraint factor for citizens with limited accessibility abilities such as children, elderly people, people with disability, household with no car, etc.). Some authors remark that for older adults it is difficult to cross the street mainly because of insufficient time to cross wide roads at slower speed and with visual impairments (Langlois et al. 1997). Similarly, traffic around home, crash risk, long distances to travel and general sense of insecurity are responsible of the decision of parents not to allow their children to walk alone (Nasar and Abdulkarim 2015). The physical distance to cross, estimated as a geometric length or in the form of the number of lanes or the types of roads (arterial, collector, local), is another important variable commonly considered together with the number and extension of incurred stops, their geometry, facilities and equipments. More in detail relevant variables often mentioned are: traffic control devices, presence and characteristics of the space at corners composed by hold area and circulation area, crossing facilities (elevated crossing, visible zebra and other pavement markings including detectable warnings for impaired). Curb ramps at opposite corners of the intersection make the elevation transition from sidewalk to street level more comfortable. A similar function is played by medians and refuge islands, better if raised and wide enough to handle pedestrian during two-stage crossing (Bian and Zhao 2013). Other factors concern the sense of place of surrounding environment influenced by good lighting, density and diversity of functions, “enclosure”, seats, trees, shade and signs. Depending on location, road furniture can become hazardous as they can obscure visual contact and compromise pedestrian’s ability to safely cross the road (Martin 2012). The same limiting effect to visibility occurs even in presence of on street parking, both regular or irregular, which can hinder the crossing vision (Peprah and Afi Ocloo 2014). Pedestrian delay at crossings is also considered (Li 2013) as a factor conducive to
risky behaviors. Moreover, as time saving represents an important benefit for those who decide
to travel by foot, pedestrian time delays are perceived as a real disutility.

**Methodology**

In order to identify and measure critical factors of urban intersections design and management
which limit pedestrian accessibility, we use a rating evaluation model that produces a ranking of
intersections from most to less hindering for pedestrians. We resort to a multicriteria evaluation
method ELECTRE TRI (Roy 1990, Roy and Bouyssou 1993) because of the properties considered
useful for the present study it is endowed with: (1) it allows an exhaustive classification of
elements in ordered prioritizing categories; (2) criteria aggregation is flexible and allows to
express the relative weights, clusters of coalitions (majority rule) and eventual vetoes; (3) it
allows a prudential non-compensative aggregation of information with limited loss of
information during consecutive stages of evaluation; (4) it is a procedure that resembles
individual models of thinking (Bouyssou et al. 2006). An audit field analysis of nine intersections
selected in the city of Alghero supports the information gathering of the qualitative and
quantitative characteristics selected according to the literature giving priority to those features
of the built environment which can be clearly conceptualized and objectively or unambiguously
measured. Table 1 summarizes the attributes of intersections we collected.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Type/Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of approaches at each intersection</td>
<td>number</td>
</tr>
<tr>
<td>Number of lanes of each road</td>
<td>number</td>
</tr>
<tr>
<td>Dedicated bike lanes (B_{bikeln})</td>
<td>Present (1) Absent (0)</td>
</tr>
<tr>
<td>Traffic lights (T_{light})</td>
<td>Present (1) Absent (0)</td>
</tr>
<tr>
<td>Cross markings (X)</td>
<td>Present (1) Absent (0)</td>
</tr>
<tr>
<td>Couples of curb cut (C_{curb})</td>
<td>Present (1) Absent (0)</td>
</tr>
<tr>
<td>Sidewalk extensions (S_{ext})</td>
<td>Present (1) Absent (0)</td>
</tr>
<tr>
<td>Elevated sidewalk (S_{elev})</td>
<td>Present (1) Absent (0)</td>
</tr>
<tr>
<td>Physical obstacles to visibility (V_{ob})</td>
<td>Present (1) Absent (0)</td>
</tr>
<tr>
<td>Parked Cars (C_{parked})</td>
<td>Present (1) Absent (0)</td>
</tr>
<tr>
<td>Sticking out Buildings (B_{protr})</td>
<td>Present (1) Absent (0)</td>
</tr>
<tr>
<td>Signs (S)</td>
<td>Present (1) Absent (0)</td>
</tr>
<tr>
<td>Fencings (F)</td>
<td>Present (1) Absent (0)</td>
</tr>
<tr>
<td>Expedients to Direct Pedestrians (D_{exp})</td>
<td>Present (1) Absent (0)</td>
</tr>
<tr>
<td>Corner area (A_{c}=H_{c}+W_{c})</td>
<td>m^2</td>
</tr>
<tr>
<td>Holding space (H_{c})</td>
<td>m^2</td>
</tr>
<tr>
<td>Space for Walking (W_{c})</td>
<td>m^2</td>
</tr>
<tr>
<td>Carriageway area (A_{c})</td>
<td>m^2</td>
</tr>
<tr>
<td>Road width from curb to curb (R_{width})</td>
<td>m</td>
</tr>
<tr>
<td>Number of pedestrians in all directions (P_{v})</td>
<td>nped/h</td>
</tr>
<tr>
<td>Numbers of motorized vehicles (in Vehicle Equivalency Units) (M_{v})</td>
<td>VEU/h</td>
</tr>
<tr>
<td>Speed limit (V_{s})</td>
<td>km/h</td>
</tr>
</tbody>
</table>

**Application of the method to urban intersections of Alghero**

We experimented the evaluation model on nine intersections located in a vibrant area of the city
of Alghero (Italy) with important facilities and services and roads involved by medium and high
volumes of motorized and non-motorized traffic. The nine selected intersections present the
most common problems with regard to pedestrian’s experience of urban space. Different
combinations of roads (collectors and local streets) converge in the selected nodes with crossing
distances ranged from 6.0 m to 20.0 m and with variable numbers of lanes. This entails
differences in geometry, operational organizations of crossing and in land-use structure. By a
field survey at each selected site physical features of crossings and data on mobility were
collected through direct measurements. As first step in evaluating an intersection we subdivide
it into individual lane crossings a pedestrian can walk in order to consider all the routing alternatives. Then we evaluated each individual crossing with regard to five criteria $H = \{H_1, \ldots, H_5\}$, with the performances of each crossing being derived from the respective variables of geometric and operational qualities collected. Each individual crossing is rated in one of the three possible classes: $C_1$ “Conducive to walk”, $C_2$ “Sufficient to support walk”, $C_3$ “Obstacle to walk” based on classification rules and class thresholds on those criteria/factors. Table 2 summarizes the criteria, their underlying variables and the rating rules and thresholds. Finally, adopting equal weight of the five criteria ($w=1/5$) we assign through ELECTRE TRI two classifications to each individual crossing, one more conservative (majority threshold $\gamma=75\%$) and one less conservative ($\gamma=50\%$). Once single crossings belonging to an intersection have been evaluated, we compute the intersection’s overall rating as a weighted average of individual crossing evaluations, by using crossings’ relative importance (calculated as the share of all pedestrians at the intersection using each crossing) as weights. Table 3 reports as an example the evaluations for the intersection $n_2$.

The resulting classification of intersections points out the physical and operational features which impede walking, and gives some hints for possible corrective interventions to implement. In order to address intervention improvements, we attempt to establish an order of priority among intersections, using two criteria respectively related to: (1) the walkability class defined by previous classification and (2) the intersection importance in terms of pedestrian flow surveyed. Class assignment rules for the two criteria are described in the following and Table 4 shows resulting classification.

1. Walkability class. Intersections are ranked in four classes ($W_1, \ldots, W_4$):

- class $W_1$, if the intersection is classified as $C_3$ for both majority thresholds ($\gamma=75\%$ and $\gamma=50\%$);
- class $W_2$, if the intersection is classified $C_3$ under the majority threshold $\gamma=50\%$, but not under $\gamma=75\%$;

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Variables</th>
<th>Rating rules / thresholds</th>
</tr>
</thead>
<tbody>
<tr>
<td>$H_1$ – Crossing control</td>
<td>$T_{\text{light}}$, $Z$</td>
<td>$T_{\text{light}}$ and $Z$, $T_{\text{light}}$ xor $Z$, Neither</td>
</tr>
<tr>
<td>$H_2$ – Continuity &amp; Ease of movement</td>
<td>$S_{\text{cont}}$, $S_{\text{ext}}$</td>
<td>$(C_{\text{cont}}$ and $S_{\text{ext}}$) or $S_{\text{ext}}$ if no $S_{\text{ext}}$, $C_{\text{cont}}$ xor $S_{\text{ext}}$, Neither</td>
</tr>
<tr>
<td>$H_3$ – Comfort</td>
<td>$P_{\text{ratio}}$, $P_{\text{ratio}} \gg 1$, $P_{\text{ratio}} \approx 1$, $0 &lt; P_{\text{ratio}} &lt; 1$</td>
<td></td>
</tr>
<tr>
<td>$H_4$ – Safety</td>
<td>$V_{\text{ObEl}}$, $V_{\text{ObEl}}$ and $D_{\text{PEl}}$, $V_{\text{ObEl}}$ and no $D_{\text{PEl}}$, $D_{\text{PEl}}$</td>
<td></td>
</tr>
<tr>
<td>$H_5$ – Barrier effect</td>
<td>$(R_{\text{width}} + M_r + V_{\text{S}})/3$</td>
<td>$0 \leq B_{\text{Eff}} \leq 1.4$, $1.5 \leq B_{\text{Eff}} \leq 2.4$, $2.5 \leq B_{\text{Eff}} \leq 3$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intersection</th>
<th>Crossing</th>
<th>Weight</th>
<th>Class $\gamma=75%$</th>
<th>Class $\gamma=50%$</th>
<th>Score $\gamma=75%$</th>
<th>Score $\gamma=50%$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$n_2$</td>
<td>$a_21$</td>
<td>0.16</td>
<td>$C_3$</td>
<td>$C_3$</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>$a_22$</td>
<td>0.35</td>
<td>$C_3$</td>
<td>$C_3$</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>$a_23$</td>
<td>0.14</td>
<td>$C_3$</td>
<td>$C_2$</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>$a_24$</td>
<td>0.35</td>
<td>$C_3$</td>
<td>$C_2$</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Final class (weighted average)</td>
<td></td>
<td></td>
<td>$C_3$</td>
<td>$C_3$</td>
<td>2.5</td>
<td>1</td>
</tr>
</tbody>
</table>
- class W3, if the intersection is classified C2 for both majority thresholds ($\gamma=75\%$ and $\gamma=50\%$);
- class W4, otherwise.

2. Intersection importance. Intersections are ranked in four classes of importance (I1,…,I4) based on the share of pedestrians on each intersection, with respect to the total number of pedestrians on all the nine intersections observed during the audit.

By assigning numeric values (Borda rule) to classes in Table 4, equivalent to their scale order, and calculating the weighted average (with weights 60\% for “walkability class” and 40\% for “importance”) we obtain the final order of priority among intersections: $n_3$ in the highest class of priority; $n_1$, $n_2$, $n_6$ and $n_7$ in the second class of priority; $n_4$, $n_8$ and $n_9$ in the third class of priority; and finally $n_5$ classified in the lowest class of priority.

<table>
<thead>
<tr>
<th>Walkability class</th>
<th>Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>n3</td>
</tr>
<tr>
<td>W2</td>
<td>n1</td>
</tr>
<tr>
<td>W3</td>
<td>n8</td>
</tr>
<tr>
<td>W4</td>
<td></td>
</tr>
</tbody>
</table>

Results

One intersection resulted of the highest priority, while four out of nine were assigned to the second level of intervention priority. Considering intersections as a whole, our assessments report a generalised need of improvement in order to promote walking. Under the most conservative procedure of evaluation (majority threshold $\gamma=75\%$) almost all intersections in their current state are evaluated as fairly unsuitable to comfortably accommodate pedestrians (eight out of nine intersections were classified as C3 “obstacle”). The scenario among surveyed intersections somewhat improves when using the majority threshold $\gamma=50\%$. In this case five out of nine intersections keep category C3 and the remaining four are classified as “sufficient” for walking. The strongest factors of impedance to walking in the nine intersections were related to the barrier effect (criterion $H_5$), produced by the combination distance to cross plus intensity of motorised traffic. Crossings often result not to be conducive to walk also with regard to the criterion $H_4$, expressing the ratio between space for pedestrians and for vehicles (77\% of crossings resulted as “obstacles” for walking, while only 20\% favourable to pedestrians). With respect to the criteria $H_1$, $H_2$ and $H_3$, the majority of crossings present an intermediate degree of pedestrian friendliness (respectively 63\%, 60\% and 74\% of the crossings belong to the category C2 “sufficient”). In case of the criterion $H_2$ concerning safety condition, 40\% of crossings are assessed as “obstacle”, suggesting a need for improvement the continuity of pedestrian paths and the ease of movement for all users.

Conclusions

The paper presents an application of an evaluation model, based on ELECTRE TRI, for rating urban intersections according to their effect in limiting or facilitating walking, and a subsequent procedure for prioritising improvement interventions. The proposed methods can serve as useful
support to: (1) detect critical factors, such as the adverse state of certain intersection characteristics; (2) assess their effect on people’s capacity to experience and use the city by foot; and (3) decision making and prioritizing of improvements. In planning practice the model can provide urban designers and decision makers with a formal method to address policies and interventions aimed at improving the liveability of the city by enhancing the safety, comfort, usefulness and pleasantness of pedestrian space. Furthermore this study represents an additional step in our ongoing research on urban walkability (Blečić 2015) aiming at incorporate intersections concerns in the model of evaluation of pedestrian accessibility. Next step of the research will be to survey pedestrian’s perception of intersections in order to verify whether the main assumptions and parameters used in the evaluation procedure are substantiated by empirical evidence.

References


Built environment and health inequalities: results from a European research project

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Key-words: urban renewal, policies, health impact, health inequalities.

Introduction

According to the World Health Organization "communities and neighbourhoods that ensure access to basic goods, that are socially cohesive, that are designed to promote good physical and psychological well-being, and that are protective of the natural environment are essential for health equity" (CSDH, 2008).

Scientific literature has recognised the health disadvantage of residents in socio-economically deprived neighbourhoods, independently on the influence of individual socio-economic conditions. But little is known about the impact on health and health inequalities of urban characteristics, and its evaluation has been acknowledged as especially challenging.

The paper summarizes some of the methods and findings of the Work Package 4 (WP4) of the 7th Framework Programme "SOPHIE" aimed at generating new evidence on the impact of urban structural policies on health inequalities, and to develop innovative methodologies for the evaluation of these policies in Europe. WP4 was coordinated by the Department of Clinical and Biological Sciences of University of Turin, supported by the ASL T03 Epidemiology Unit ("Struttura Complessa a Direzione Universitaria - Servizio Sovrazionale di Epidemiologia") of Piedmont Region, which works as national referral centre for the WHO "Health in All Policies" program, and SiTI Higher Institute on Territorial Systems for Innovation, with its experience in urban policies.
Methodology

In the framework of the SOPHIE Project, the WP4 was specifically dedicated to the evaluation of the effects of the Built Environment on health inequalities under different perspectives. Three different kind of analysis were conducted by national work units from Italy, the Netherlands and Spain.

The Italian approach: literature review and quantitative analysis

The Italian Work Unit produced a literature review (Gelormino et al, 2015) collecting evidence from the scientific literature about how the built environment affects health inequalities by influencing natural environment, social context and behavioural aspects, in order to provide a logical foundation for both researchers and policy makers.

The review was carried through a broad scoping approach for searching both urban planning and medical literature since 2000, analysing socio-economic inequalities in relation to different components of the built environment. The criteria adopted for articles inclusion were quite selective and only those really focused on inequalities were kept. After the identification of the elements and pathways through which the built environment affects individual health, the project focused on an empirical case study.

Turin Case study (Melis et al, 2015) based on quantitative method was aimed at evaluating the evidence of relationship between urban structure and wellbeing. In particular, the study was aimed at identifying the effects on people exposed to a different mix of social or physical characteristics such as density or level of accessibility. Specifically, the study focused on Mental health as it might be considered one of the most responsive health targets of the urban structure: anxiety and non-psychotic depression are well associated to socioeconomic individual and neighbourhood characteristics (Melis et al, 2015). Among Turin urban population, the association at area level of different urban structure characteristics (density, accessibility by public transport, accessibility to services, green and public spaces) and consumption of antidepressants was analyzed. Estimates were adjusted by individual socio-demographic variables (education, housing tenure, employment) and contextual social environment variables (social and physical disorder, crime rates). Data were extracted from the Turin Longitudinal Study (TLS)- a census-based cohort study following up prospectively the mortality and morbidity of the population since 1971 (Rasulo et al, 2012). Demographic information from the registry is individually linked to census variables as well as to routinely registered health events. The huge TLS database allowed to follow up Turin adult residents as for first antidepressant medication, considered as a proxy of mental health, from January 1st-2004 to December 31st-2006, according to the characteristics of the neighbourhood they live in, adjusted by individual and contextual socio-demographic circumstances and their residential stability, involving a population that counts around 547.000 observed residents.

The Dutch approach: qualitative methods

Perceived urban quality is a key-element of wellbeing. The Dutch Work Unit, represented by the Academic Medical Centre of Amsterdam, assessed the impact of a Dutch area-based initiative, called the District Approach, on trends in perceived area safety and underlying problems in deprived target districts.
A quasi-experimental design was used. For 36 out of the 40 target districts, data on the content, duration, and scale of interventions implemented as part of the District Approach since 2008 were retrospectively collected using standardized questionnaires and face-to-face interviews with local district managers. Repeated cross-sectional data on perceived area safety and underlying problems were obtained from the National Safety Monitor (2005–2008) and its successor the Integrated Safety Monitor (2008–2011). Study population consisted of 133,522 Dutch adults, including 3,595 adults from target districts. Multilevel logistic regression analyses were performed to assess trends in self-reported general safety, physical order, social order, and non-victimization before and after the start of the District Approach mid-2008. Trends in target districts were compared with trends in various control groups. (Kramer et al, 2015)

The Spanish approach: qualitative and quantitative methods

The Spanish Work Unit also worked with qualitative methods: they investigated the health impact of Llei de Barris (Neighbourhood Law), a urban renewal program affecting 10% Barcelona population between 2004-2011.

The study used Concept Mapping, a mixed methods methodology, to develop a conceptual map of perceptions of residents affected by recent physical, social and economic changes that had occurred within their neighbourhoods. (Mehdipanah et al, 2013)

This design combined the input by the residents (got through focus groups) followed by a series of multivariate analysis to represent the participant’s views and how such views are related one to another (Kane & Trochim, 2007). The study was completed within the first two Barcelona neighbourhoods that participated to a specific program called Neighbourhood Law: Santa Caterina I Sant Pere (referred to as Casc Antic in the study) and Roquetes. All data collection took place from March to May 2012.

Concept mapping consists of six steps; preparation, generation, structuring, representation, interpretation and utilization. Data collection occurs within the generation and structuring steps where participants brainstorm answer to the focus question, and then rate and sort these responses. More detailed explanations are provided for each of the steps elsewhere (Kane & Trochim, 2007).

A quasi-experimental pre and post design was, in a second stage, used to compare adult residents in five intervened neighbourhoods to eight non-intervened comparison neighbourhoods with similar socioeconomic characteristics. The Barcelona Health Survey was used for studying self-rated and mental health in pre (2001, 2006) and post (2011) years. Poisson regression models stratified by sex, were used to compute prevalence ratios comparing 2011 with 2006, and later stratified by social class, to study health inequalities (Mehdipanah et al, 2014).

Results and discussion

The literature review on the built environment and its health equity impact helped producing an explanatory framework (fig. 1), based on the Social Model of Health framework developed by Dahlgren & Whitehead (1991). We assumed that key features of the built environment (specifically identified in density, functional mix and availability of public services and spaces) may influence individual health through their impact on both natural environment and social context, as well as behaviours, and that the exposure to determinants may be unequally distributed according to the social position of individuals.
The expected links proposed by the framework are well documented in the literature; however, evidence of their impact on health inequalities remains uncertain due to confounding factors, heterogeneity in study design, and difficulty to generalize evidence that is still very embedded to local contexts.

The results of Turin case study on Mental Health (Melis et al 2015) suggest that built environment has a stronger effect for people who spend more time in the neighborhood. Therefore, this research suggests that good accessibility to public transport, as well as a dense urban structure (versus sprawl), could contribute to reduced risk of depression, especially for women and elderly, probably by increasing opportunities to move around and have an active social life.

The results of the Italian quantitative study show very fable associations, but still statistically significant due to the robustness of the studied population. On the other hand, results are somehow confirmed by the quasi-experimental study on the Dutch deprived neighbourhoods (Kramer et al, 2015). This one showed statistically significant results only for women, older adults, and lower educated adults. These population groups may spend more time in their local neighbourhood than the counterparts, so we can suppose a relationship between urban quality and exposure to neighbourhood in perception of safety, comfort and (consequent) wellbeing.

Finally, in Barcelona, the qualitative analysis confirmed that urban requalification is positively perceived on wellbeing and quantitative analysis confirmed the effectiveness of positive impact of structural intervention on inhabitants health (Mehdipanah et al 2014).
Conclusions

The way cities manage density, accessibility, safety and social mix makes a difference in the health of residents, women and elderly being more vulnerable; policymakers and stakeholders in the urban setting should consider this marginal health equity benefit when addressing these requirements in their own decisions. Only few studies in Europe tried to assess health inequalities linked to the built environment and urban policies, and those results are highly influenced by the local context, making it difficult to generalize conclusions.

The population health in the most deprived areas could benefit from investments in urban regeneration but positive outcomes from policies supporting social mix should not be given for granted, as they might be influenced by the scale of the intervention and by the implementation of complementary measures.

This is also true when analysing the impacts of purely physical or infrastructural intervention. Local urban conditions and structural variables should be carefully evaluated before the project implementation: some expected positive impacts may not occur when contour conditions are not favourable (Barosio et al, 2016).

That highlights how the qualitative approach (interviews, focus groups, questionnaires...) could be useful in the design phase of urban regeneration, to get better results, tailor made for each specific community of citizens. One of the strengths of concept mapping for evaluation is, indeed, its potential to identify various mechanisms that could contribute to the evaluation of complex interventions compared to quantitative studies that tend to rely heavily on outcome based variables often resulting in premature conclusions of interventions (Curtis et al. 2002).

One common limit of the studies collected in WP4 is the lack of data about confounders which would help isolate the effect of urban structure and interventions on the selected outcome: this is due to the difficulty to collect detailed information about the lifestyles of studied population, and the very time consuming process to get qualitative data about individual habits. New technologies and apps could successfully support future research to involve more people and get more detailed data about the studied districts or cities, to overcome the lack of information which makes weaker this kind of results.

New technologies could be very helpful to depict and represent a situation closer to reality when looking at individual exposure to neighbourhood characteristics: the wide spread use of mobile devices with GPS can be an interesting starting point for tracking the real use of space by the residents.

References


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ESSP - Ecosystem Services and Spatial Planning
Graph Representations of Site and Species Relations in Ecological Complex Networks

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Key-words: Complex networks; Ecological networks; Graph models; Knowledge discovery; Similarity.

Introduction

Historically, nature protection areas have been established only as isolated regions, to protect specific endangered habitats or species. On occasion, this narrow view has resulted in an inadequate size of natural reserves, a heavy fragmentation of habitat patches, and an excessive distance between areas. These factors negatively affect the effectiveness of nature protection areas (Diamond 1975), and have an adverse impact on biodiversity, due to the frequency at which inbreeding takes place. To address these issues, the concept of ecological network has been defined. According to this paradigm, nature protection areas should be established to contribute to large-scale conservation goals, resulting from a network behaviour that should emerge in a wide area. Essentially, migration of species between sites should be possible, thus merging the genetic pools of populations of different sites. Where relevant (most notably, for land animals), the actions taken to increase biodiversity should include the protection of existing connection elements between sites, often referred to “green corridors”, or the establishment of new ones. Several studies have reported a positive effect on biodiversity from green corridors, at least for some species in the short term (Gilbert-Norton et al. 2010).

In the European Union, environmental and biodiversity policies have converged into the definition of the ecological network denominated “Natura 2000”, consisting of nature protection areas designated by the EU and member states. Land management plans prepared by local administrations for territories including Natura 2000 sites have to meet requirements set at EU level. While green corridors aren’t as thoroughly regulated as sites are, the understanding of implications of their presence are to be considered even in land management plans that do not overlap Natura 2000 sites in territorial extension.

This work aims at improving the understanding of network behaviour in ecological network by performing complex network analysis (CNA) on graph models that represent them.
Methodology

Complex network analysis has its foundations in the computation of statistical properties of a graph model of a real network. A graph is made up of a set of nodes (vertices) and a set of edges, which represent links between pairs of nodes. The remainder of the document focuses on discussing methods to build three kinds of graphs to represent relations between sites and species in an ecological network, namely: a “species graph” and a “similarity graph”, in which sites are linked to one another according to the presence of a single species or a similarity score calculated between pairs of sites; and a “shared-report graph”, in which relations between species are represented. Opportunities to apply CNA on these graphs for knowledge discovery purposes are also presented.

Topological models

The topology of an ecological network can be represented by a graph, using a node to represent an area (site), and edges to represent connectivity between sites. While this may appear simple at first glance, there are several design choices to be considered; decisions depend on analysis goals. For example, different degrees of granularity can be considered: nodes may represent a protection site as a whole, or smaller entities, down to single habitat patches. Then, a set of edges should be determined; nodes are typically linked in a way that represents observed or expected migration paths for a target species (functional connectivity). This is due to the fact that attempts at building graphs to represent structural connectivity, based on the presence of physical connection elements, have been unsuccessful (Urban et al. 2009:264).

The graph representing functional connectivity with a focus on a single species can be referred to as a “species graph”. To build this kind of graph, sites are considered only if the species has been reported to be present, and pairs of sites are linked if they meet criteria for the possibility of migrations. For example, the geographical distance between sites should be within the dispersal distance of the target species. For animals, this can be thought of as the distance that can be travelled between periods of rest. The resulting graph can be used to represent the current state of the ecological network with respect to the target species, and the results of CNA applied on this graph can uncover possible shortcomings of its configuration, such as a lack of alternatives to important migration paths for the target species.

Depending on analysis goals and scopes, it is possible to represent sites where the target species is not present as isolated nodes, which is particularly useful when multiple graphs are to be compared. The method to estimate geographical distances is another important design choice. More specifically, distances can be calculated between boundaries of sites, or between their centroids.

The most basic result – but not the least important one – is the identification of the connected components of the resulting graph: for biodiversity goals, it is generally best for the graph to be made up of a single connected component, where a path can be found between any pair of nodes. If there are multiple connected components, it can be argued that separate metapopulations exist (Minor and Urban 2008). To protect biodiversity, the goal of finding ways to establish connections between them can be considered.

CNA can also be used to measure the degree of redundancy of existing links, for example by evaluating their local clustering coefficient. Moreover, it is possible to identify the areas with a higher risk of disconnections taking place due to disasters, by computing indices such as the betweenness centrality index, which expresses a proportion of shortest paths including a node or an edge (Mazaris et al. 2013), or by evaluating the results of community detection, which involves the partition of a graph into subsets with the property that each subset has a high density of edges, while the density of edges between subsets is low. Algorithms exist that detect
Similarity-based models

To assist land managers in evaluating proposals that involve the creation of migration paths, similarity scores between current Natura 2000 sites are evaluated, based on land use or habitat types found in their configuration, or the reported presence of species. To do so, a binary vector is constructed for each site, to represent the presence or absence of each specific habitat type, land use type, or species. The Jaccard coefficient is used as a measure of similarity between pairs of vectors. This coefficient takes values from 0 to 1, where 0 is the similarity score for vectors with no elements in common, and 1 is the score given to identical vectors.

To build a similarity graph, a node is used to represent each site in the region of interest, and pairs of nodes are linked if two conditions are met: the similarity score of the corresponding pair of sites should be above a chosen threshold, and their geographical distance should be below a set value.

If a similarity graph is built using the same maximum geographical distance as a species graph, it can be used to identify links, which could be interpreted as notable missing links in the species graph. To do so, a non-isolated node can be chosen in the species graph, and the sets of nodes adjacent to it in the two graphs can be compared. By definition, adjacent nodes in the similarity graph represents pairs of similar sites; if such a pair is not linked in the species graph, it makes sense to investigate on the reasons why the target species is not present in the unlinked site, or possibly, whether a barrier exists preventing migration between sites. This process can be repeated for every node representing sites where the target species is present. An example of this comparison is provided later.

Conceptual graph models

As a tool for data analysis and knowledge discovery, CNA is not limited to topological graph models as a field of application. The most striking limitation in the models described thus far is the necessity to focus on a single species at any given time. To work around this limitation, while attempting to represent and understand network behaviour at a high level of abstraction, the most common approach is to select a single species for analysis, such that the species is representative of an ecosystem; for example, the improvements in sustainability of a site (or usability of a corridor) should naturally result in improvements for the largest number possible of co-existing species. A species with this property is referred to as an “umbrella species”. Finding umbrella species and focusing on their protection is considered a useful approach, especially under strict time requirements (Roberge and Angelstam 2004). However, its limitations should be taken into consideration. Representing inter-species relations is a challenge in itself, and it can be considered an interesting field of application for CNA. In a straightforward example, it is possible to build a conceptual network, representing each species as a node, and forming links between pairs of species that have been reported to be present in a minimum number of Natura 2000 sites in a region of interest. The graph constructed with this criterion can be referred to as a “shared-report graph”. The analysis of properties of these graphs can be used to further support observations on sets of species, e.g. to assess which species are most adaptable among those found in a region.

Results and discussion

To act as a benchmark case, Natura 2000 sites in Sardinia are used to build graph models as described in the previous section. At the time of this writing, 124 sites are part of the Natura 2000 network in Sardinia. To provide an example, Cervus elaphus corsicanus was chosen as a
target species; a graph was built to represent the part of the network where this species was reported to be present. A similarity graph was also built from data on land use types according to CORINE Land Cover codes, but due to land use data being unavailable for 7 sites at this time, only 117 sites are considered. Graphs are built for a maximum distance between sites of 40 Km (note that all distances are to be treated as estimations). A minimum similarity score of 0.7 was required to link nodes in the similarity graph. Graphs were built using custom software, and imported into the open-source Cytoscape suite (Shannon et al. 2003) for visualization and analysis. Figure 1 shows the resulting graphs.

In Figure 2, an area in Southwestern Sardinia is shown, enlarged from Figure 1. A basic example of a possible observation is that in the similarity graph (right), node A is linked to node B, which is also linked to other non-isolated nodes in the species graph (left). Essentially, the target species has not been observed in site B, which is similar to A with respect to land use. This prompts the question of whether barriers are present between A and B, and whether it is
sensible to extend the network for this species by building migration paths in the region. Land managers and environmental planners can cross-reference this information with that of related species as a way to support decisions.

Conclusions

In this work, multiple approaches at representing entities in an ecological network have been discussed. Topological approaches are certainly most promising as a tool to assist land managers, but in light of the limitations of current methodologies, the opportunity to devise further conceptual models should not be underestimated. Further research will focus on the identification of possible vulnerabilities in species graphs built for a number of species, and on the comparison of different similarity measures to find the most meaningful measure for applications in this context.

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References


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Conflicting issues concerning land uses related to ecosystem services under the provisions of the Habitats and Birds Directives

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Key-words: ecosystem services, Natura 2000 Sites, land use conflicts, conservation measures, management plans of the Natura 2000 Sites.

Introduction

The origins of the use of the category ecosystem services (ESs) can be traced back to the late 70s, when Westman (1977) discussed the question of nature’s services. In the 80s, Ehrlich and Mooney (1983) treated systematically the issue of extinction and substitution of natural elements, that is populations, species and guilds, as a question of loss and substitute supply of ESs. Thereafter, a structured definition of the scientific and technical taxonomy and appraisal methodologies and uses of ESs was only put forward in 2003 by the Millennium Ecosystem Assessment (MA), an international research project that involved more than 1300 experts worldwide (Gómez-Baggethun et al., 2010).

According to the classification proposed by the MA, ESs “[A]re the benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as regulation of floods, drought, land degradation, and disease; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, spiritual, religious and other nonmaterial benefits” (Millennium Ecosystem Assessment, 2003, 3).

ESs can be considered as a two-dimensional category (Abson at al., 2014). From this perspective, we can see them as an operational framework to explain and assess the mutual relations between human beings and natural systems (Balmford et al. 2011). Moreover, we can interpret ESs as sources of normative bonds to implement system persistence, biodiversity conservation and enhanced human well-being (Abson at al., 2014).

In this conceptual framework, Natura 2000, a coherent network of areas established under Directive 92/43/EEC (Habitats Directive), represents the principal instrument to protect biodiversity, species and habitats. In particular, this EU-wide network of protected areas includes Sites of Community Interest (SCIs) and Special Areas of Conservation (SACs) identified under the provisions of the Habitats Directive, and Special Protection Areas (SPAs), identified under the provisions of the Birds Directive (Directive 2009/147/EC). Article 6 of the Habitats Directive establishes that Member States have to define the necessary conservation measures that can include appropriate management plans (MPs) and appropriate statutory, administrative or contractual rules, consistent with ecological needs of habitats and species. However, despite these conservation measures, biodiversity in the EU is decreasing at rapid rates due to alarming conservation status of species and habitats (European Environment Agency, 2010).

Indeed, although starting from the end of the 20th century the Natura 2000 Sites (N2Ss) have represented a paragon of spatial protection and conservation in terms of minimization of the impacts generated by human activities on biodiversity, species
and habitats, the spatial planning-related relations and connections between the N2Ss and the surroundings have been almost totally neglected (Martín-López et al., 2011). Therefore, careful and structured spatial analysis of the dialectical and possibly conflictual dynamics, which involves local societies and N2Ss under the provisions of the Habitats and Birds Directives, is an important and mostly still unexplored field of work. Therefore, the establishment of N2Ss should aim not only at preserving species and habitats, but also at protecting the adequate and productive capacity of the ESs (Castro et al., 2015). As a consequence, the N2Ss should eventually assume a double operational function, that is protecting species, habitats, processes and functions in ecological terms, and providing the local societies with ESs (Scolozzi et al., 2014).

From this perspective, the relationship between N2Ss and ESs is quite evident. Indeed, ESs should be provided and/or preserved both within and outside the limits of the N2Ss. As regards this issue, Kettunen et al. (2009) have elaborated an overview of the potential ESs provided by N2Ss. So a new conservation paradigm should be included into the sets of the biodiversity conservation measures. Initial steps forward towards the new paradigm can be traced back to the Strategic Plan for Biodiversity 2011-2020 and the Aichi Targets, whose the Target 11 highlights the necessity to incorporate ESs within future protected areas planning rules. On the other hand, conservation measures concerning protected areas may possibly entail changes in land uses and, as a consequence, negative trends in the supply of ESs (Kovács et al., 2015), such as a reduction of parcels dedicated to food production (Castro et al., 2015).

In this paper, we analyse the land use-related conflicts that may very possibly occur with reference to the conservation rules established by the MPs of the N2Ss under the provisions of the Habitats and Birds Directives, which may eventually decrease substantially the supply of ESs, especially provisioning services. In the following sections, we discuss the methodological approach and the case studies (section two), the analysis of results (section three), and our concluding remarks and directions for future research (section four).

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1 The Strategic Plan for Biodiversity and the Aichi Biodiversity Targets were adopted by the tenth meeting of the Conference of the Parties to the Convention on Biological Diversity, held in Nagoya (Japan) from 18 to 29 October 2010, through the decision X/2.
Methodology

MPs entail the statement of conservation measures in order to protect habitats and species in the spatial contexts of N2Ss, that could prevent or seriously limit the production of ESs, and, by doing so, they could determine a net loss, in particular of provisioning services. In order to analyse the conflict, we consider the technical approach proposed by Burkhard et al. (2009), where the authors study the association of ESs demand with different Corine land cover classes, by assessing the capacity of each land cover type to provide specific ESs. In our study, we analyse the issue of the loss in provisioning ESs with reference to four case studies concerning two SCIs and two SPAs and the municipalities where they are located, as follows:

1. the SCI “Wetlands of Colostrai and of Saline” and the municipality of Muravera;
2. the SCI “Lake of Baratz – Porto Ferro” and the municipality of Sassari;
3. the SPA “Mountain of Sette Fratelli” and the municipality of Dolianova;
4. the SPA “Ortobene Mountain” and the municipality of Nuoro.

In particular, for each case study we assess the overlap of the habitats distribution and the land cover classes of the 2008 Corine Land Cover Map.2

Results and discussion

The overlap of the areas of the habitats and the cartographic units of the 2008 Corine Land Cover Map identifies different critical zones (Table 1) in terms of provisioning services for each N2S. In relation to the municipality land of Dolianova, Habitat (H) no. 9340 overlaps land use categories (LUCs) nos. 241, 311 and 321. We observe, following Burkhard et al. (2009), that LUCs nos. 241 and 321 have a high capacity to provide livestock and fodder (no. 241), and a medium capacity to provide livestock (no. 321), meanwhile LUC no. 311 shows a high capacity to provide timber. Moreover, the MP identifies excessive pastoral activities, pasture, illegal logging and blazes as the main critical factors that make the protection of this habitat difficult.

As regards the municipality of Nuoro, two out of five cases are the most critical: i. the overlap of LUC no. 241, which shows a high capacity to provide crops, livestock and fodder, and H no. 9340; and ii. the overlap of LUC no. 321, which presents a medium capacity to provide livestock, and Hs nos. 5330 and 5330-6220*-9340. The MP identifies pasture and pastoral activities (H no. 6220*), and pasture, pastoral activities and human activities (H no. 9340), as the main critical factors that make it difficult to protect these habitats. The lack of specific rules concerning the logging concessions on behalf of the MP is the most outstanding problematic issue of the other three cases of overlap within the N2S.

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2 The Sardinian Regional administration produced the 2008 Corine Land Cover Map, which is available from the regional geoportal [available on the Internet at http://www.sardegnageoportale.it/index.html [accessed April 2016]].
Tab. 1. Overlaps of the areas of the habitats and the cartographic units of the 2008 Corine Land Cover Map concerning the municipalities of Dolianova, Nuoro, Muravera and Sassari.

<table>
<thead>
<tr>
<th>Dolianova</th>
<th>Nuoro</th>
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<tbody>
<tr>
<td>Yellow point: overlap between LUC no. 241 and H no. 9340</td>
<td>Yellow point: overlap between LUC no. 241 and H no. 9340</td>
</tr>
<tr>
<td>Red point: overlap between LUC no. 311 and H no. 9340</td>
<td>Red point: overlap between LUC no. 311 and Hs nos. 5330, 5330-6220*-9340, 6220*-5330-9340, 9340, 9340-5330</td>
</tr>
<tr>
<td>Green point: overlap between LUC no. 321 and H no. 9340</td>
<td>Green point: overlap between LUC no. 313 and H nos. 5330-1150*</td>
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<tr>
<th>Muravera</th>
<th>Sassari</th>
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<tr>
<td>Yellow point: overlap between LUC no. 411 and Hs nos. 1150*, 1310, 1410, 1510*, 2230, 6220*</td>
<td>Red point: overlap between LUC no. 311 and Hs nos. 5330-5210</td>
</tr>
<tr>
<td>Red point: overlap between LUC no. 511 and H no. 6220*</td>
<td>Yellow point: overlap between LUC no. 312 and Hs nos. 2270, 2270-2230-2240, 5330-5210, 92D0</td>
</tr>
<tr>
<td>Green point: overlap between LUC no. 521 and Hs nos. 1150*, 1130</td>
<td>Green point: overlap between LUC no. 313 and Hs nos. 2270, 2270-2230-2240, 5210-5330, 92D0</td>
</tr>
<tr>
<td>Brown point: overlap between LUC no. 321 and Hs nos. 5330, 5330-6220*-9340</td>
<td>Brown point: overlap between LUC no. 321 and Hs nos. 5330, 5330-6220*-9340</td>
</tr>
</tbody>
</table>

In relation to the municipality of Muravera, LUC no. 411, which shows a high capacity to provide fodder, overlaps Hs nos. 1150*, 1310, 1410, 1510*, 2230 and 6220*. In particular, with reference to Hs nos. 1310, 1410, 1510* and 2230, the MP identifies pasture and pastoral activities as the...
most critical factors for habitat conservation. Moreover, two issues should be taken into consideration with reference to pastoral activities implemented into H no. 6220*, since, on the one hand, the protection of the habitat is fostered by their balanced use, and, on the other hand, excessive land exploitation may possibly compromise the habitat conservation. Finally, although the overlap of LUC no. 511 and H no. 6220* does not put in evidence negative impacts in terms of provisioning services, H no. 521, which shows a high capacity to provide aquaculture, covers Hs nos. 1150* and 1130, for which the MP identifies fishing activities (H 1150*) and water-related projects (H 1130) as the main critical factors that make it difficult to protect these habitats. In relation to the municipality of Sassari, the most critical overlap is represented by LUC no. 321, with a medium capacity to provide livestock, and Hs nos. 5330 and 5210. In this case, pasture and pastoral activities are identified as the most dangerous threats related to H. no. 5210. As in the case of Nuoro, the lack of specific rules concerning the logging concessions is the most outstanding problematic issue of the other three cases of overlap within the N2S.

So, in general terms, our assessment shows several critical situations related to potential productive losses concerning the provision of ESs as a consequence of habitat protection. Therefore, the comprehensive statement which comes from the outcomes of our study is that the issue of ESs production needs careful and analytic consideration within the definition and establishment of MPs.

Conclusions

Our study shows that conflicts may possibly arise in the definition and statement of MPs and related conservation measures aimed at protecting and enhancing the supporting ESs supplied by the habitats and species of the N2Ss, since conservative measures may eventually entail important limitations to the exploitation of the productive potential of provisioning ESs, mainly consisting in limitations to agricultural, pasture and pastoral land uses. Directions for future research related to this issue are particularly promising and interesting in terms of the assessment of the economic trade-off between the supply of supporting and provisioning ESs within N2Ss. On the one hand, the appraisal of the economic value of the potential loss of provisioning ESs, mainly agricultural production, pastures and pastoral land uses, is pretty straightforward, as it is commonly implemented through market prices of the lost productions (Burkhard et al., 2009; Burkhard et al., 2012; Busch et al., 2012). On the other hand, there is a substantial lack of analytic economic (monetary) assessments concerning supporting ESs related to the value of biodiversity and the conservation and enhancement of habitats and species protected under the provisions of the Habitats and Birds Directives (Scolozzi et al., 2014). Possible approaches to be explored can be related to the estimates of willingness-to-pay (MA; Busch et al., 2012), which can be implemented either in direct terms, through the hedonic models (Palmquist, 1984; Cheshire and Sheppard, 1995; Zoppi et al., 2015), or in indirect terms, through contingent valuation-base estimates (León, 1995; Zoppi and Lai, 2010; Busch et al., 2012). The use of direct or indirect willingness-to-pay to estimate the value of biodiversity is due to the public-good-nature of supporting ESs related to the conservation and enhancement of habitats and species, which implies the non-existence of market prices, since supporting services are intrinsically non-rivalrous and non-excludable. Theoretical and technical debates on how to address the issue of the trade-offs between the production and availability of supporting and provisioning ESs involve planners, politicians, public decision-makers, environmentalists, biologists, naturalists and so on, and the discussion would gain substantially from the availability of insights concerning trade-offs. Following the comprehensive approach proposed by Kovács et al. (2012), a fundamental starting point is to analyse, identify and systematize the potential trade-offs between different types of ESs. The discussion we propose in this paper identifies trade-offs between provisioning and supporting
ESs. These trade-offs do occur in terms of decreased production of crops, fodder and cattle farming and increased protection of biodiversity through the conservation and enhancement of habitats and their species. Kovács et al. define the scope of their assessment by considering a much larger set of ESs and characteristics of the ESs, including their utilization (direct or indirect), level of needs (basic/physiological, secondary), spatial scale of changes and related trade-offs (local, regional, global) and temporal scale of changes and related trade-offs (short, medium long term). Moreover, they put in evidence that an important issue concerning the assessment of trade-offs is to identify who (categories of stakeholders) is going to win and who is going to lose in terms of net benefits. The economic assessment of trade-offs is one of the qualitative dimensions of a multifaceted complex question which needs further analytical and interdisciplinary research work.

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Federica Leone and Corrado Zoppi have made substantial contributions to the conception and design, background and concluding remarks of the paper. The first section has been jointly written by the authors. Federica Leone has taken care of the second and third sections. Corrado Zoppi has taken care of the fourth section.

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Assessment: land use and capacities to provide ecosystem service. The case study of Tertenia

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Key-words: Natura 2000 network, ecosystem service, land use, assessment, mapping.

Introduction

Ecosystems, through chemical-physical, biological and ecological processes, provide an irreplaceable support to the quality of life. These processes are known as Ecosystemic Services (ESs), that is to say, all those material and immaterial benefits that ecosystems provided to human genre. As it is clear from the recent report on the condition of the European environment, the territories most gifted in ESs are generally more resilient and less vulnerable when facing extreme natural events (e.g. heavy rains, heat waves), in other words, they can better tolerate the impacts (Scolozzi, Rocco Carlo et al. 2012). The world’s protected areas, currently 12% of the land, are biodiversity sources and are among the most productive areas of ESs (Ispra, 2011). The discussion on protected areas has rarely focused on the ESs however, choosing a sterile, counterproductive and passive protection of these areas, which are completely thrown out of any human activity. In response to the strategic global objective “Halting the loss of biodiversity by the year 2010”, the European Union (EU) has activated the “VI Action Program for the Environment” in 2002, whose goal was not achieved, and that’s why the “EU biodiversity strategy to 2020” was adopted in 2011 (Blasi, Carlo et al. 2005). The strategy, which is founded on the recognition of the intrinsic value of biodiversity and ESs, is based on six objectives that focus on the root causes of biodiversity loss and aim to reduce the main pressures on nature and ESs in the EU. The action 5 goes: “Improve the knowledge of ecosystems and their services in the EU” of target 2 “restoring and maintaining ecosystems and their services” provides that “By 2014 the Member States, with the assistance of the Commission, will carry out a mapping exercise and evaluation of the state of ecosystems and their services on their national territories, they will assess the economic value of such services and promote the integration of these values into accounting and reporting systems at EU and national level by 2020” (European Union, 2011).
Methodology

This work, result of a wider and still ongoing project, applies the evaluation model of Burkhard (Burkhard, Benjamin et al. 2009) to the study area of Tertenia municipality. Tertenia is a municipality in the southeast coast of Sardinia (Italy), that is currently adjusting its Municipal Urban Planning (MUP) to the Regional Landscape Plan (RLP) and the Water Catchment Management Plan. The municipality of Tertenia was chosen because it hosts the Site of Community Importance (SCI) ITB020015 “Area del Monti Ferru di Tertenia”: set up in 2006, it covers an area of 2,625 hectares, where 3% belongs to marine environment. 64.47% of the SCI land area belongs to the town of Tertenia, but it also involves the municipalities of Gairo, Osini and Cardedu (Municipality of Tertenia, 2016. Studio di incidenza). In this study we used the data produced during the preparation of the MUP adopted by resolution of the town council in November 2015. All the spatial data were highlighted on the land use map (scale 1:10000) coded according to the fourth level of the legend Corine Land Cover (CLC) (Municipality of Tertenia, 2016. Carta dell’uso e copertura dei suoli). The developed analysis, has been divided into three phases basing them on the potential capacity of each land use to provide ESs. A first phase in which each of the soil cover is made to correspond to one or more ecosystem services as shown in Figure 1. A second phase of construction of the evaluation matrix Burkhard, a double entry matrix where the types of land use cover are to be found in the columns, according to legend (CLC), while, on the lines you find the ESs identified in the study area. Each intersection of the matrix is populated with a value between 0 and 5 according to the following scheme: 0 = no ability to provide ESs; 1 = low ability to provide ESs; 2 = significant ability to provide ESs; 3 = average ability to provide ESs; 4 = high capacity to provide ESs; 5 = very high ability to provide ESs. A third and final phase is that of processing in GIS the data produced in the evaluation phase and that of the land use map.

![Image](image_url)

**Fig. 1. Ecosystemic services (ESs) potentially provided by each soil cover (CLC).**

Results and discussion

The result of the contextualization of the evaluation matrix Burkhard to the territory of Tertenia is a matrix that shows 29 land cover classes on the columns and 26 ESs on the lines, all classified according to the classification system Common International Classification of Ecosystem Services (CICES). The following are the changes made to the Burkhard valuation model based on the
knowledge of the local context, on the documents drafted during the PUC and on the regional regulations (Figure 2).

Eliminated the land use classes not present in the territory of Tertenia and added new as ground occupied by graveyards.

Given the torrential character of the rivers, these have been included within the land cover class beaches, dunes and sand plains as reported in the third level of the legend CLC.

The ecological integrity was not evaluated because it is not foreseen of CICES classification and the local ranking system CICES-RAS_Tertenia.

The crops, livestock and wild foods services, were combined in the terrestrial plants, fungi and animals for food services. The report agro-soil showed that even the classes of land use broad-leaved forest, bushes and shrubs, sclerophyllous vegetation and transitional woodland are commonly used to feed the livestock wild pasture, for this reason it has been attributed to these land covers a very high ability to provide ESs (Municipality of Tertenia, 2016. Studio pedaagronomico e territoriale).

The aquaculture services has been replaced by freshwater plants and animal for food services. Relatively to the land cover classes estuaries and sea no capacity to produce ESs has been attributed on the basis of local knowledge.

To the capture fisheries services, replaced with the marine algae and animals for food services, given the small size of water bodies (7500 m²), it has been assigned no capacity to produce ESs, on the basis of local knowledge to the land cover class of Estuaries no ability to produce ESs has been attributed.

The fodder and timber services have been replaced respectively by materials from plants, algae and animals for agricultural use and by Fibres and other materials from plants, algae and animals for direct use or processing.

The wood fuel and energy (biomass) services have been combined and replaced from the plant-based energy resources services. In keeping with the "Emergency addresses for the management of the coastal zone management posidonia beached", which prohibits the removal of posidonia beached and fruition of dune system, it has not been attributed any capacity to produce ESs (RAS, 2008).

The biochemicals/medicine services has been replaced with the genetic materials from all biota services.

The assessment value of the services fresh water, replaced with the surface water services for non-drinking purposes (non-potable water), was reduced with regard to the land cover beaches, dunes and sand plains because the torrential character of the rivers does not allow to assign a higher rating than the low capacity to provide ESs.

The regulation services, have been boosted through the introduction of six ESs: buffering and attenuation of mass flows, seed dispersal, maintaining nursery populations and habitats, control of (alien and/or local) invasive species, prevention and control of fire, weathering processes and weathering processes, decomposition and fixing processes. The capacity to provide ESs has been attributed based on local conditions.

A high and a low ability to provide ESs has been recognised respectively to the pollination services for land cover olives groves and natural grassland.

The air quality regulation, erosion regulation and local climate regulation services, has been replaced respectively by capturing (fine) dust, chemicals and smells, mass stabilisation and control of erosion rates and micro and regional climate regulation ESs. Especially the Capturing (fine) dust, chemicals and smells services, has been modified. To the land cover Olive groves a relevant capacity, has been recognised. While a high relevant capacity has been given to land cover sclerophyllous vegetation and transitional woodland, finally a low capacity has been acknowledged to land cover sparsely vegetated areas.
The **mass stabilisation and control of erosion rates** was modified to land cover **Olive groves**. By analogy the same capacity has been given to land cover to fruit trees and berries namely relevant capacity.

The assessment value of **hydrological cycle and water flow maintenance** and in particular the classification level of **bushes and shrubs, sclerophyllous vegetation and transitional woodland** land uses, has been increased to very high capacity.

The only changes to **cultural** services concern the land cover which provide the landscape good - goods subjected to a special protection regime under the provisions of the National Law enacted by decree no. 2004/42 - namely **natural grassland, sclerophyllous vegetation, transitional woodland, beaches, dunes and sand plains, bare rock and water bodies**. A very high capacity has been assigned to these land cover and to the **sea** because it has high social and cultural value (RAS, 2004).

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The proposed methodology, based on the correlation between land use and ESs, confirms that the main cause of the variation in the ability of ecosystems to produce services can be attributed to land use change, to the changes in land cover and, thus, to ecological integrity. It is clear, from Figure1, that artificial soils have poor, or no ability to produce ESs; agricultural soils, instead, are able to provide fair ESs supply, while the wooded or semi-natural soils have a great variety of ESs providing, however, favouring those of adjustment, though. The reclassification of the land cover in relation to their potential ability to produce ESs (supply, regulation and cultural ones). Figure3 shows that even in a scarcely populated area, such as the study area, ecosystems show a clear decline in the ability to produce ESs with an increase in the intensity of use of the soil confirming that human activities affect the ability of ecosystems in providing services. It is not a coincidence that the SIC, which represents 14% of the municipal area, provides 18.4% of all areas with high capacity and as much as 28.3 % of all areas with high ability to produce ESs. The spatial evaluation also highlights how the areas within the scope of SIC have 34.2% of very high ability to produce ESs and 46.9% of high capacity. The peaks of Monti Ferru and Punta Cartucceddu,
Conclusions

Despite the progress made in science over the last few decades, the ESs do not find a position within the planning and decision-making processes, therefore, it is necessary that the scientific community builds a solid foundation for the integration of ESs in decision-making of the management resources. There should be available tools for an ex ante evaluation of the status quo and of the effects that the policies related to land use can generate ecosystems and their ability to provide ESs (Santolini, Riccardo, 2010). The evaluation is to be considered as one of the main requirements for the inclusion of ecosystems and their services within the decision making and planning processes. The reflection proposed here attempts to outline a possible answer to the problem of integration of ESs in the planning process, through a methodological proposal of non monetary evaluation. Evaluating ESs means taking notes of the potential of an area, giving the right value to protected areas and finding a compromise between development and protection of biodiversity. There is, therefore, a need for greater awareness in perceiving Rete Natura 2000, the EU’s efforts directed towards the protection of habitats and species through designation of protected areas for the conservation of biodiversity maintain and even improve the supply of ESs, which potential is often underestimated. Hopefully this model -once tested and improved in other municipal contexts of Siti Natura 2000, will play an important support for the ex-ante evaluation of the loss of ESs dued to wrong planning decisions.

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The Natura 2000 Network in the context of the Metropolitan City of Cagliari: an example of Habitat Suitability Approach (part one)

Daniela Ruggeria and Ignazio Cannasa

Key-words: Natura 2000 Network, Metropolitan Planning, Strategic Environmental Assessment, Habitat suitability.

Introduction

The framework of our study concerns Ecological Networks (ENs), in particular the Natura 2000 Network, in metropolitan contexts. Metropolitan contexts are wide areas where environmental dimension and anthropic dimension exist together. Human activities are often cause of increasing habitats fragmentation, and one of the most critical issue is the reduction in land connectivity for species (Pereira et al., 2011; Ferretti et al., 2013). In this context, planning processes should integrate Ecological Networks; in fact, several studies (e.g., Cullotta et al., 2011) highlight multi-disciplinary aspects related to planning in the field of EN.

Planning in metropolitan areas is a process which involves also natural elements; hence, in accordance with McHarg (2007, p. 202) “design with nature” is an important issue. In this first part, we describe the current situation of the Natura 2000 Network in the metropolitan context of Cagliari (Sardinia, Italy), and we deal with general ecological aspects for the integration in land use planning.

In our opinion, the Strategic Environmental Assessment (SEA) allows to take into account issues related to ecological network in planning processes, involving identification and evaluation of environmental impacts. We have structured our topic in two parts: in the first one, we deal with the description of the context of the Metropolitan City of Cagliari and the Natura 2000 Network; in the second one, we discuss a qualitative approach based on Habitat Suitability for a specific species in the metropolitan context of Cagliari to improve the coherence of the Natura 2000 Network. Due to a better comprehension of issues, the two parts should be read together.

This first part is organised as follows. We start introducing some general concepts about EN and the Natura 2000 Network, focusing on sites management. After, we analyse the context of the Natura 2000 Network in the Metropolitan City of Cagliari. Then, we discuss the integration of the environmental dimension in metropolitan planning, by means of the SEA. In order to conceive strategic objectives for a sustainable land use planning, our proposal concerns to get the habitat suitability results into the SEA process.
Ecological Networks and the Natura 2000 Network

ENs are strategic tools for the purpose of reducing anthropic pressures on natural components. Unsuitable agricultural and forestry practices, pollution, spread of exotic species, infrastructure construction and urbanization, are often cause of environmental impacts, ecosystems changes and fragmentation.

In processes of land-use government, a systemic approach, based on ENs, improve the conservation, protection and management of biodiversity (D’Ambrogi et al., 2013).

ENs ensure movements of wild fauna and flora species through the so-called ecological corridors, which are important landscape elements. About this argument, there is a conceptual difference between “connectedness” and “connectivity” (Baudry et al., 1988).

The “connectedness” concept regards the physical contiguity between kinds of ecosystems and/or populations; the “connectivity” concept is based on two components: structural elements, which depend on spatial position of ecosystems, on their physical continuity, on the presence, type and size of natural or anthropic elements; functional elements, which regard to the species perception scale, and their ecological and behavioural requirements, including their degree of specialization. Thus, about land “restitching” relatively of species mobility, both physical and functional aspects have to be taken into account (Battisti, 2004; D’Ambrogi et al., 2015).

In matter about ENs, in the Article 3 of the Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora (Habitats Directive), is established the Natura 2000 Network as a coherent EN within the Member States, with the aim of protecting biodiversity and preserving wild flora and fauna species and natural habitats, also with reference to economic, social and cultural requirements. In the Natura 2000 Network, Sites of Community Importance (SGs) and Special Areas of Conservation (SACs), designated under the Habitats Directive, and Special Protection Areas (SPAs), designated under Directive 79/409/EEC of 2 April 1979 (Birds Directive, modified by the Directive 2009/147/EC on the conservation of wild birds), are included.

The ecological coherence is a function of individual sites in their overall interrelation of the entire network. In this issue, ecological corridors play an essential role; in fact, Member States should endeavour to define features as linear and continuous structures essential for the migration, dispersal and genetic exchange of wild species (Habitats Directive, Article 10). In Italian law, the definition of connective elements, about ecological corridors, is “aree di collegamento ecologico funzionale” [functional ecological linking areas] (Decree of the President of Italian Republic no. 357 of 8 September 1997).

Accordingly, land-use planning should integrate connective elements to improve the ecological coherence of the Natura 2000 Network, with regard to priority natural habitats and species.

Moreover, with reference to the Natura 2000 Sites, Habitats Directive introduces the management plans, eventually integrated into other development plans (Habitats Directive, Article 6, paragraph 1) to contribute to the coherence of the EN.

In Italian law, the management plans constitute not compulsory conservation measures which have the purpose of regulating activities, maintaining sites in a good state of conservation and establishing protection rules (Decree of the President of Italian Republic no. 357 of 8 September 1997). National guidelines for the management of the Natura 2000 Sites, introduced by the Ministerial Decree of 3 September 2002, recommend that management plans evaluate the peculiarities of sites and all planned activities, ensuring integration of environmental objectives into planning practices.

In Sardinia, management plans of SCIs and SPAs are required; moreover, regional guidelines suggest when the SEA process supports the process of management plan, and when the process of management plan needs a screening phase (RAS, 2012).
The Natura 2000 Network inside the Metropolitan City of Cagliari

Our study concerns the Natura 2000 Network in the Metropolitan City of Cagliari. The Italian Constitution defines metropolitan cities as local authorities, and the Italian Law no. 56 of 7 April 2014 attributes them several functions (e.g. three-year strategic metropolitan plan drafting; general land-use planning). Furthermore, in Sardinia, according to the Regional Law no. 9 of 8 September 2006, the preservation and enhancement of natural environment, and the protection of flora and fauna, are tasks of the Metropolitan City of Cagliari.

As shown in Fig. 1, the Metropolitan City of Cagliari is located on the southern coast of Sardinia and is composed of 17 municipalities: Assemini, Cagliari, Capoterra, Elmas, Monserrato, Quartu Sant'Elena, Quartucciu, Selargius, Sestu, Decimomannu, Maracalagonis, Pula, Sarroch, Settimo San Pietro, Sinnai, Villa San Pietro, Uta. There are about 430,000 inhabitants, and Cagliari and Quartu Sant'Elena are the most populated. Its extension is about 1247 km² (the 5% of the Sardinia’s surface). There are some of the most strategic transport poles of Sardinia, such as ports and airports.

The land use, classified with the Corine Land Cover (CLC) level 1, shows a specular structure of the metropolitan area: in the middle lowland, the landscape is constituted from urbanization process results, which over time represents the attractiveness, and wetlands and water bodies; gradually, both eastward and westward, rising at higher altitude, the landscape switches from agricultural areas to forest and semi-natural surfaces.

In the metropolitan area there are 16 Natura 2000 Sites: 12 SCIs and 4 SPAs. However, some sites are partially included within the metropolitan boundaries; and, about the 29% of the metropolitan context is involved in the Natura 2000 Sites. Each of the SCIs is endowed with a management plan, but without a SEA process. Two of the four SPAs are endowed with a management plan jointly with a SEA process; instead, the other two are not even endowed with a management plan.
In the Natura 2000 Sites, as regards the metropolitan context, there are 90 species of Community interest: 3 amphibians, 63 birds, 3 fishes, 2 invertebrates, 9 mammals (only one is a priority species: *Cervus elaphus corsicanus*), 6 reptiles (only one is a priority species: *Caretta caretta*) and 4 plants (only one is a priority species: *Carex panormitana*).

**The Natura 2000 Network in planning processes**

Metropolitan planning processes are one of levels of land-use government to integrate environmental concerns and specifically management plan objectives. Thus, the integrated planning is able to address the set of requirements for the protection and enhancement of environmental systems (MATT, 2002). Indeed, metropolitan planning should formulate strategies at municipal level, assuming the role of coordinator to materialize an EN. Planning sciences should transpose their theoretical basis from an environmental point of view (Battisti, 2001, p. 40), but, in conventional urban and regional plans, the integration of environmental objectives is seldom guaranteed. Indeed, a weakness of plans is the lack of specific analysis to formulate objectives and indicators for the context of ENs monitoring. ENs integration into land-use planning pursues environmental and conservation objectives (Boitani, 2000; Battisti, 2003; Boitani et al., 2007; as cited in MATTM, 2009, p. 9).

In our opinion, ENs, and specifically the Natura 2000 Network, could be integrated into planning by the SEA process related to metropolitan plan and management plans. This is an opportunity to formulate objectives and to support the monitoring phases, on environmental, economic, social, political issues oriented at the sustainable development.
In relation to the Natura 2000 Sites in the Metropolitan City of Cagliari, the management plans, and, eventually, their SEA processes, analyse the environment inside sites boundaries, without they consider the movement of several species between sites. Furthermore, not even the municipal plans take this ecological aspect into account.

In the second part of our work we illustrate a habitat suitability approach to provide a framework of the potential suitability and movements of species in the metropolitan context. The integration of similar approaches in planning processes, especially in the SEA process, both of management plans and metropolitan plan, allows to a better management of metropolitan environment, contributing to the coherence of the Natura.

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This essay comes from the research work of the authors. Sections “Introduction”, “Ecological Networks and the Natura 2000 Network” and “The Natura 2000 Network in planning processes” have been jointly written by the authors. Daniela Ruggeri has taken care of section “The Natura 2000 Network inside the Metropolitan City of Cagliari”.

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The Natura 2000 Network in the context of the Metropolitan City of Cagliari: an example of Habitat Suitability Approach (part two, continued from part one)

Ignazio Cannasa and Daniela Ruggeria

Introduction

In this second part of our study, resuming from part one, which concerns the Natura 2000 Network in metropolitan context of Cagliari (Sardinia, Italy), we describe an analytical approach based on habitat suitability models that should be integrated in the metropolitan planning of Cagliari into the Strategic Environmental Assessment (SEA) process. This analytical approach also regards ecological connectivity issues inside the Metropolitan City of Cagliari.

In metropolitan contexts, emblematic problems (e.g. intensive farming practices, excessive urbanisation and infrastructure networks) generally cause disturbs for species movements, which consist in natural habitats reduction and fragmentation. Spatial planning allows to recognise hitches on eco-environmental dimension that should be resolved in conservation policies and strategies (Ferretti et al., 2013).

The proposed approach takes environmental relationships between land spatial elements and the perception of species, or groups of species, into account starting by data available in literature that concern only the inner part of the Natura 2000 Sites in the Regione Autonoma della Sardegna (RAS) [Autonomous Region of Sardinia]. We apply these data to the Metropolitan City of Cagliari, in order to analyse connectivity aspects. For this purpose, we choose a fauna species representative of a critical situation for its preservation, in addition to availability of data.

This work is organised as follows. We start describing the methodology, materials and data used, and some aspects of the chosen species. Then, we discuss the application of the approach in the Metropolitan City of Cagliari, results and critical issues. Finally, we point out potential connectivity concerning species dissemination and conservation, like a potential ecological corridor, underlining problems resulting from intersection of the Natura 2000 Network and wide-area planning.
Description of the methodology based on habitat suitability

During planning processes, an eligible strategy concerning natural environment that would mitigate fragmentation effects and improve ecological connectivity considers both physical-spatial and ecological-functional elements (Battisti, 2004). The methodology applied in the metropolitan context of Cagliari is founded on a twofold concept that assumes spatial and ecological aspects. This approach is based on suitability species-specific values and on the land use, for the purpose of building maps, which describe spatial patterns of species habitat suitability and landscape resistance. This resistance is the effect of physical impediments to flow of species, energy, and material (Forman, 1995, p. 279; EEA, 2014). Resistance values could be related by similarity of suitable habitats for a specific species, with the aim of classifying the study area into more-suitable and less-suitable. The lower is the suitability, the higher is the resistance (Forman, 1995, p. 279).

We prepare an approach, as suggested in several studies (Massa, 2001; Boitani et al., 2002; Marull et al., 2005), qualitatively applied to the metropolitan context of Cagliari, associating land use meanings (physical-spatial elements) with the species perceptive scale (ecological-functional elements). This consideration should be integrated in the SEA process, in order to set up strategical objectives related to the Natura 2000 Network in metropolitan planning.

Materials and data

The applied methodology joins two types of materials and data: concerning environmental variables (e.g. land use classes and infrastructure networks data), and concerning land use species perception (e.g. suitability of fauna species-specific values).

In our study, the land use database that the RAS has built is useful. The land use classification of the RAS is adapted from the Corine Land Cover (CLC) standard coding to the local situation and is extended until the level 5, but we assume the CLC level 3 for land suitability analysis.

Another useful material is the monitoring system of the conservation status of habitats and species of Community interest, in which fauna suitability values are associated with land use classes, specifically for the CLC level 3 (RAS, 2010). These values derive from the "Rete Ecologica Nazionale [National Ecological Network]" (REN), which is a document for the protection of several fauna species at Italian level (Boitani et al., 2002). However, the values of RAS are set only for the inner area included into the Natura 2000 Sites. In these documents, the suitability values are listed with the meaning: 0 (not suitable): spatial elements that do not meet the ecological requirements of species; 1 (low suitability): spatial elements that can support presence of species, but not stably over time; 2 (average suitability): spatial elements that can support stable presence of species, but that are not optimal places; 3 (high suitability): spatial elements that are optimal places for permanent presence of species.

The species chosen: Euleptes Europaea

The above-mentioned REN does not analyse all fauna species listed in the Habitats Directive, and, consequently, in Sardinia suitability values are not identified for all species. Thus, in our study, we select the Euleptes Europaea species in the "Prioritised Action Framework for the Natura 2000 Network of the Sardinia region" (RAS, 2014, p. 41). Considering several assessed aspects, like range, population, habitat and future prospective, the conservation status for this species is evaluated, as overall assessment, unfavourable, with the meaning that this species is in serious danger of extinction (at least locally).

The Euleptes Europaea is an endemic nocturnal reptile species in the west-central Mediterranean, which prefers coastal areas. Its favourite habitats are arid and rocky areas, also in agricultural land, but it shuns maquis vegetation, woodland and urban areas.
In Sardinia, the urbanization poses a threat to its habitat (Corti et al., 2009). According to the literature, the *Euleptes Europaea* is present in seven Natura 2000 Sites within the Metropolitan City of Cagliari (as shown in Fig. 1, panel 2).

**Application of the methodology based on habitat suitability**

Using data and materials, previously described, we assume fauna suitability values, not just within the Natura 2000 Sites, but we extend them also within the entire metropolitan area, in order to integrate the planning and management of the metropolitan area with an eco-environmental perspective dimension. In this way, we elaborate the habitat suitability map in the context of the Metropolitan City of Cagliari for the species *Euleptes Europaea* (as shown in Fig. 1) specifying a colorimetric scale: in red, areas with absent suitability; in yellow, areas with low suitability; and, in green, areas with average suitability. In this case, we do not use a dark green, because there are not areas with high suitability. Then, we select the green patches, namely areas with average suitability (in this case the higher suitability), and we use them in order to draw qualitatively a potential species-specific "ecological corridor" (as shown in Fig. 1, panel 3 and 4), which the species should tread in a hypothetical movement from East to West.

The mobility of a particular species is a function depending on the scale of its perception; for this reason, functional connectivity is a species-specific condition. But, "universal corridors", to mitigate fragmented habitats, and a unique scale, to resolve ecological connectivity, do not exist (Gurrutxaga et al., 2010). Nevertheless, a habitat suitability assessment represents a fundamental initial basis to evaluate potential localisations of species in the study area (Boitani, 2002, p. 34). The relationships between species and environment could be highlighted by habitat suitability analysis, and a similar approach could constitute a support decision-making in conservation and regional planning.
Analysis results

In the metropolitan context of Cagliari, the highest population density is concentrated in the central area and along the coast, where there is a high urban and industrial pressure. Applying our approach, we note that there are some critical situations in the fauna species point of view, in particular in the central sector, such as the main road infrastructures and the settlement growth, breaking the ecological connection among East and West, and weakening relationships between environmental systems (as shown in Fig. 1, panel 4). The metropolitan planning should improve and reinforce these environmental weaknesses, considering an ecological network configuration. The reading of the possible movements species map allows to anticipate negative influences that the metropolitan plan could induce.
The EN implementation into a wide area planning should be an evaluation of species in the context globally based on the knowledge of the ecological functionality, not only a species-specific network. A habitat suitability analysis is useful to improve the knowledge in this sense. The *Euleptes Europaea* species is not listed in all standard data form of the Natura 2000 Sites, despite in our study we observe it has a potential suitability in certain other sites. This potential is highlighted using this approach based on habitat suitability. Indeed, in the metropolitan area, management plans of the Natura 2000 Sites, not even in the SEA processes, do not consider the species connectivity with other sites.

**Conclusion**

The aim of this work is to show the results of an ecological analysis approach using species-specific habitats suitability analysis. We analyse the vocation of the metropolitan context of Cagliari to be crossed by species, identifying the potential ecological connectivity. This approach is an empirical study and should be deepened with a sensitivity analysis, verifying the robustness of results. These aspects should be analysed both in municipalities planning, at local level, and in the metropolitan planning.

Similar methodologies, based on the knowledge of physical and functional elements, should address the conservation of species in spatial planning, marking species relationships with land uses and finding specific association of fauna and flora to correlate the species presence with landscape structural elements, especially during the SEA processes. In this way, the metropolitan plan will be built on the concept of sustainability.

In our opinion, the integration of environmental analysis, based on the habitat suitability, into the SEA processes allows to define objectives for the purpose of the ecological and natural heritage protection and the ecological corridors identification. Overall, these issues become essential in planning decision-making processes in order to improve the Natura 2000 Network coherence.

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This essay comes from the research work of the authors. Sections “Introduction”, “Analysis results” and “Conclusion” have been jointly written by the authors. Ignazio Cannas has taken care of sections “Description of the methodology based on habitat suitability” and “Application of the methodology based on habitat suitability”.

**References**

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Ecosystem services within the appropriate assessment of land-use plans: exploring a potential integration

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Key-words: land-use planning, Natura 2000, ecosystem services, appropriate assessment.

Introduction

Land-use changes are regarded in the literature (DeFries et al., 2004; Geneletti, 2013) as the main driver of alteration of ecosystem structures, functions and services (ES), that is those goods and services provided by nature that contribute to human well-being. Although ES are usually categorized into four main groups: provisioning, regulating, cultural, and supporting services, some scholars (e.g. Boyd and Banzhaf, 2007) question whether the latter should be regarded as ES, as no human demand is directly placed on them. After Müller (2005), some authors refer to them as Ecosystem Integrity or Ecological Integrity (EI), that is, “the self-organizing capacity of ecological systems as well as their resistance against non-specific ecological risk” (Stoll et al., 2014), hence a resilient feature which is in itself a prerequisite for the delivery of the other ES. Following the “Millennium Ecosystem Assessment” initiative, great effort has been put on mapping ES at various scales, from the European (among many, EEA 2016) to the regional or local one (e.g. Grêt-Regamey et al., 2015). Few studies have looked into how such mapping approaches can be used to support the making of land-use plans (e.g., Geneletti, 2013; Casado-Arzuaga et al., 2014) or to enhance environmental assessments by predicting the impacts on ES which would be brought about by implementing planning tools and policies. This is especially important for land-use plans that concern the Natura 2000 network, a coherent network of areas established under Directive 92/43/EEC (the so-called “Habitats Directive”) that are protected on the grounds of their ecological importance, because they host habitats and species endangered, vulnerable, rare, or endemic. Preservation of EI is a key aim of this spatial backbone of the biodiversity European policies, hence to foresee what the impacts of a given plan on EI would be on the Natura 2000 network is even more important than in other contexts.

In this short paper, an application of EI and ES assessment is proposed to support current practice in the appropriate assessment (AA) of impacts of land-use plans on Natura 2000, by looking at the case study of the town of Tertenia, in Italy, which is revising its land-use plan, and whose territory partially overlaps a Natura 2000 site. After briefly presenting the study area and the data analysis developed in two phases, one according to the traditional AA procedure and the other taking into account effects on EI and ES (second section), the results of the analysis are presented in the third section, together with a short discussion on the benefits of integrating the two stages. Finally, the fourth section concludes with some remarks for future applications.
Methodology

Study area
The municipality of Tertenia, a town located close to the East coast of Sardinia, in Italy, is currently undergoing the process of revising its land-use plan in compliance with the Regional Landscape Plan approved in 2006 (for a critical discussion of this process, see Zoppi and Lai, 2010). The “new” plan was adopted by the town council in November 2015, but it has yet to be approved, as various amendments are needed in response to a number of issues raised by the regional administration. Part of Tertenia’s territory is included in the Natura 2000 site ITB020015 “Area del Monte Ferru di Tertenia” and therefore the new plan is undergoing an “appropriate assessment of its implications for the site” under the article 6.3 of the Habitats Directive, beside the broader Strategic Environmental Assessment under Directive 2001/42/EC.

![Fig. 1. The Municipality of Tertenia and the ITB020015 Natura 2000 site.](image)

Stretching over four municipalities (Figure 1), the ITB020015 site has an area of 2,625 hectares, out of which around two thirds within Tertenia’s administrative borders. Red porphyry-granite is the main distinctive feature of the inland landscape, together with the vegetation consisting predominantly of holm oaks (Quercus ilex), cork oaks (Quercus suber), juniper (Juniperus phoenicea and Juniperus turbinata), and carob trees (Ceratonia siliqua). As for the coastal part of the site, pebbled beaches characterise the northern coast, while high granite and porphyry cliffs mark the southern part. The site is especially important for its populations of bats and bird of preys (among which Falco eleonorae, Aquila chrysaetos, Falco peregrinus), and for several vegetal endemic species.

Dataset and data analysis
For this study, a spatial dataset developed within the making of the municipal land-use plan between 2013 and 2015 was made available. The spatial resolution of data varies between 1:10,000 and 1:2,000 depending on the theme, as the dataset comprises layers on environmental features (e.g. soil types, morphology, vegetation, land cover), on the built environment (e.g. individual buildings, archaeological sites and cultural heritage), on landscape units, on the current zoning system and on the proposed one. The Regional Landscape Plan implementation code mandates that such data be produced when preparing a new land-use plan or when revising an existent one. A second dataset, mapping the spatial distribution of habitats within Natura 2000 sites, produced by the regional government in 2008 and updated in 2011, was also used. The scale is 1:10,000 and habitats are coded in compliance with the Habitats Directive.
The analysis was developed in two phases. In the first phase, a typical AA under the Habitats Directive was carried out, aiming at identifying those areas in which the new land-use plan would produce changes in the zoning system (Figure 2) so as to predict impacts on habitats and species of community interest associated with the implementation of the new zoning scheme (Figure 3). The assessment of potential impacts was next carried out examining in detail, for each zone, the provisions of the new plan in terms of new buildings and infrastructure, as well as any other human-induced pressures that might be spurred by other allowed activities (e.g. tourism).

In the second phase, building on Burkhard et al.’s (2009) qualitative methodology, which assumes that a correlation exists between land cover on the one hand and ES and EI on the other hand, a four-step approach was developed: first, current ES and EI were mapped on the basis of the municipal land-cover map for the share of the ITB020015 site included within the municipality of Tertenia (the map was preliminarily reclassified since land covers were coded at the fourth, local, level of detail in the Corine nomenclature, while Burkhard et al.’s method makes use of the third level, the European one); second, by means of geoprocessing and reclassification techniques, potential land-cover changes that would be produced in the ITB020015 site by implementing either the current plan (not fully implemented yet) or the new plan were mapped - therefore, two scenarios were simulated; third, the spatial distributions of future ES and EI in
both scenarios were mapped; finally, the effects of the two plans on ES and EI were compared by mapping differences in ES and EI production resulting from the third step (Figure 4).

Fig. 4. Qualitative assessment and mapping of current EI and ES (top), of differences in EI and ES that would be produced by implementing the new plan (centre) and by implementing the current plan (bottom): an example.

Results and discussion

The traditional AA carried out in the first phase showed that, in comparison to the current plan, the proposed one performs much better when looking at their likely effects on the Natura 2000 site, as for the most part of the site the proposed zoning allocation is “H - conservation and safeguarding zone” (that is, in the Italian zoning code, the most conservative and least transformative, with little or no room for land development). Some issues did emerge and concerned the south-eastern part of the site (Figure 4, overview in the bottom-left corner), where the current plan allows tourism-related development (Figure 2, code “F”) and the proposed plan dramatically reduces such F-zones while introducing some new designations (Figure 2, code “G”): an area bordering the Natura 2000 site where a new marina is proposed, and an area hosting a camping site. Potential effects on habitats, species, and the marine environment that could stem from the implementation of the plan were highlighted in the traditional AA report.

Further investigation on these problem areas in the second phase revealed that EI could plummet dramatically, albeit locally, within the Natura 2000 site. Although in quantitative terms EI decreases equally in both scenarios (Figure 4), the spatial dimension of this decrease would be much larger in case the current plan were implemented, while, if the proposed plan were implemented, the size of the affected area would be smaller. As for provisioning and cultural services, the impact from the implementation of either plan is much lower in scale than that on EI in both scenarios. On the one hand, this signals that ES are in the Tertenia case study more resilient to human pressure than EI; on the other hand, the negative responsiveness of EI to land-use changes is an important issue if we bear in mind that EI are key to preserving habitats and species, and, ultimately, the Natura 2000 network's integrity which is the focus of European policies on biodiversity.
AA does not directly focus on choosing the “best” planning alternative, but rather on preventing possible impacts on biodiversity and on the site’s integrity which could be caused by the implementation of a plan. Spatial identification of problem areas where EI are negatively affected could therefore support public authorities in charge for issuing the final statement that concludes the AA process on at least two levels. First, it enables to identify preliminarily areas that deserve further evaluations: in principle, it is possible that a given local land-use change does not affect directly a certain species or habitat (and therefore in the traditional style of AA it is possible that no impact is detected), but the potential loss of EI signals that secondary, indirect impacts (Scott Wilson et al., 2006) on habitats and species are likely to occur. Second, it allows to effectively pinpoint areas where mitigation measures should be implemented, concerning either the zoning designation of the area itself, or its implementation code.

Conclusions

An integration of ES and EI assessment has been here proposed to support current practice in the AA of land-use plans concerning Natura 2000 sites. This integration has the potential to support decision makers overcome one of the main issues in traditional AA practice, that is the identification of sources of likely indirect impacts on habitats and species; moreover, it can contribute to formulating specific mitigation measures aiming at avoiding the loss or degradation of EI, including, for instance, changes on the proposed zoning scheme or limitations on allowed transformations and uses. Directions for future research point to the need to tailor the qualitative scale here used to local characteristics and local specifications of land covers.

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References


Courtyards, Climate regulation services and Nature-based solutions: a modelling approach to support urban regeneration of empty spaces

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Key-words: ENVI-met, UHI, thermal comfort.

Introduction

Urban Green Infrastructure (UGI) is defined by a range of multifunctional green and blue areas with different externalities that are able to add aesthetic, social and ecological values to the urban environment and the city architectural project (Pelorosso, Gobattoni, La Rosa, & Leone, 2015; Pelorosso, Gobattoni, & Leone, 2014, 2015). All these positive externalities can be recognized as Urban Ecosystem Services (UES), i.e. benefits that people derive directly or indirectly from natural and managed ecosystems (Haase et al. 2014; Gómez-Baggethun and Barton 2013).

Nature-based solutions (NBS), as green roofs or tree plantations are actions inspired by, supported by or copied from nature. NBS can be designed to enhance the UGI functionalities in urban environments, e.g. to ensure a sustainable urban water management or reduce thermal discomfort and the Urban Heat Island (UHI) effect. Definitely, NBS aim to mimic Nature furnishing similar provisioning, regulating, supporting and cultural functions and services (EU 2015).

Spatio-temporal relationships between urban land use, heat fluxes, UHI, outdoor and indoor microclimate are well recognized by researchers. UGI can reduce air and surface temperature by providing shading and enhancing evapotranspiration, which leads to a reduced energy use and an improved thermal comfort at building and neighborhood scale (Demuzere et al. 2014).

UGI therefore plays an important role in climate change adaptation: introducing strategic NBS in the city can alter surface and near-surface energy flows and act as wind tunnels or barriers, potentially reducing the intensity of UHI and improving thermal comfort. However, the socio-ecological complexity of urban structure and the geographic variability of cities require adapted strategies to the local conditions to maximize the NBS effectiveness. The translation of these notions in urban planning practice seems still inadequate.

This paper presents a first analysis of climate regulation services provided by potential NBS realized within the UGI of Bari. In particular, this study will analyse the cooling effect of green actions planned inside a courtyard coupled with the realization of extensive green roof. The climatic differences between actual and post scenario will be analysed in terms of T decrease and thermal comfort index (PMV). These indicators are then proposed as proxy for local climatic regulation services and, widening to the urban system, for the mitigation of UHI effect.
Study area

The study area (850 ha) is the most compact and populated district of Bari city considering also the historical center (Fig. 1). In general, Bari city suffers a strong scarcity of urban green spaces. Among the biggest European cities, Bari presents one of the lowest levels of accessibility to green spaces within a walking distance from home: only around 20% of population has urban green space (≥ 2 ha) available within 500 m in its administrative boundary (Kabisch et al., 2016). This green space scarcity has several consequences on people health and functionality of the urban system, in particular on storm water control (Pelorosso et al., 2013) and climatic regulation and UHI phenomenon. Summer extreme heat events have potential high impact on people, above all for young and old citizens which cannot move for cooling places (e.g. sea or green space with shade trees) or don’t have cooling systems in their homes. Since the lack of public and shaded green spaces, planners should look for new spaces and strategic actions. Several unused or underused spaces could be subject of green regeneration projects with the aim to mitigate the UHI impact and provide further UES to the citizens. These spaces (Fig. 1) are however outside the compact city and the possibilities of action appear very limited. The compact city present however many courtyards inside buildings due to the particular urban configuration of Bari. Approximately, these courtyards amount to 300,000 mq and they represent the 3.6% of the study area.

![Fig. 1. Bari city, courtyard distribution and the study area.](image)

Model simulation

In order to evaluate how the green strategies affect the microclimate and outdoor thermal comfort of a courtyard, ENVI-met version 4.0 Beta II was used (Bruse 2016). ENVI-met is a free 3D microclimate model designed to simulate the interactions among buildings, surfaces, vegetation and air in urban environment. It relies on the fundamental laws of fluid dynamics and thermodynamics and it can be used for neighbored urban scale evaluations. Several scientific
studies have adopted this model even in simulations of courtyards (e.g. Berkovic et al., 2012; Ghaffarianhoseini et al., 2015; Salata et al., 2015). The software is able to calculate several meteorological and microclimatic variables and thermal comfort indexes. Moreover, several land use scenarios and NBS can be simulated and therefore the model was used as Spatial Decision Support System in many climatic urban studies. The present work focuses on Fanger’s Predicted Mean Vote (PMV), one of the most widely used indexes to evaluate outdoor thermal comfort. The simulated green scenario (Fig. 2) is constituted by two main interventions (NBS): an extensive green roof (20 cm of grass) on the top of the building and the greening of the courtyard with trees and grass soil coverage. Cooling effect of NBS was then estimated comparing base scenario with the green scenario in terms of atmospheric T and PMV index at street and roof level. The simulated day was the 23 July 2003, one of the hottest days of the last years. Only a light wind from east (from sea) was considered to describe the climate of a heat wave day. Settings for PMV calculation were referred to the thermal resistance of a typical summer clothing (Salata et al. 2015).

Fig. 2. 3D-model of the courtyard and identification of the NBS.

Results and discussion

Considering the green roof scenario, a mean reduction of air temperature of 0.1 °C was registered during the simulated day with respect to the base scenario. PMV decrease was around 0.3 with a higher thermal benefit of the green roof pointed out during the night (mean PMV reduction of 0.5). Green roofs have demonstrated only a limited cooling capacity in the first layer of air. Courtyard with the planned NBS shows an improved microclimate with a mean reduction of 0.45 °C during all the simulated hours. Moreover, NBS scenario defines a less warm environment than the neighborhood streets above all during the hottest hours of the day (-0.63 °C at 14:00). A similar trend is reported also in terms of PMV reduction. During the hottest day hours, within the green courtyard, the mean PMV reduction is 0.8 with respect to the base scenario without NBS.
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with a peak of -0.7 points at 14:00. Comparing the green courtyard with the neighbored streets the mean PMV difference is around 0.5 points less with a reduction peak of -1.35 at 14:00. Moreover, in shaded areas, the reduction of PMV index has reached also -4 points defining a small area of thermal comfort inside the courtyard during the hottest hours of the day. Model assessment has defined a critical situation of the simulated area under the climatic point of view. PMV values define high human discomfort both inside and outside the courtyard. The courtyard presents highest values of T and PMV in the simulated environment resulting as the warmest and unhealthiest open space during the hottest hours of the day. The simulated green roof didn’t show significant benefits to the courtyard at street level. These results are in line with other findings reported in literature for high building-height-to-street-width (H/W) ratio where thermal green roof benefits at pedestrian level were not pointed out (Ng et al. 2012). However, benefits of thermal insulation of the building and large-scale green roof installation are here not considered. The simulated NBS inside the courtyard have demonstrated their capacity to mitigate the microclimatic condition of the courtyard. Further studies and evaluations are necessary to setup best NBS configurations (e.g. increasing the tree canopy and the shaded area inside the courtyard).

Conclusions

ENVI-met model has shown its capacity to provide useful and objective information regarding climatic functionality (microclimatic regulation service) of NBS. In particular, the impact of the vegetation on the thermal index PMV is resulted significant even with small air temperature reductions. Both indexes (Air temperature and PMV index) can therefore be employed has proxy indicators of urban ecosystem services related to climate regulation of urban system. The impact of the simulated study case on UHI cannot be determined directly by the model output. However, the model results appear encouraging since a clear climatic improvement of courtyard was pointed out, above all with respect to the neighborhood streets where traffic congestion can further worse the climatic situation. Courtyards, above all if no green areas are present in the proximity of the home or office, can therefore represent cool islands, the only possibility for the citizens to counteract adverse climatic conditions in the hottest hours of the day. Further studies on a wider area and temporal scale (e.g. considering different days of the year and climatic conditions) could help to quantify the extended thermal benefits for people during the year and even the reduction of UHI phenomenon due to courtyard greening. A census of the courtyard typology and distribution in relation with the density of population and the real green area availability is then welcomed. We argue that a coupled urban assessment of courtyard and model simulations could point out useful information to the planners and designers in order to choice the best location for urban regenerations based on nature strictly related with local conditions.

References


For the transition toward resilient communities


TSC - Towards the Smart City
A critical review of parameters within urban sustainability models: how much do soil and natural resources weight?

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Key-words: soil consumption, urban sustainability assessment, parameters.

Introduction

The urgency to adopt new growth models promoting the decrease of natural resource consumption, has recently drawn the attention of researchers and policy makers to soil. This complex resource must be preserved, as it fulfills several ecological and eco-systemic functions and supports human activities. Its duality of functions determines the extreme vulnerability to degradation processes, such as sealing, desertification, loss of biodiversity. This awareness led Europe to approve the Seventh Environmental Action Community Programme (2014), which encourages Member States to adopt a more integrated approach to the transformation of soil, as a result of impacts that the land take phenomenon can produce on other natural resources and climate change processes (Yuan and Bauer 2007, 377; Wu 2008, 47).

According to these brief considerations, strategies and actions aim at ensuring a more sustainable use of soil, reducing land and energy consumption and climate change effects should be promoted. In this perspective, this work describes an initial segment of a wider research oriented to define which actions allow mainly to limit the soil sealing and, at the same time, to reach energy-environmental sustainability goals too, at the urban scale. In detail, the article aims at proposing a first set of parameters measuring the consumption of soil and other urban resources, describing the main characteristics of the physical subsystem and which allows evaluating the efficiency of saving-oriented actions in the next stage of the research. To achieve this aim, a comprehensive critical review of urban sustainability models, reports and composite indicators was done, in order to provide useful insights on the measurement strictness and reliability of the numerous urban sustainability assessment reports and models, almost related to the institutional world rather than to the academic one.
Methodology

The comprehension framework developed for defining the set of parameters to measure the consumption of soil and other urban resources (energy, water) concerned both the scientific literature and the technical-institutional models and reports. Whilst soil consumption has always been related to the government of urban transformation, due to the different forms of city expansion, it is a topic that, in recent years, has been attracting growing scientific and political interest because of the rapid urbanization of agricultural land that is being reached a significant and concerning worldwide scale. Despite the centrality of this issue, the research and studies that deal with it by the approach characterizing the governance of urban transformation are still few and geared mainly to the definition of new IT methods for measuring the phenomenon. According to this state of art, the wide range of urban sustainability assessment documents and methods developed in institutional rather than scientific setting has been considered, in order to develop a knowledge framework suitably updated and shared. Among the numerous indices, reports and models aimed at assessing urban sustainability, this work studied those developed or updated during the last ten years (in order to include new issues as soil sealing, energy or climate change), which include all dimensions of sustainability, whose manuals and guidelines are open access, which are well known at international level and, finally, which were developed at urban scale. Sixteen sources have been selected, according to these criteria: six composite indicators (European Green City, Urban Sustainability, Global City Indicators Program, Sustainable City - UK and Arcadis - and EILITE cities), five reports (Indicators for Sustainability, Urban Ecosystem Europe, Benessere equo e sostenibile, Ecosistema urbano e Qualità ambiente urbano) and five models (LEED, CASBEE Urban Development, BREEAM Community, STAR Community and DGNB for Urban Development). As sustainability is a complex and interdisciplinary issue, it is not possible to identify a one size fits all list of parameters to describe and measure it, as well as a method for their classification and comparison (Ugwu and Haupt 2007, 666; Dawson et al. 2014).

Therefore, based on the review of a wide array of studies (f. i. Bourdic et al. 2012; Sharifi and Murayama 2013, 76-78; Morelli et al. 2013), a classification system was defined in order to “re-classify” all the parameters included in the composite indicators, reports and models and compare both variables and frameworks. This work provides a classification system of parameters on three levels. The first level is related to the three main sustainability dimensions: environment, society, and economy. For each of them specific aspects have been defined, according to the numerous previous studies that sought to analyze the strengths and weaknesses of urban sustainability assessment models (Gil and Duarte 2013, 319-320; Komelj and Srinivisan 2015, 34-37). Then, the aspects of environment dimension have been articulated in specific categories that describe urban resources and some main physical characteristics affecting soil consumption. Based on this classification system, all the parameters have been “re-classified” according to what part of the sustainability they measure, both in term of consumption and quality. After “re-categorizing” the variables, the importance of each of them was determined by applying the weights calculated in all models and in a few composite indicators. As regards the reports, the comparison refers to the number of parameters and not to scores, as these have not been established.

Results and discussion

The comparative analysis of the urban sustainability assessment models and composite indicators were made calculating the sum of the weights of each aspect and category, after
applying the maximum scores and weighting coefficients to every parameter according to the tools. Although the assignment process weights to the variables is not available for any model, and so it is not possible evaluate their measurement strictness and reliability, it is necessary referring to weights as their application determine significant changes to the influence of aspects and categories. For instance, the BREEAM Communities has the 50 per cent of the parameters related to society, but the weight of this dimension is not the highest (37 per cent versus 52 per cent of environment). According to figures 1, and 2, both composite indicators and models emphasize the environment dimension (except for STAR Community), but the first ones focus on the aspect of “resources” and the second ones seem to give more importance to “built environment” (except for BREEAM Communities). European Green City Index and Urban Sustainability Index aim at taking into account a wide range of environmental and ecological aspects, but neither of them considers the soil category, underlying instead the “energy” and “air” ones. Therefore referring to synthesis indices, energy saving and emission reduction appear to be the main pillars of environmental sustainability of cities, according to the fact that energy policy and low-carbon growth represent the main objective of EU action and start to be key elements in urban planning of Asian cities, with the aim of increasing life quality and narrowing the gap with western benchmark cities.

“Energy”, “soil” and “water” (in this order) are the “resources” categories characterized by greater importance in the models, explaining about half of the weighting of this aspect, but they are evaluated through different perspectives. Most parameters of “energy” and “water” refer to features as consumption, use and quality, while the variables referable to “soil” estimate mainly the preservation of natural areas and of biodiversity and the re-use of brownfields or buildings (DGNB UD, LEED and CASBEE UD). Hence, it is worth noting that for “energy” and “water” categories the assessment of their efficiency is stressed, while for “soil” the approach seems to reflect an ecosystem perspective oriented to measure more the level of protection and which function the soil fulfills, than its consumption or degradation. Switching to the “built environment”, this aspect dominates within “resources” in almost all the models (at least 30 per cent) and the most weighted categories are mainly “compactness” and “accessibility” (figure 2). These represent remarkable elements both in the American urban planning policy (LEED and
STAR Community) and in the European one (CASBEE UD, BREEAM Communities and DGNB UD), because of the sprawl issue in the first case and of urban growth model in the second one. Nevertheless “mixed-use”, that should be a core feature of a sustainable city, is the least relevant category both in the composite indicators and in most models (except for LEED and DGNB UD, according to what just stated).

Fig. 2. Weights of aspects and categories (models).

Conclusions

This work reviewed and compared some broadly used urban sustainability assessment composite indicators and models in order to reach two main goals: (i) underlining which aspects of environmental sustainability are most considered and which weight is attributed to them; (ii) proposing a first set of parameters related to soil, urban resources and physical aspects of built environment useful to the next step of a wider research. The study has firstly shown that weighting system still represents a weakness for models, due to subjectivity and ambiguity characterizing it. Even though each tool is affected by local context, policy, standards and so on, comparing and classifying numerous aspects without having knowledge of the related assessment criteria procedure, results really challenging. Weighting percentages are assigned according to methodologies as multi-criteria analysis (Ameen et al. 2015), but how the weighting ratios are determined is not a transparent and available information, that make difficult estimating the measurement strictness and reliability both of these procedures and moreover of the urban sustainability models. For all tools reviewed “environment” is the main sustainability concern and this result reflects the great attention to pressing challenges as energy efficiency or reduction of carbon emissions. Especially “energy” category is characterized by both numerous parameters and high weights, compared to the other resources. If energy and also water and air are categories that all models and composite indicators agree for their importance, soil does not catch the same attention. In most tools it is not included within environmental aspects and the
models that instead consider it, seem to be interested just in its protection or loss of biodiversity. Soil sealing, land use change, permeability are not taken into consideration in any of the analysed sources, except for the Italian report “Qualità ambiente urbano”. To sum up the foregoing and to answer to the question of this paper’s title, soil does not represent a pillar of environmental sustainability compared to the other urban resources. Furthermore, aspects as urban form, transport and design seem to be issues that are more emphasized than the ones related to the saving of resources. Therefore, this work confirms Komeily and Srinivisan’s (2015, 36) main findings, according to which the aspects and categories related to the environment dimension and, in general, to the urban sustainability issue are characterized by «the lack of a balanced approach». These considerations lead to state that these models should not be considered the only tool for assessing the sustainability of urban communities because the lack of scientific recommendations both regard to the approach and to the weights given to the individual aspects of sustainability.

The review of the sixteen methods allowed defining a first set of parameters that, according to the main aim of the wider research, is oriented to measure consumption and quality of urban resources and some main physical characteristics affecting soil consumption. The set proposed in figure three is not intended to be comprehensive, at this stage of the research, and so it represents an initial step in the development of a broader group oriented to measure more deeply the effects related to urban soil consumption, according to the main findings of this study. Since this work dealt with the broad theme of urban sustainability assessment, several interesting topics emerged that could be investigated in future research. One could concern the reliability of the parameters and their weighting criteria by using uncertainty and sensitivity analysis.
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http://www.ncl.ac.uk/ceser/


The building aspect ratio for an energy efficient green network design

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Key-words: aspect ratio; green areas; energy efficiency; microclimate simulation; cooling load prediction.

Introduction

The new paradigm of smart city includes the topics of land consumption and climate change adaptation thus bringing to the fore the role of open spaces system in the strategic development of urban areas (Gill et al., 2007; Gargiulo & Zucaro, 2015). In this context, the study of different characteristics of urban settlements and the focus on the relationship between full and empty urban spaces, could provide an important set of information for an energy saving based design of open spaces (Jones et al., 2001; Papa et al., 2014). In particular, within the relations between the elements composing the urban physical space, green spaces play a major role thanks to the many positive effects they produce on the urban environment. Vegetation, in fact, in addition to being a key component of quality of life, has an important role to make cities more sustainable and resilient, through the so-called "oasis effect", significant for reducing the energy consumption due to the use of air conditioning in summer (Coronel & Alvarez, 2001; Zhang et al., 2014). This paper intends to propose a methodology for measuring the impact of the green areas in different types of urban fabric, in terms of temperature mitigation and energy consumption reduction in order to contribute to the scientific debate on the definition of new instruments able to integrate climate and energy aspects in the design of green space networks.

This work, in particular, represents a development of a previous research aimed at effectively localizing, dimensioning and distributing green spaces, starting from data related to a heterogeneous urban pattern for density and presence of green in the municipality of Naples. The variable of building aspect ratio, related to the geometry of the road network, was inserted in the calculation parameters, thus achieving, through the use of a thermal simulation software, the incidence of solar radiation on the main facades of the buildings and its rated thermal input for air conditioning of indoor environment. The obtained data were integrated, through the GIS system, with the results of the previous study creating a useful decision support tool to test the effectiveness of the green network system in the analyzed urban context, and to strategically define the areas to place new vegetation elements, both punctual (green spaces) and linear (tree rows).
Methodology

The previous research work, carried out as part of the broader research project Smart Energy Master, and currently in course of publication, was aimed to analyze the microclimatic behavior of small green areas in three districts of Naples, Chiaia, Vomero and Arenella. The study has identified the minimum size of the green areas able to guarantee a perceptible cooling effect, and has measured their range of influence on the surrounding urban fabric, by combining urban parameters (settlement density, coverage ratio, height of buildings), characteristics of the green areas (extension of the area and type of vegetation), and climatic variables (geographic position, air temperature, wind speed, etc.). The table below is a summary of the results:

<table>
<thead>
<tr>
<th>Low density areas</th>
<th>Non planned areas</th>
<th>Historical Compact Areas</th>
<th>Average value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ΔT (°C)</td>
<td>Cooling distance (m)</td>
<td>ΔT (°C)</td>
</tr>
<tr>
<td>Small Green Area</td>
<td>0,940</td>
<td>83,32</td>
<td>0,15</td>
</tr>
<tr>
<td>Medium Green Area</td>
<td>2,21</td>
<td>81,90</td>
<td>0,83</td>
</tr>
<tr>
<td>Big Green Area</td>
<td>1,28</td>
<td>132,55</td>
<td>0,81</td>
</tr>
</tbody>
</table>

The work proposed in this paper aim at integrating the results of the previous research with data related to the potential energy consumption of the building sector. For this purpose a new set of data were analyzed in order to describe the thermal behavior of buildings, with the aim to provide specific information about the potential consumption due to the summer cooling of buildings included within the radius of influence of green areas identified in the previous study. The methodology adopted was focused on the analysis of linear elements (roads). This choice was dictated by the higher incidence of the latter in terms of energy consumption on the urban scale. The punctual elements consisting of squares and plazas, in fact, represent only a very small percentage of the open spaces. For this purpose, a synthetic indicator, describing punctually the geometric characteristics of the road network, has been identified in the literature (Ali-Toudert & Mayer, 2006; McKeen & Fung, 2014) in order to calculate the heat input of solar radiation on the main facades of the buildings. The geometric variable detected is the building aspect ratio ($Ar$), defined as the ratio between the average height of buildings and the distance of the facades on the two fronts of the road. From the combination of this variable with the orientation of a road segment, it was possible to define, through the software Solar Irradiance, the irradiance of solar radiation for each type of road section expressed in kWh/m², in the summer period. The $Ar$ values used for the simulations were identified through a query on the analyzed area in GIS. The different spatial configurations were depicted with three-dimensional models developed in CAD and analyzed according to the following procedure:

- Sample area consisting of a vertical strip of to 1 meter width, were identified on the two surfaces of the volumes facades facing the road and analyzed with the tool Solar irradiance.
- On the single unit of surface area the software Solar Irradiance calculated the total incident irradiance in the summer season (from 1st of June to 15th of September). The obtained values were divided by the total square meters of the analyzed surface and by the number of days, in order to normalize the results of different geometric configurations, having different heights and, therefore, different heat storage surfaces.
The value is expressed in kWh/m², and is representative of the average amount of irradiance that the area receives on average in a day. The monthly solar gains through the external opaque structures have been defined by the following equation:

\[ Q_{SE,o} = I \times 0.6 \times (1.223/25) \]

(1)

where \( Q_{SE,o} \) represents the amount of solar energy absorbed by the external opaque surfaces and transferred to the indoor environment considering an average transmittance value of the walls, and \( I \) indicates the irradiance value obtained from simulations.

The data were reported in a summary table and processed in form of scatter chart (Figure 1). The obtained graph describes the trend of the solar energy absorbed by the walls on varying of the \( Ar \) factor for the four main road orientations considered (N-S; W-E; NW-SW; NE-SW). Afterwards, values of aspect ratio and orientation of several sections of the roads were calculated in GIS, thus giving the possibility to join data obtained from the simulation to the related buildings; The result is a classification of all buildings facing the roads according to the potential energy consumption due to the rated thermal input for air conditioning of indoor environment.

**Results and discussion**

Through the procedure described in the previous paragraph, different geo-referenced data were obtained, allowing to develop a map (figure2) that highlights the most highly exposed buildings to solar radiation falling within the range of influence of green network; in this way it is possible to identify the areas where the lowering of the temperature due to the presence of vegetation is more effective. By observing the map (figure2) it is possible to draw some conclusions:

- The influence of green areas network of the study case reaches less than a third of the total building stock. This is mainly due to the distribution of green areas system rather than to its total surface. From the collected data it was estimated that, with an ideal
distribution of the same amount of green surfaces, the area of influence of vegetation would have reached about twice of the built environment.

- Starting from the previous consideration and observing the results we can deduce that, with the same amount of green surfaces, the best response in terms of mitigation of temperatures is given by a system of small green spaces (not lower than 5000 square meters) equally and densely distributed in the urban fabric, rather than a concentration of big parks located in a few points of the city.

- The areas of the city characterized by wider road sections or lower buildings, especially if oriented along the east-west axis, are more exposed to solar radiation during the hot season. Therefore, it would be preferable to place green areas close to areas with these geometric characteristics or alternatively insert, in the identified road, rows of trees which act as solar shading in order to reduce the thermal load on the facades of buildings.

In addition to an assessment of the current green spaces network the methodology could represent a useful decision support tool during the planning stages for an energy based integration of the green network in the wider urban system configuration, locating the vegetation in an energy-efficient way.

The opportunity to act effectively in the urban context through small interventions is particularly relevant considering the current urban growth and land use trends that involves most of the urban centers. In a context of this kind, in fact, it is essential to balance the need of localization of new green spaces with the availability of unbuilt space limitations.

The proposed tool can be implemented by including additional variables, related both to vegetation typology and to the urban morphology characteristics. It is the case, for example, of the green roofs whose energy consumption based location may be defined from indicators such as the sky view factor, shadow density and daylight distribution (Ratti & Richens, 2004).

Fig. 2. Extract of the map representing the most highly exposed buildings to solar radiation falling within the green areas influence range.
Conclusions

This work, in the field of studies dealing with the effects of the green areas on the urban microclimate, lays the basis for the creation of a decision support tool useful to define new energy saving based strategies of urban transformation as a function of the relationship between vegetation and urban morphology. For this purpose, a methodology for data collection and analysis was developed, combining thermal simulation models analysis and geographic information data; it returns an overall picture on the urban scale of the vegetation effects on the thermal behavior of buildings, providing the decision-maker useful elements for the green network design.

The methodology has been tested on the case study of Naples, within the area included in the Chiaia, Vomero and Arenella districts. The result is a set of information transferred in the form of maps, showing the cooling distance of green areas and the potential energy consumption of buildings. The complex nature of the interactions between the processes of evapotranspiration and the multiple physical characteristics of urban spaces, suggests further development of this research work which should also consider other relevant variables related both on the type of vegetation (green roofs, types of trees, etc.) and on the relationship between urban form and energy consumption (sky view factor, shadow density and daylight distribution). The research could be extended also to the influence of the green areas in the winter season, in order to collect more information about the energy balance over a year.

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e-agonà-le-agópa for the transition toward resilient communities

Energy efficiency measures for building and their impact on the grid in a Middle East case study

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Key-words: energy efficiency, renewable energy sources, urban regeneration, electric grid.

Introduction

Increasing population and urban growth are driving a major change in energy demand, boosting consumptions and requiring environmentally sustainable solutions. At the same time, global warming and related worldwide CO₂ reduction policies are forcing a technologic transition from fossil fuels to Renewable Energy Sources (RES), like wind and solar. RES market will be one of the main driver of green economy, representing both a need and an economic opportunity, within a wide strategic scenario that can be oriented to energetic independence.

Such approach is even more important in the areas where the energy provision is highly dependent from foreign countries, as in the case of the Palestinian territories whose energy needs are mainly covered through an import from Israel. Moreover, Palestinian territories offer a great potential in terms of exploitation of solar energy through photovoltaic panels and solar collectors thanks to high availability of sun radiation.

One of the main ways to improve the penetration of renewable energy sources in a urban area is the integration with energy efficiency measures for existing buildings, paving the way for urban regeneration and improvement of the quality of life. However, energy efficiency measures at city scale can have an impact also on the distribution grid, changing the energy requirements of final users. Moreover, additional RES plants can be directly connected to the grid (both at low and at medium voltage level) creating an ideal environment for the development of innovative energy governance models.

Starting from the RENEP (Renewable Energy for Palestine) project, an initiative in the framework of the PMSP (Palestinian Municipality Support Program) with the participations of SiTI, Ai Engineering s.r.l., the Municipality of Torino and the Metropolitan City of Totino, this paper aims to describe an approach to evaluate the potential impact on an urban environment of the implementation of energy efficiency measures. The approach has been validated through real data collected on the fields, thanks to the collaboration with Hebron Municipality and HePCo (Hebron Power Company), the local utility responsible for the management of the electric grid.
Methodology

The analysis was carried out in two main steps. The first step was related to the evaluation of the impact of energy efficiency measures on buildings, aiming at defining new load profiles. In the second step, the analysis was focused on the possible impact on the distribution grid, also taking into account the connection of photovoltaic panels.

Building load profiles

The Hebron urban environment is characterized by a great variety of building typologies. However, these structures can be grouped into four main categories: residential, commercial, industrial and educational. For each category, some representative buildings have been chosen, representing the pilot buildings on which the energy consumption analysis have been performed.

Using the GIS database provided by the Hebron Municipality, the presence of these typologies has been assessed to determine the total floor area of each type. This hypothesis, according to the analysis of the distributions of the buildings throughout the city (2/3 of compound buildings of 2-3 floors), will allow to extend the results obtained to all the buildings returning fairly accurate estimates.

Initially, the profile of energy consumption has been assessed for the most representative buildings through a dynamic energy modeling using IES<VE> software. The energy modeling has been performed for each scenario, been focused on the evaluation of:

- Hourly Energy Demand, in the 3rd Wednesday of July and the 3rd Wednesday of December.
- Monthly Energy consumption;
- Annual Energy consumption.

In order to obtain an accurate energy assessment, it was necessary to consider the energy contributions of the constructive elements and the different devices in the interior of the buildings, specifically: building elements (transparent and opaque envelope), people, water heating, lighting and electrical devices, and heating/cooling appliances.

Next, some improvement sets have been chosen for each type of building. The first and the second kind of improvements concern those measures able to improve the opaque and the transparent envelope, acting on the U factors, solar factor $g$ and light transmittance $t_L$. The third kind of improvement regards the installation of high efficiency air conditioning systems instead of the existing ones. Based on the energy modelling results, the "best scenario" for each typology of building can thus be identified, defining the set of suggested improvements.

Later, the results of the energy modelling have been spread over the area, considering the buildings distribution. Every condition is described by a hourly load profile, describing the electricity demand of the buildings. The profiles have been evaluated in two conditions (winter and summer), considering the improvements and possibly estimating the new construction trend.

Within the network analysis, the buildings play a key-role and affect the size and type of RES system needed to reach the equilibrium. Thus, the new load profiles are an important input for the distribution network analysis providing information concerning the user-side of the smart grid.

Modelling of load profiles

Two main scenarios can be defined and analyzed:
- Scenario 0 – Actual conditions: no improvements on energy efficiency in buildings are considered
- Scenario 1 – Future conditions: best improvements on energy efficiency in buildings are considered

However, at this stage, this abstract presents the results of the PV impacts only for the Scenario 0, but additional results for the Scenario 1 will be integrated into the final manuscript.

The load profiles for Scenario 0 has been defined combining the methodology proposed in (Lazzeroni et al., 2015) with the profiles obtained through the IES<VE> software. Under the assumption that the end-user load profile is the same for each MV/LV substations of the corresponding subnet, the measurement data of load consumption at each HV/MV substation over a year, provided by HePCo, has been arranged in order to define an hourly average normalized load profile.

In short words, the demand corresponding to the same hourly interval were summed up. In this way, N days of hourly measures were obtained. Then, the average hourly load profile was defined, by calculating the mean value of the hourly consumption in the N measuring days (1).

\[
P_{mh}(i) = \frac{\sum_{j=1}^{N} p_{j}(i)}{N}
\]  

(1)

where \( P_{mh} \) is the average power at the \( i \)-th hour, \( j \) is the day and \( N \) is the total number of the days with available measures. Finally, the average hourly power was normalized with respect to the maximum value calculated, to define a hourly power factor (2):

\[
F_{CO}(i) = \frac{p_{mh}(i)}{\text{max}(p_{mh})}
\]

(2)

Similar procedure is used to define a monthly load factor, calculated as the ratio between the consumption in that given \( m \)-th month and the maximum experienced value (3).

\[
F_{CM_{m}} = \frac{e_{m}}{\text{max}(e_{1}, \ldots, e_{12})}
\]

(3)

Assuming that daily energy consumptions in a given month is constant for each day of the month, the daily energy consumption (4) for each HV/MV substation is calculated as:

\[
e_{m,d} = \frac{e_{m}}{N_{d,m}} = \frac{F_{CM_{m}} \cdot \text{max}(e_{1}, \ldots, e_{12})}{N_{d,m}}
\]

(4)

The same energy can be also calculated as the sum of all the energy consumptions measured in the MV/LV substations, assuming that the energy is evenly distributed between each substations according to the size of the transformers (5).

\[
e_{m,d} = k_{m} \cdot \sum_{j=1}^{N_{TR}} s_{n,j} \cdot \sum_{i=1}^{24} F_{CO}(i)
\]

(5)

where \( k_{m} \) is the monthly correction factor for the hourly load factor \( F_{CO} \) defined in (4), \( S_{n,j} \) is the nominal size of the \( j \)-th MV/LV transformer, and \( N_{TR} \) is the total number of MV/LV substations connected to a given subnet. Using (4) and (5), it is then possible to calculate \( k_{m} \), in order to get the correct load profile of a given month to be used in the NEPLAN simulator.

When improvements of energy efficiency in buildings are implemented (Scenario 1), the load profiles for cooling and space heating defined for Scenario 0 should be considered as a portion of the overall demand measured at each HV/MV substations. In this way, the aforementioned profiles for space heating and cooling can be subtracted from the measured load profile in order to define a net trend. Subsequently, the profile for scenario 1 can be obtained summing up this net-profile and the profile for space heating and cooling for the “best scenario”.

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Photovoltaic system models

It is important to provide a preliminary evaluation of the productivity of the photovoltaic (PV) systems that will be connected to the grid in order to cover the energy needs of the city, using the same approach described in (Lazzeroni et al., 2015).

Considering a daily irradiance profile $G(t)$ for a given period of the year and area where PV modules are installed, a daily production profile for each PV plant can be calculated as follows:

$$P_P(t) = P_{PV,peak} \cdot \frac{G(t)}{1000} \cdot PR$$

(6)

where $P_{PV,peak}$ is the peak power of the plant and $PR$ the performance ratio that takes into account the various system loss (usually $PR$ is equal to 0.75). The daily irradiance profile can be obtained accordingly to the methodology implemented in (Carpaneto et al., 2015) based on the European database PVGIS, in order to take into account also weather conditions.

The peak power can be evaluated by means of the photovoltaic penetration factor (PF) into the grid, defined in (Kordkheli et al, 2014) as:

$$PF_{PV} = \frac{P_{PV,max}}{P_{load,max}} \cdot 100$$

(2)

where $P_{load,max}$ is the maximum power consumed by the connected loads and $P_{PV,max}$ is the maximum peak power installed. Thus, for different penetration factors, different maximum peak power values can be considered. These values can be subdivided among the different nodes of the grid according to the rated power of the substations.

Simulations and results

Different load-flow simulations were performed for different PV penetration factors and for each subnet by means of NEPLAN software. Consequently, possible violations of grid limits have been recorded in order to evaluate the maximum installable PV power into the grid. The main grid limits investigated in this work are:

- OC-TR: Transformer overload/overcurrent
- OC-LINE: Line congestion (i.e. line current is over cable ampacity)
- OV-BUS: Bus voltage raise/decrease (i.e. bus voltage is over limits imposed by EN50160)

Following the approach proposed by (Lazzeroni et al., 2015), the load-flow calculation was initially performed by increasing the PV penetration factors at LV stage, by placing PV generation at LV side of the MV/LV transformer, up to reach transformer overload or possible line overcurrent. When these limits are reached, the corresponding PV generation represents the maximum installable PV power at LV stage. Later, the PV penetration factor was further increased in order to reach line congestions into the grid, by including additional PV power generation at MV level in each busbar. In both the conditions voltage buses and line current were also monitored in order to verify the limits imposed by the EN50160 and the cable ampacity, respectively. The results obtained in the simulations regarding Scenario 0 are summarized for each subnet in Table 1.
Results show that the busbar overvoltage condition is never reached, even if line overcurrent in some cases is experienced. The maximum PV penetration at LV stage is due to transformer overload for Substation 3, 4 and 5, while it is due to the achievement of overcurrent limit for the Substation 1, 2 and 6. On the other hand, the maximum PV penetration at MV stage is only due to the violation of line overcurrent. Finally, the penetration factors shown in Table 1 highlight as the maximum PV generation that potentially can be connected to the grid at is approximatively equal to 251.09 MWp.

**Conclusions**

Hebron city presents a high potential to became an attractive point for the Middle-East area in terms of investment both for PV development and the implementation of energy efficiency actions in buildings. The preliminary analysis conducted highlight how the distribution grid can potentially be capable to connect up to 251 MWp of PV systems. This condition paving the way for an interesting development and investments in RES applications, since the capital costs for PV installation are generally cheaper than ones evidenced in EU countries.

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Energy consumption in hospitals: towards a new benchmark

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Key-words: energy, benchmark, naples, hospital.

Introduction

Almost a third of the total energy usage in Italy is due to the building sector and in particular hospitals belong to a very energivorous sector. In fact, consumptions in the hospital sector are on average 3 times higher than the residential civil sector at the same climatic conditions (Grassi et al. 2009). This can be attributed to the many activities taking place within them and the need for heating and electrical systems operating 24 hours 24, 365 days a year, for essential functions (Battarra, Fistola and La Rocca 2016, 2-3). However, the energy consumption of health structures, may vary due to factors that affect the energy performance: hospital size, number of berths, year of construction, geographical location, exposure, climatic conditions, number of buildings, medical specialties, number and types of existing installations, type of management etc. (Bigotti 2012, 54-60).

In the literature, in order to make a quick estimate of energy consumption (for example in the drawing up of an energy plan but also in the development of rules and regulations), index of benchmark are often used. Among the first researches in Italy, it is worthy mentioned the ENEA-FIRE joint research, which, in 1993, proposed reference values for the calculation of total power and thermal consumption of health structures\textsuperscript{3} (Grassi 1997). The identified values refer to the number of beds, the volume and floor area of the hospital and are provided as a function of three intervals of degree days. In 2002, after almost ten years, the Regional Energy Agency of Liguria has developed guidelines for energy efficiency in the Italian hospital system. The study is a reference for urban planners and managers of technical services of the local health and hospitals (ARE Liguria 2002, 24-28). This study proposes a survey to collect data of energy consumption, both electrical and thermal, comparing data of the Ligurian structures with those of the hospital system of the German region of Nordrhein-Westphalen. This comparison shows that German hospitals present higher thermal consumption of the Ligurian structures but lower energy consumption. This result is due to climatic differences. In the European panorama the study of CADDET (Center for Analysis and Dissemination of demonstrated Energy Technologies) "Saving Energy with Energy Efficiency in Hospitals" of 1997 shows the electrical and thermal consumption for Italy and nine other EU Member States (Caddet 1997, 8); in 2002, the European research project PROST "Public Procurement of Energy Saving Technologies in Europe" identifies both the total specific consumption of electrical energy and divided by end-use (Pindar and Papetti 2002, 23-24).

\textsuperscript{3} The thermal energy is required for the heating of rooms, for the production of domestic hot water, for sterilization, for laundry and kitchen facilities. The electrical energy is used for summer air conditioning of the rooms, for the illumination (internal and external), for air treatment, for the power supply of medical equipment, diagnostic and monitoring, for the preservation and for the operation computer systems and security.
It is provided below an overview of the identified indexes\(^4\) (Table 1).

It should be noted that the above studies are quite outdated and do not consider some important factors such as:

- the latitude (this includes climatic conditions and geographic location). In fact, if the structures of the northern areas recorded higher consumption for heating in winter, the structures of the southern record higher electrical consumption for summer air-conditioning systems;
- the period of construction. Over the years, in fact, more restrictive rules concerning energy consumption have been introduce that have influenced the techniques and the materials used for building spatial and distributional aspects.

This study aims to confirm the update of benchmark indexes for the hospital buildings.

\(^4\) The ENEA values have been converted from Gcal to KWh whereas 1 cal = 1,1622x10^-3 Wh
Methodology

For these reasons, this research proposes a methodology to analyze consumptions of hospitals in the town of Naples in order to neglect the effect of climatic conditions. The choice has fallen on five buildings located in the same city. Conversely the buildings differ significantly in size, features and year of construction. For each building, the following data were collected: heating and electricity consumption; dimensional parameters such as floor area, total area of the floor, the gross volume, average height, surface and ground density; functional parameters such as the number of beds and committed professionals. The values are given in Table 2.

### Tab. 2

<table>
<thead>
<tr>
<th>State</th>
<th>KWh/m² for year</th>
<th>MWh/posti letto for year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Heat energy</td>
<td>Electricity</td>
</tr>
<tr>
<td>Italy</td>
<td>174 - 209 (GG&lt;1000)</td>
<td>50 - 70</td>
</tr>
<tr>
<td>Australia</td>
<td>240</td>
<td>180</td>
</tr>
<tr>
<td>Canada</td>
<td>625</td>
<td>340</td>
</tr>
<tr>
<td>Holland</td>
<td>340</td>
<td>90</td>
</tr>
<tr>
<td>Belgium</td>
<td>260</td>
<td>90</td>
</tr>
<tr>
<td>Sweden</td>
<td>170</td>
<td>100</td>
</tr>
<tr>
<td>Switzerland</td>
<td>190</td>
<td>60</td>
</tr>
<tr>
<td>Germany</td>
<td>300</td>
<td>110</td>
</tr>
<tr>
<td>England</td>
<td>500</td>
<td>105</td>
</tr>
<tr>
<td>USA</td>
<td>690</td>
<td>230</td>
</tr>
<tr>
<td>Italy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liguria</td>
<td>297</td>
<td>116</td>
</tr>
<tr>
<td>Germany</td>
<td>300</td>
<td>70</td>
</tr>
</tbody>
</table>

The gas consumption values have been converted in KWh. They have been used conversion values of ENI, 1 cubic meter of Gas = 10,5 KWh
A correlation analysis has been applied to the collected set of data and results for both electricity and gas consumption are provided respectively in table 3 and 4. This analysis has supported the subsequent comparison between the indicators of reference provided by the literature and the collected data on the sample's energy consumptions. Following is a comparison was made between the reference indices detected in the literature with specific consumption resulting from the survey sample.

**Results and discussion**

Observing table 3, the strong positive correlation between the three indexes of benchmark proves that they can be mutually used. The most interesting result is that all the three indexes are significantly negatively correlated to four out of six variables referring to the hospital buildings characteristics, this means that bigger structures are more efficient than the smaller. Very different results have been found for the gas consumption. As table 4 shows, indeed, the two indicators gas/floor area and gas/volume do not strongly correlate with any variable referred to the physical structure of hospitals, but both of them are strongly negatively correlated to DI, which means that an increase in the hospital building compactness significantly decreases its gas consumption. One more interesting finding regards the relationship between the three indexes of benchmark used in the literature: gas/floor area and gas/volume are so highly correlated that can be considered equivalent, while the third index, gas/beds, is negatively and weakly correlated to both of them.

<table>
<thead>
<tr>
<th>San Giovanni Bosco</th>
<th>10120</th>
<th>19110</th>
<th>66885</th>
<th>12</th>
<th>33462</th>
<th>0.57</th>
<th>202</th>
<th>292</th>
<th>3,13 x10^6</th>
<th>280.379</th>
<th>2,94 x10^6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pascale</td>
<td>6773</td>
<td>37165</td>
<td>143482</td>
<td>28</td>
<td>55600</td>
<td>0.67</td>
<td>232</td>
<td>766</td>
<td>6,62 x10^6</td>
<td>836.919</td>
<td>8,78 x10^6</td>
</tr>
<tr>
<td>Clinica mediterranea</td>
<td>1871</td>
<td>17794</td>
<td>53381</td>
<td>20</td>
<td>4081</td>
<td>4.36</td>
<td>180</td>
<td>400</td>
<td>3,59 x10^6</td>
<td>9.214</td>
<td>96,74 x10^3</td>
</tr>
</tbody>
</table>

Tab. 3

<table>
<thead>
<tr>
<th></th>
<th>Floor area</th>
<th>Total area of the floor</th>
<th>Gross volume</th>
<th>Average height</th>
<th>Ground surface</th>
<th>Ground density</th>
<th>Beds</th>
<th>Operators engaged</th>
<th>Elett./floor area</th>
<th>Elett./gross volume</th>
<th>Elett./beds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor area</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total area of the floor</td>
<td>0.98</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross volume</td>
<td>0.98</td>
<td>1.00</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average height</td>
<td>-0.62</td>
<td>-0.50</td>
<td>-0.51</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground surface</td>
<td>0.99</td>
<td>0.99</td>
<td>1.00</td>
<td>-0.50</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground density</td>
<td>-0.45</td>
<td>-0.35</td>
<td>-0.36</td>
<td>0.24</td>
<td>-0.43</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beds</td>
<td>0.98</td>
<td>0.99</td>
<td>0.99</td>
<td>-0.61</td>
<td>0.98</td>
<td>-0.34</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operators engaged</td>
<td>0.96</td>
<td>0.99</td>
<td>0.99</td>
<td>-0.56</td>
<td>0.97</td>
<td>-0.35</td>
<td>0.99</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elett./floor area</td>
<td>-0.98</td>
<td>-0.94</td>
<td>-0.94</td>
<td>0.57</td>
<td>-0.96</td>
<td>0.55</td>
<td>-0.92</td>
<td>-0.90</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elett/gross volume</td>
<td>-0.90</td>
<td>-0.85</td>
<td>-0.86</td>
<td>0.52</td>
<td>-0.89</td>
<td>0.79</td>
<td>-0.85</td>
<td>-0.85</td>
<td>0.92</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Elett/beds</td>
<td>-0.92</td>
<td>-0.92</td>
<td>-0.93</td>
<td>0.61</td>
<td>-0.92</td>
<td>0.52</td>
<td>-0.94</td>
<td>-0.96</td>
<td>0.85</td>
<td>0.91</td>
<td>1.00</td>
</tr>
</tbody>
</table>
The following graphs show a lack of homogeneity between the values proposed by the literature consulted: the values of both thermal and electrical energy indexes related to beds and to the surface increase according to the year in the same study (Figure 1 and Figure 2). So it is not possible to refer to values deduced from studies conducted more than ten years ago. In fact, the buildings have increased consumption due to the large diagnostic machines and air handling units. If we refer to the values proposed by ARE Liguria, we find that the thermal consumption indexes are much higher than those of electricity consumption. The reason is that the case study used for the processing of indexes, is exclusively composed by health facilities in the Liguria Region where the need for heating is strong.

These values are in conflict with the specific consumption of the study buildings where the specific electrical consumption are very similar to the thermal. This result is due to necessity of cooling of the regions of southern Italy.

Also the specific consumption of the structures examined are distant: hospitals are different from each other in terms of size, employment and building technologies. The buildings selected, in fact, have been constructed between 1900 and 1960. In these six decades, building systems included exclusively the use of tufo stone, with systems that included a mixed of tufo stone and reinforced concrete up to the latest frame structures of reinforced concrete.
Conclusions

As previously mentioned, this research aims to evaluate the effectiveness of benchmark indexes for hospitals consumptions currently used. It is necessary to revise or update the indexes or create new indexes. In fact, beds, area or volume are good benchmark but, for the calculation of new indexes, it is essential to have a set of geometric data consisting of information on the structure (as evidenced by the strong correlation between the gas/m2 or gas/m3 consumption and land density). A another relevant information is represented by the type of building and construction and the year of construction (as shown in the comparison between the report and the specific consumption indexes of the sample). On the basis of this information of a large number of structures, it is possible to create organized classes for significant construction types and, for each of them, it is possible to create at least six sub-classes as climatic zones identified under Presidential Decree N. 412 of 1993 (Gargiulo, Pinto and Zucaro 2013, 359). Unfortunately disaggregated consumption data are difficult to find, because there is little interest in the problem of energy consumption by the leadership of the health institutions and there is a scarcity of the dissemination. To confirm this, there is an attempt supported by ENEA in 2010 to create new consumer benchmark indexes. It has launched an information campaign to the presidents of the various Italian Regions. He submitted a questionnaire on energy consumption and on the building type of health buildings. The confirmation came only from 7 regions that have sent only 50 questionnaires compared with 654 public health facilities (Belcastro, Di Santo and Fasano 2010, 10-13).

References


Introduction

In the last decades, the necessity of employing tools to evaluate the sustainability of urban areas, in all its forms, has encouraged the spread of a new kind of instruments, called Neighborhood Sustainable Assessment tools (NSA tools). Such tools can be considered as analysis procedures able to lead the decision-making process, from the design to building phase of a new urban settlement. The majority of NSA tools, produced mostly by non-governmental bodies, has been developed as spin-off, whose methodology derives from sustainable assessment tools at building scale. Furthermore, from the literature review (Sharifi and Murayama 2012; Orova and Reith 2013) it arises that their spread has also been favored by the need for NSA tools, coming from different urban cultures, to drive urban transformation processes according to their own territorial peculiarities. At international level, one of the most known NSA tools is LEED ND (Leadership in Energy and Environmental Design for Neighborhood Development), developed in 2009 by the US Green Building Council (US GBC). In Europe, one of the most widely used tools is BREEAM Communities (Building Research Establishment Environmental Assessment Methodology Communities), released in 2009 by the Building Research Establishment (BRE). In Italy, one of most successful one is GBC Quartieri, created in 2015 by the GBC Italia and inspired to LEED ND (GBC Italia 2015). Considering the vast number of instruments and their increased spread, it seems to be necessary to verify, with a scientific approach, which are the strategies pursued by each tool and how their choice may affect the planning of a new urban area. Many studies have dealt with NSA tools with a scientific approach (Orova and Reith 2013; Sharifi and Murayama 2013), but only a few of them have taken into consideration the outcome of the assessments on a large number of certified projects. Taking into account their impacts on the layout and the organization of urban settlements, it is fundamental that NSA tools be designed to pursue all the objectives concerning the urban life. Therefore, such instruments should primarily take account of people and activities as well as the space and territory, without neglecting any of the elements affecting the urban environmental quality. Therefore, among several NSA tools, it has been analyzed LEED ND, because it states, in a decisive manner, that its main purpose is the sustainability of new urban areas. The aim of this paper is to understand whether and how such instrument is able to help a new settlement turning into a more sustainable area, as well as considering the needs of the society of the future (Salvati et al. 2013; Zyngier, Pensa and Masala 2014; Gargiulo and Dispoto 2015). This paper is divided into three paragraphs. The first describes the method adopted for analyzing the tool; the second presents the main findings derived from the analysis of the
certified projects; finally, the third proposes future developments of the study and their potential applications.

6 We refer to plans that have achieved a "LEED ND Plan version 2009" certification, i.e. inbuilt settlements with an approved and certified plan.
Methodology

In light of the abovementioned considerations, a unitary methodology of analysis has been developed. It has been organized into a four-phase process:

1. Analysis of LEED ND’s structure;
2. Recognition of categories and macro-categories;
3. Organization of LEED ND’s indicators into macro-categories;
4. Development of a ternary diagram of LEED ND’s indicators;
5. Analysis of LEED ND certified case studies through the ternary diagram.

The first phase showed that LEED ND’s structure consists of criteria, indicators and points. Each of the 41 indicators correspond to different criteria (Smart Location & Linkage, Neighborhood Pattern & Design, Green Infrastructure & Buildings) and each indicator counts an amount of points, for a maximum score of 100 points. Besides, 10 more independent points are available, referring to Regional Priorities, Innovation & Design Process, which have not been considered in this study (US Green Building Council 2014). The second phase focused on the analysis of many studies on NSA tools. Such studies aimed at compare NSA tools to each other, through the development of categories where indicators should be organized. In light of the issues emerged from literature, some brand new categories have been developed in order to classify each LEED ND’s indicator. This step has given a synthetic overview of LEED’s main priorities. After that, the categories have been synthetized into three macro-categories, which may be considered the key criteria of environmental quality and sustainability of urban areas. The assignment criterion used to organize indicators has derived from the definitions provided for the macro-categories:

- Accessibility: integration between governance of urban transformation and mobility, with the aim to enhance the ability of places to be reached and guarantee safe and easy transportations, both public and private;
- Community: improvement of quality of life, both in the sense of social integration and in that of safety and psycho-perceptual wellbeing, strictly related to urban quality and environmental protection;
- Sustainable Development: linkage between urban layout and resources saving, both renewable and non renewable (e.g. water and soil).

In the third phase, LEED ND’s indicators were collected in the macro-category. Table 1 shows the amount of indicators collected in each category and its rate. The quantity and rate of the maximum score achievable for each category provides a framework of their relevance over the total, as well as the max score/indicator-rate-ratio shows the relevance of each indicator.

<table>
<thead>
<tr>
<th>Categories</th>
<th>Indicators</th>
<th>Indicators rate</th>
<th>Max scores</th>
<th>Max scores rate</th>
<th>Max scores/indicators rate ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessibility</td>
<td>6</td>
<td>14,6 %</td>
<td>25</td>
<td>25 %</td>
<td>1,6</td>
</tr>
<tr>
<td>Community</td>
<td>17</td>
<td>41,4 %</td>
<td>27</td>
<td>27 %</td>
<td>0,7</td>
</tr>
<tr>
<td>Sustainable Development</td>
<td>18</td>
<td>43,9 %</td>
<td>48</td>
<td>48 %</td>
<td>1,1</td>
</tr>
</tbody>
</table>

Tab. 1. Distribution of the maximum LEED ND scores for each of the macro-categories.
During the fourth phase, a ternary diagram of LEED ND maximum achievable points was developed. Each vertex of the triangle corresponds to one macro-category (Figure 1).

During the fourth phase, a ternary diagram of LEED ND maximum achievable points was developed. Each vertex of the triangle corresponds to one macro-category (Figure 1).

The fifth phase focused on the analysis of LEED ND's certified projects. Data made available by US GBC regarding successful LEED ND certified plans, has been collected and organized. Starting from 44 projects’ scorecards (i.e. forms filled by GBC reporting scores achieved for each indicator by certified projects), each point is been classified according to the macro-categories proposed above. Lastly, the fourth phase has been dedicated to develop a graphic and synthetic representation of results through a ternary diagram, whose vertex are represented by the three macro-categories. The diagram has been divided into 7 areas\(^7\), in order to organize projects and understand the relevant issues of each one (Figure 1). They are:

- Area 1: Community;
- Area 2: Accessibility;
- Area 3: Sustainable Development;
- Area 4: Responsible Community;
- Area 5: Mobility Oriented Urban Development;
- Area 6: Inclusive Mobility;
- Area 7: Balance Area.

\(^7\) Areas 1, 2, 3 and 7 represent equilateral triangles and their surface is defined by the following integral:

\[
A = 2 \int_{0}^{a} mx \, dx
\]

where:
- \(m\) is the slope of the function to be integrated, equal to \(\sqrt{3}\);
- \([0,a]\) are the bounds of the interval in which the integral is defined and \(a\) is equal to 20 per cent.
Results and discussion

The evaluation method proposed for LEED ND, based on the distribution of indicators into three macro-categories, enables to make some final significant comments on this tool. If we analyze the amount of indicators for each macro-category (Table 1), we find that Sustainable Development has the highest value (43.9 per cent); Community follows (41.4 per cent) and Accessibility lags behind (14.6 per cent). If we compare the indicators rate with the scores rate, we deduce that Sustainable Development weights even more, with an incidence of almost a half of the available points (48 per cent); instead, Community reduces its incidence (only 27 per cent) and Accessibility gains ground (25 per cent). In other words, Accessibility has the highest Max scores/indicators rate ratio (1.6 points/indicator). This result shows that, though LEED ND is particularly orientated to Sustainable Development, Accessibility represents an important aspect as well. As regards the ternary diagram of LEED ND maximum score achievable, Figure 1 clearly shows once again that LEED’s indicators and scores are not balanced, quite the opposite: even if the central point lies in the Balance Area, it is still strongly oriented to Sustainable Development. From the analysis of the ternary diagram of the certified projects, a different framework emerges (Figure 2). Though the majority of LEED ND’s projects is in the Balance Area and tends to Sustainable Development, they are more located in the center. Indeed, if we analyze the average value of points achieved by the certified projects, still Sustainable Developments has the highest incidence (41 per cent), but it is lower than the results registered for the maximum achievable points (Figure 1). Therefore, LEED ND’s projects reveal more balanced results, i.e. they pay more attention to Accessibility and Community (29.6 per cent and 29.4 respectively)(see Figure 2). Finally, it is noticeable the presence of some projects in the intermediate areas (Area 4 and Area 5) termed Responsible Communities and Mobility Oriented Urban Development. These areas identify unbalanced projects, respectively being in the middle of Sustainable Development and Community (Area 4) and Sustainability and Accessibility (Area 5).
Conclusions

The aim of this study is to investigate how LEED-ND may guide urban transformations and support new urban developments, which meet all the needs of the involved communities. To date, most of research studies about such topic have analyzed the NSA tools’ structure in order to compare them and examine their strategies (Yoon and Park 2015). Instead, little attention has been paid to the evaluation of the certified projects in the scientific literature. Such evaluation allows to make some further observations about conceptual framework, implementations and results of such instruments. Therefore, this study proposes to compare the results of both analysis by studying, on the one hand, indicators by LEED-ND and, on the other hand, scores recorded by 44 certified projects. Through the articulation of indicators in three macro-categories – Accessibility, Community and Sustainable Development – LEED-ND has been analyzed both qualitatively and quantitatively. These findings have been illustrated through two ternary diagrams. Observing the diagram of LEED ND maximum score achievable, it has emerged that the tool is mainly oriented, to ensure sustainability in the development of urban transformations. On the other hand, the diagram obtained applying the same methods to the certified projects’ scores illustrates a different situation. The evaluation of the certified projects shows that they tend to satisfy not only sustainable development but also the other two aspects: Accessibility and Communities. At this early stage, comparing the projects’ and LEED ND maximum scores’ positions in the diagrams, it appears that, though the tool is oriented to mainly evaluate Sustainable Development, the contents of the projects have revealed to be more balanced, by virtue of the value they assign to each macro-category and, above all, of their quality (Figure 1 and 2). To sum up, it might be said that administrators, urban planners and local communities which have contributed to the development of certified projects, have far more awareness than the LEED ND’s technicians themselves, since they managed to produce, despite these indicators, projects more careful to all the three macro-categories. Future developments of this research may be addressed to apply the same procedure to other instruments. In this sense, it would be worthwhile to compare the tools and the evaluations of their applications on urban layouts of new settlements through the certified projects.

References


DIPENDE – a tool for energy planning of building districts based on energy performance certification data

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Key-words: Building, Energy planning, data visualization, monitoring and assessment.

Introduction

Low-carbon and energy efficiency targets in the building sector still require relevant information and training efforts for decision makers to establish long term strategies. Big-data creation taking advantage of the contribution of the stakeholders, who are both final users and main policy implementers, is worldwide assumed as a priority.

In Italy databases are already being used for the registration and quality control of energy performance certification (EPC) and inspections of heating/air-conditioning (HAC) systems, but have an untapped potential for wider use.

Within an European project, ENEA has recently developed a system architecture model, based on an integrated dataset combing estimated building performance data with bottom-up information on recent energy services and products installations and housing status, which can be used as a tool to support decision making at regional and municipal level. To date, such model, named DIPENDE - Database integrato per la Pianificazione ENergetica dei Distretti Edilizi, has been delivered and implemented for Lombardy region only, but the prospective for wider applications is enabled by the present legislative context. The aim is to facilitate analysis and visualization of the energy performance of the building stock: for public authorities, to enhance control, monitoring, planning and, for private actors, to establish marketing and business strategies.

The paper shows the methodology, outputs and possible applications of DIPENDE.
Methodology

Databases of Energy Performance Certificates (EPC) have the potential for much wider usage, and some examples already exist in Europe: Ireland, United Kingdom, Lithuania, France, and Hungary. In some cases calculated data are combined to real measured ones (Sweden, Netherlands), in others the EPC database is used to establish renovation strategies (i.e. Austria). In Portugal the analysis of EPC data was used to establish new minimum standards for buildings (whole building, lighting, and building envelop systems and technical elements) and voluntary labels (i.e. for windows). (1)

The Italian Lombardy region has the only totally public EPC open database (2) in Europe. Moreover these data are combined with the regional cadastre of building technical heating systems (3) and the ground source heat pumps cadastre into a wider information system for energy and environment (4). This system feeds and updates the regional energy balance and the regional emission monitoring system and was used to draft the Regional Energy and Environmental Plan. Nevertheless consistency of the certified building sample, combination with socio-economic territorial data and information of actual progress due to retrofit interventions are missing in the system.

Within the REQUEST2ACTION project, Removing barriers to low carbon retrofit by improving access to data and insight of the benefits to key market actors, starting from this leading experience, ENEA elaborated and integrated data from the EPC pen database. Cross referencing with other datasets was developed so allowing further analyses: for example, , establishing consistency and relationship between performance/EPC issued and ownership and occupation, building stock age and typology, population/household density, geographic/climatic issues, technical building plants and elements replacement/retrofit, identifying erroneous records.

Notably, bringing EPC information up-to-date with unregistered performance levels variations can be inferred by overlaying bottom-up installation data coming from 65% tax deduction scheme inventory managed by ENEA. (5)

The integrated database is made of social, territorial, building and building components data, energy and energy service data, as set in the figure below:

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**Fig. 1. DIPENDE – the integrated database model architecture.**
Records are aggregated at urban level. The database covers more than 1500 municipalities in Lombardy region, includes more than 60 fields for each record and amounts to nearly 100,000 data.

The fundamental assumptions at the basis of the DIPENDE model were:

- to allow analysis at municipal, district, regional level
- to provide targeted support to both public and private decision makers by easy-to-interpret analysis outputs (tables, graphs, GIS)
- to enable replication and wider use on the national territory

**Analysis:**

The following requirements have been taken into account in the DIPENDE design:

- The harmonisation of regional cadastres to the new national EPC
- Interoperability of different datasets and the possibility to stock, monitor and analyze data from all of them
- Analysis standardization and setting up relevant queries for stakeholders group
- Selection of a list of common indicators that can be relevant for comparison of different territorial contexts
- Definition of easy-to-understand output formats.

The analysis process is shown in figure 2 below:

![Fig. 2. DIPENDE – analysis process.](image)

Future users' feedback was supplied from the pilot region authority through several contacts and meetings. IlSpa, Lombardy in-house company, acting as local energy agency and manager of the regional energy datasets, provided support to the analysis of their EPC open-data and helped in customizing the tool. IRE Liguria energy agency was also consulted and reaction from a wider stakeholders' audience was sought.

**Targeted support and visualisation:**

The DIPENDE tool will be soon available on an ENEA Hub for Energy efficiency of Existing Buildings (7). The outputs will be visualised as tables, graphs and geo-referenced maps illustrating standardized or free queries, depending on user's rights.

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8 Presentation of DIPENDE at the Workshop Metodologie e strumenti a supporto della pianificazione energetica locale ("Support to local energy planning"), Turin 19th April 2016 organised by LAME, http://www.politocomunica.polito.it/events/appuntamenti/(idnews)/7595
Further repeatability of the model is guaranteed by the reference to the new harmonized EPC scheme, by selecting indicators available in all the regions and by the use of available resources (65% tax deduction scheme data managed by ENEA, national Census and open data). It is also facilitated by the current legislation 9.

9 DM 26.06.2015, Adaptation National guidelines for Energy Performance Certification in the framework of EPBD implementation. Beyond EPC harmonisation, this decree assigned ENEA the role of developing a national information system (SIAPE) and to assist regions to analyse/manage their main energy building related registers. The upcoming SIAPE (collecting EPC data from all the Italian regions), guarantees the interoperability of existing regional systems and links between other databases (TBS, cadastre) to create a Business Intelligence in the near future. It will allow statistical analysis in an Open Data format (according to law 134/2012).
Results and discussion

The major content of the paper in this section will deal with:

**Benefits and barriers:**

- The benefits of, and barriers to, combining various building-related databases (value / cost-justification / privacy) with reference to the delivered DIPENDE tool and to other experiences from Request2Action partner countries.
- Data quality / validity / consistency / primacy

**Application:**

- From Public Authorities: identification and localisation of intervention priorities and saving potential (i.e. visualisation of areas where certification/retrofit promotion campaigns are needed), building stock characterisation and energy performance benchmarking for the development/monitoring of policies (within Municipal Sustainable Energy and Environment Plans within the Covenant of Mayors initiative, Regional Energy and Environment Plans)
- From private actors (service providers, investors, associations of trades): identification of business opportunities, investment programmes and market strategies (i.e. visualisation of the relationship between temporary houses and penetration of individual cooling/heating equipment)

**Predicted impact:**

- Actions/policies defined by using the database (i.e. to support implementing regional/national decrees transposing EU legislation such as EPBD, EED, Ecodesign and Ecolabelling)
- Improvement of governance and coordinated actions by linking the local, regional and national levels
- Recommendations and advances on how to deal with incomplete or unreliable energy and building information and solutions for filling the gaps
- Stakeholder involvement: the model could be enriched by further feedback and data from the private sector (trades company, ESCOs, cooperatives, banks, DSO, property associations, consumers).

**Conclusions**

EPC data have a high usability potential in aggregated forms rather than in raw format. Meaningful analyses are feasible if EPC data are combined with other datasets and if subsequent modelling is undertaken.

Barriers to wider application are:

- consistency and quality of data
- system interoperability
- accessibility and easy-to-interpret data
- financial and human resources and skills.

The DIPENDE tool provides:

- Cleaning and processing services and creation of easier-to-interpret categories
- Elimination of systematic errors
- Key indicators and user-friendly standard output formats
- Integration with other datasets for added-value analyses
On-purpose customised paying services to relevant key private actors after consent of the regional authorities providing data. (8)

Moreover the new regulatory framework in the energy and building sector can endorse the replication of this prototype and extension to the national level, to help achieve policy targets and implement EPBD (Energy Performance of Building Directive art.10 “definition of support measures”) and EED (Energy Efficiency Directive art.4 “building renovation strategy”). Integration with other database (product databases, materials databases, renewable energy/district heating databases, other financial schemes) would be possible in collaboration with local authorities and other stakeholders. Further opportunities could arise from possible development of like real-time prospects (i.e. intelligent monitoring and metering).

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References

Energy Efficiency and Participation: a double smart approach in LEO project

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Key-words: Energy efficiency, living lab, Public Administration, Involvement.

Introduction

The LEO project (Living Lab for Energy Optimization), funded by Regione Piemonte, belongs to those actions devoted to improve energy efficiency by means of an innovation in the way the energy is used and handled, keeping the level of investments contained and financially sustainable for Public Administrations. Furthermore, by means of the involvement of citizens through the Living Lab approach, it aims to increase awareness and ecological consciousness in the inhabitants. LEO combines the use of technological devices to simplify the energy management together with the social approach to get people involved in this initiative proposed by public offices. New and open technologies can help administrations to have a smarter energy management and save public resources, but they also can contribute in spreading a greener attitude between citizens. It is widely recognized that change is much more effective if it moves bottom-up.
Methodology

The project assesses the effects of an ICT platform (open and based on standard technologies) which monitors indoor and outdoor energy consumption of a middle sized suburban city. The City of Collegno, 50,000 inhabitants in Turin conurbation, has been a laboratory for smart energy management since 2014, when -in partnership with ISMB Istituto Superiore Mario Boella- it joined the AURORA Project on public lighting ("Risparmio energetico a Collegno" 2014).

Technological aspects

Public Lighting is the most expensive voice in the energy budget of a municipality: AURORA proposed the installation of a device to control the switching on - off of lighting systems. The single lighting lines are remotely controlled and directed according to an astronomical clock coupled with a centralized lighting sensor as a backup system for managing timing anomalies (e.g. summer time rainstorm which needs the light to be on also in the middle of the day): this ensures no energy waste neither light shortage. The power used is continuously measured and the irregularities on the line are reported.

Project LEO aimed to integrate the AURORA lighting control: indeed, if with the astronomical calendar the potential saving can reach values around 10-15%, an additional 30-40% savings can be reached by controlling the over voltage conditions during night time.

In addition to the outdoor experimentation, LEO also aimed to build an indoor living lab for energy reduction. Heating is indeed the second largest shares of Municipalities spending and, by addressing this vector, the project assumes a broader relevance. This parallel experimentation was based on the evolution of the VIRTUS IoT middleware developed by ISMB. It allows to interconnect sensors and actuators to monitoring presence, humidity and temperature and react to those measure with a room by room heating control.

Finally, thanks to the wireless communication infrastructure set in place with this experimentation, LEO was also able to collect and elaborate environmental data in specific and sensitive positions in Collegno.

An important step was to select the most promising buildings where to create the living lab, goal of this experimentation. How and where to operate in the town territory was decided together with Collegno energy managers, in order to ensure the city the highest benefit return from the project. On the one side, indoor temperature probes and repeaters were installed in Anna Frank Public High School and in the Fourth Pavilion, where a Museum and spare rooms used by local association are hosted. On the other side, outdoor flow limiting devices on streetlights have been installed choosing 3 sites in the city, and connected with the backend ICT infrastructure offered by ISMB with the AURORA system through a series of gateways.

Figure 1 shows the overall system architecture that LEO has set in place for the living lab experimentation in Collegno. The core of the system is AURORA, a cloud system able to collect an heterogeneous set of measurements. A middleware called VIRTUS is managing all the necessary issues in the communication protocol to make completely transparent to AURORA details such as the kind of sensors, the manufacture brand, the frequency of the data collection or other non-relevant parameters to the purpose of the real measurement. Once enough data has been collected, AURORA elaborates the best set points for the actuators for optimizing the system, acting on the lighting timing control and the correct temperature room by room respectively.
A specific connection between the AURORA cloud system and the Piedmont Smart Data Platform (SDP) was also one of the crucial output of the LEO project. The SDP main goal is to create an open box to collect data from the local public authorities and when possible make them available as open data.

**Citizens involvement**

In addition to providing the Municipality with new devices for monitoring and gathering data, LEO also tries to involve population encouraging a responsible approach to energy as a common resource: the first step of this long pathway is to make public consumptions easier to understand.

The choice of monitoring a school among all the public buildings is supported by the fact that new generations are the favorite target for participation projects. Furthermore, mobile phones are the teenagers’ most used devices: that’s why the app for mobile seems to be the best tool to increase interest and interaction on energy optimization.

The LEO app is meant for every citizen who wants to have a role in a more efficient, transparent, and smart community, interacting directly with the local officers. Of course the most interested target will be:

- users of public buildings monitored by LEO
- users of public spaces with street lights monitored by LEO and AURORA
- maintenance workers
- energy managers

As a first attempt, the app has been designed for students and teachers, to allow an easy access to local environmental data and start a discussion over environment-friendly behaviors.

The availability of real time data concerning their school can offer to students and researchers a real living lab, in which personal choices have concrete effects (i.e. monitoring temperature, consumption and heating regulation in the classroom). Therefore teachers can involve their pupils in taking control of the energy consumptions: through educational activities, a new generation will grow up caring for common resources and the quality of public realm.

The app, which collects and provides open data, is organized in 3 sections:
• Heating, in public buildings where sensors are active: temperature in each room, monthly trend;
• Lighting: energy consumption for each public lighting line, data about the system hardware (e.g. lumen provided, led/non led bulbs, last upkeep.)
• Environment: air quality indicators, with alert when the limit value is exceeded.

In addition, the app opens a direct communication channel for citizens with the city officers, to ask, congratulate or communicate malfunctions typing a message on their personal device. All the messages (and the answers) can be visualized in chronological order by all users: that will help to avoid the doubling and repetition of a same alert.

In addition to the app, LEO proposed the smart visualization of information that are normally very technical and hard to understand for non-experts, through an Interactive Visualization Tool (InViTo) developed by SiTi (Masala and Pensa, 2016; Pensa et al 2016; Pensa et al, forthcoming) and accessible on the web.

Results and discussion

Consumptions reduction

By the technical side, the installation of voltage regulation and lines flow solutions implied a reduction of about 31% in the energy consumed in the two lines where those systems where installed. The annual energy consumption for these two lines without regulation was about 1.42MVAh while LEO was able to measure a reduction to 0.98MVAh with the voltage regulation controlled by AURORA.

For indoor monitoring, AURORA implemented a system to react temperature information by controlling the heating elements (room by room) so to assure an average comfort level set to 20 degrees.

Fig. 2. Example of monitored temperature reports the monitored temperature in the Anna Frank school without the LEO control. It is possible to notice how the average temperature is considerably above the 20-degree value with a corresponding 30% (7% for each Celsius degree) of energy wasted for overheating that particular classroom.

Fig. 2. Example of monitored temperature.
Generally, the heating monitoring, though it lasted for a shorter time than needed, showed
overheat in classrooms (+2.5 °C average) and 22% of possible economy of thermal energy. The
investment for technical implementation could be paid back in 2 years.

**App for mobile and user friendly visualization of data**

The LEO app for mobile is available in a Beta version, not yet published in any mobile market,
because the test phase is still not completed.

In test phase, the first selected audience are adults avowedly sensible to resource optimization: a
limited number of people called to a constructive exchange in order to calibrate the application
according to the needs of citizens. These actors have been previously identified among the
environmental committee of Collegno, the technical staff managing the city facilities,
representatives of the Anne Frank School.

Aside from the app, SiTI developed two webpages\(^\text{10}\) where people can freely check, select and get
a smart visualization of a sample of environmental data collected during the project.

\(^\text{10}\) http://130.192.92.243:8000/~invito/?project=leo2\ and \http://130.192.92.243:8000/~invito/?project=leo-living-lab-
for-energy-optimization
Fig. 4. A intuitive visualization of NO data (per hour) e PM10 (per day).

By this kind of interactive visualization, LEO aims to get the consumption data easily usable by citizens, in order to increase awareness.

Conclusions

For an effective success of this kind of initiatives the very limited duration is a real obstacle. LEO started in November 2014 and ended in July 2015: too small time for a complete check of heating system at operating speed all over the year. Even if the indoor living labs were able to collect a only limited set of data, due to timing of sensors installation and accidental technical problems, they showed interesting potential savings due to voltage regulation and lines flow solutions: anyway, without real investments, the experimentation has limited effects.

About the participation initiative, the LEO app is now available in a Beta version, but not published in any mobile market due to the sensibility of the data which can be displayed. Actually, even in Collegno, the direct flow of data collected to open source infrastructures is impeded by technical and political difficulties.

The lack of open real time data weakens the entire involvement process and cut down the usability of the app and website. Indeed, the results of LEO were not yet widely spread among the population, so that the inclusion process is still in a hesitant launch phase.

Despite of the mentioned weaknesses, LEO project mixes in an original way the technical improvement of innovative control devices and the cultural education to approach energy consumption. It represents a pioneering experience in Piedmont, that proposes a new approach for Public Administrations.
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Identify the sustainable level of local plans and urban sectors. Proposal for an operational procedure

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Key-words: Operative planning, Near Zero Neighborhoods, Sustainability, Indicators, Labelling.

Introduction

The city is the man-made structure with the largest consumption of energy. To achieve more sustainable levels of resource's use and to reduce its environmental impact, it needs to transform its way of working. For this purpose, it is necessary to act on the urban structure by ensuring that the resources necessary for its running, and for the same functional level, are less and less.

To achieve the outcome we can act on the existing urban structure, improving the functioning, or on that to be planned ones, if an action of urban transformation is expected. In the latter case, it is necessary to build a plan containing elements of sustainability that, once implemented, will enable the direct achievement of the default aims.

The paper wants to deepen the measurement of the effects of plans aiming to create urban areas with neutral consumption or Near Zero Neighborhoods (NZN). It is appropriate, in this regard, to define the most appropriate planning level to apply these innovative procedures. Even if the spatial dimension to be used may vary from case to case, it is possible to assume the neighbourhood/urban sector scale as the best scale, thanks to its basic features, namely the limited extension and the immediate possibility to transform the indications of plan in physical and functional elements.
Methodology

The proposed methodology is closely operational. The paper presents the structure and the phases which compose it. We refer to a subsequent deepening the application testing. At the basis of the methodology is the identification of areas of action that structure the operational plan and, at the same time, allow to evaluate and certify it. The paper refers only to this second point.

First, the areas of action on which it is appropriate to build the procedure are identified. These sectors must be transformed into measurable design elements. Next, for each sector, the most appropriate indicators to measure them and the national and international reference standards are identified. The last step is to develop a procedure to assign to the case study a level of sustainability within a predetermined scale.

The success of the method is largely based on the identification of a system of quantitative and qualitative indicator able to lead to a clear and shared assessment. The expression of this assessment is based on the definition values’ classes of the indicators aimed at identifying the level of sustainability that, in turn, is considered as a combination of vulnerability and resilience criteria (Mazzeo, 2014a, 2014b, Galderisi et al, 2016).

The certification system can be applied either to a local plan or an urban neighbourhood. The areas of action are reported in Table 1. Each area is associated with one or two codes: the LP code indicates the use of the same in the local plan certification, while the N code indicates the use in the neighbourhood certification.

### Tab. 1. Areas of action and their use.

<table>
<thead>
<tr>
<th>Areas of action</th>
<th>Use for local planning</th>
<th>Use for neighbourhood</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1 – land use</td>
<td>LP</td>
<td>N</td>
</tr>
<tr>
<td>A2 – urban form</td>
<td>LP</td>
<td>N</td>
</tr>
<tr>
<td>A3 – urban green</td>
<td>LP</td>
<td>N</td>
</tr>
<tr>
<td>A4 – buildings</td>
<td>LP</td>
<td>N</td>
</tr>
<tr>
<td>B1 – energy and climate</td>
<td>LP</td>
<td>N</td>
</tr>
<tr>
<td>C1 – garbage</td>
<td></td>
<td>N</td>
</tr>
<tr>
<td>C2 – air quality</td>
<td>LP</td>
<td>N</td>
</tr>
<tr>
<td>C3 – water quality</td>
<td>LP</td>
<td>N</td>
</tr>
<tr>
<td>C4 - mobility</td>
<td>LP</td>
<td>N</td>
</tr>
<tr>
<td>D1 – local economy</td>
<td></td>
<td>N</td>
</tr>
<tr>
<td>D2 – demography and health</td>
<td></td>
<td>N</td>
</tr>
<tr>
<td>D3 – user’s behaviour</td>
<td></td>
<td>N</td>
</tr>
</tbody>
</table>

The areas from A1 to C4 are related to characteristics measurable by physical and functional indicators and, for the most part, are quantitative; those from D1 to D3 relate to socio-economic characteristics of urban space and to anthropic behaviour once the area is transformed, or in the case of existing neighbourhoods. Moreover both quantitative and qualitative indicators represent D1-D3 and they are more complex to define since they are related to social welfare and to the
use of public space done by citizens and city users. They are connected to the knowledge of how to use anthropic structures, to the processes of development of the activities carried out there, and to the changes that occur over time and that can be linked to persistent or change factors in the use of the city (EEA, 2013).

Each area is formed by a system of indicators. They can be marked by qualitative or quantitative data usable to determine the sustainability of a local plan (LP) or of a neighbourhood (N). For each indicator is defined a quality range as combination of two limit values: the first is the minimum quality value (MIN), the second is the maximum quality value (MAX). We define observed data (OBS) as the real value related with case study A (Figure 1). The value foreseen or observed represents the state of LP/N for that indicator (1).

Each indicator is quantified in its unit of measurement. Consequently, the necessity of obtaining a final value makes necessary the homogenization of the measure's units. For this aim, each observed datum is changed in standardized value using one of the available methods (2). The following passage is the association of a weight W to each area (3). This passage is necessary for defining the relative importance of an area compared to the other. The sum of the points represents the final value (FV) (4) that is used to associate the LP/N(A) to a level in the certification (5).

![Diagram](image)

**Fig. 1. Theoretical passages for the use of the indicators.**

The areas of action A1÷A4, B1, C1÷C4 are represented by physical and functional indicators, while D1÷D3 are represented by social and behavioural indicators. For their characteristics, A1÷A4, B1, C1÷C4 can be used to define the certification of a plan, while A1÷A4, B1, C1÷C4, D1÷D3 can be used to define the certification of a neighbourhood.
Fig. 2. Certification of a local plan or an area as a combination of areas of actions and of indicators.

The application of this procedure allows to establish a certification system for local plans and/or urban areas based on values related to the consumption of resources and to the impact on environmental elements. This certification system associates to each operative plan or neighbourhood a synthetic index defining its level of sustainability (Figure 2).

**Results and discussion**

The operative structure is useful for three aims:

- to evaluate the sustainability level of a LP/N at a given time;
- to evaluate the evolution of an urban area in the course of time. If we apply the procedure to an instant \( t_0 \) we carry out the same at \( t_1 \) it is possible to investigate possible positive or negative changes in the level of sustainability;
- to evaluate the level of sustainability of an urban structure as a sum of more areas, each of which has its specific environmental sustainability level. Even this assessment can be diachronic.
The third aim is very interesting. We consider at time \( t_0 \) an urban structure consisting of \( N \) neighborhoods, existing or in planning. To each neighborhood can be associated a sustainability certificate level in \( A-F \) scale, for which the \( N \) system may be characterized by a vector of values formed by the sum of the \( n \) areas associated to their \( k \) certified levels. This vector, related to \( N \), defines the level of sustainability of the whole urban structure (Figure 3). If the operation takes place at a time \( t_1 \) it can happen that some neighborhood have changed its level of sustainability affecting, in this way, the final level of the entire urban structure.

The proposed methodology is characterized by being an expeditious procedure that certifies the sustainability of existing or planned urban areas. The phases of which it is composed are all important in the development of the procedure.

We emphasize, however, the choice of the indicator system as a crucial time for the success of the operation. In addition, we can assume that this system is not closed, but may vary to the changing of the basic conditions creating the necessity of an urban intervention or characterizing a city.

As regards the areas of action we believe that they seem to be well defined and representative of the categories of intervention affecting the urban transformations.

**Conclusions**

The city is an anthropic organized structure that often ends up under indictment for its unsustainability. Among the phenomena affecting the urban load we mention the urban diffusion and the high functional concentration, negative especially in relation to the high levels of energy consumption and greenhouse gas emissions. Not forgetting the social order processes such as those of segregation and exclusion.

75% of Europeans live in towns and cities, 85% of GDP is created in urban areas, towns account of 80% of energy use and they face special social cohesion and environmental challenges. These numbers create the necessity of make towns and cities pleasant and environmentally sustainable places to live and work.
Over the past years, a series of innovation applied to urban and regional planning have proposed. This has changed the approach to the city and has affected on the performances of the urban and territorial systems. The examples are various and, among them, it is possible to mention the urban regeneration tools, designed to improve the use of urban space, or the mobility planning tools that want to increase the extension of the public network connection and its efficiency, or to experiment new techniques that incorporate the control of energy processes in the planning.

The developed methodology wants to put a further step in this process because, on the one hand, highlights the elements that must be part of a sustainable plan and, on the other hand, defines a procedure to quantify the sustainability reached by that plan. It is therefore possible to arrive at an overall sustainability labelling, namely a sorting of plans on the basis of their contribution to the reduction of climate change processes, labelling to extend to the city as a whole and to characterize it according to the advances actually realized.

References


**Key Messages:** a decision support system based on the integration between city and mobility

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Key-words: Decision support system, Sustainable mobility, Key messages.

**Introduction**

The increasing levels of congestion and pollution, especially due to private vehicular traffic, are drastically reducing quality of life in the most densely populated European cities, which are characterized by a strong physical and functional stratification. During the last ten years in order to reduce such externalities, several cities have adopted strategies, programs and measures aimed at the development of a new urban mobility model - the sustainable mobility model. The main objectives of such model consist in changing the current urban mobility system based on the wide use of private cars, improving quality of life of citizens, reducing environmental degradation and making urban areas more competitive (Critelli et al. 2011).

Several researchers are involved in such topics and they consider the adoption of an integrated approach between urban transformations and mobility (Tira 2011; Gargiulo 2014) as one of the best solutions for congestion, pollution and urban decay caused by the spread of cars. According to such perspective, studies about the relationship between urban form and mobility, recommend the adoption of a compact city model. Indeed, such model is energy efficient and enables the reduction of travel distances and, consequently, of air pollution (Breheny 1995; Nijkamp and Rienstra 1996; Newman and Kenworthy 1999; Jabareen 2006). Thanks to high level of compactness and density, European cities represent suitable areas where introduce forms of sustainable mobility such as alternative modes of transport to private cars.

In the last twenty years also the European Union has defined documents and directives addressed to the integration of the urban and the mobility systems in order to promote a more sustainable mobility. Indeed, according to the scientific literature, such an integration can guarantee the achievement of environmental challenges related to sustainable mobility (Gargiulo, Pinto and Zucaro 2012; Gargiulo 2014).

Therefore, considering the importance of integrating the government of urban transformations with that of mobility, research studies and EU directives push to rethink how to innovate both the current decision-making systems and the role of actors involved in the decision-making process, as well as to develop integrated planning tools.

Accordingly, this paper proposes a decision support system, called *Key Messages*, for addressing choices and strategies in order to promote the sustainable mobility in consolidate urban areas. The paper is divided into three sections: the first section describes the methods adopted to develop the *Key Messages*; the second one explains the steps and the main results of the study; finally, the third section illustrates some possible next steps of the study.
Methodology

The elaboration of Key Messages - a system to support the decision-making process integrating the government of urban transformations with the government of mobility – has been articulated in four steps (Figure 1).

Fig. 1. Steps of the Key Messages elaboration.

The first step is dedicated to the literature review and to the analysis of the main European political documents about sustainable mobility. Considering the review of scientific literature, a positive relationship between urban forms (characterized by high building and functional density) and sustainable mobility model arises. However, the scientific literature highlights several weaknesses related to the need to define cohesive policy strategies that should be coherent with sustainable mobility principles. Such principles are: the integration of land use policies with mobility policies; the investments on public transport and the promotion of walking and cycling; finally, the use of ICTs and the increase of fuel prices (Nijkamp and Rienstra 1996). With regard to the European political documents, the Green Paper “Towards a new culture for urban mobility” (Commission of the European Communities, 2007) and the White Paper “Roadmap to a Single European Transport Area. Towards a competitive and resource efficient transport system” (Commission of the European Communities, 2011) have been analyzed. The Green Paper identifies the main European “challenges” related to urban traffic, environmental pollution, accessibility, road security and the promotion of a new urban mobility "culture". The White Paper is mainly addressed to define actions and measures for the development of sustainable mobility, such as the construction of new transport infrastructures and more efficient services, the use of sustainable fuel and innovative propulsion systems, the encouragement of alternative and energy efficient modes of transport. The main result of such step consists in the identification of the most important strategies and measures to be implemented for promoting sustainable mobility.

The second step consists in the selection of the case studies. In order to determine a significant sample of European cities, such selection has been made considering two parameters: the population size, which is one of the criteria internationally used for the classification of urban areas (DPS and Comitato Tecnico Aree Interne 2012); the motorisation rate, which allows to know car diffusion in European cities and to understand the impacts of measures undertaken to implement mobility sustainable. Considering these criteria, ten case studies have been selected (Table 1). Each case study has been analysed identifying the strategies and the measures implemented for promoting sustainable mobility. Based on the bigger or smaller success of the initiatives promoted within the selected case studies, best and bad practices have been identified.
The third step includes the definition of the best and bad practices’ strengths and weaknesses. It highlights that the effectiveness or the failure of specific measures is strongly influenced by social participation, citizen cultural level and public awareness to “sustainability” issue, by the inter-institutional and intra-institutional partnerships and management, as well as by the planning, programming and implementation of measures, considering mainly the financial availability of the public administration or produced by public-private partnerships.

In the fourth step the selected urban areas have been classified in relation to their physical and functional structure. In accordance with the literature review and the case studies, one of the main factors in the choice of effective sustainable mobility measures is represented by the physical organization and functional structure of the urban area where they have to be implemented. Based on the previous steps, urban policies and strategies have been grouped in Policy Challenges, which collect and classify strategies for specific objectives. In particular, taking into account the results of the four steps, especially the last two, a set of recommendation, the Key Messages, has been developed for two classes of urban areas - historical centers and consolidated urban areas - which are parts of the European cities characterized by high population density and high levels of functionality.

### Results and discussion

This section describes how the Key Messages have been developed. In detail, they support decision maker in implementing effective measures for the development of sustainable mobility.

Considering the results of the first and the second step, strategies – Policy Challenges – and categories of measures to implement – Action Classes – have been defined for consolidated urban areas. In particular, taking into account the relationship between externalities due to the current mobility system and objectives for its sustainable development, four Policy Challenges have been identified: Challenge 1 aims of making the city economically sustainable and accessible through several actions for reducing road traffic; Challenge 2 refers to the issue of climate change and to the protection of global environment and its resources; Challenge 3 pursues the livability in urban centers considering road safety conditions; Challenge 4 aims at requalifying degraded urban areas.

Each Policies Challenge has been associated to one or more Action Classes aimed at reducing specific externalities of the mobility system. Key Messages have been defined for each Action Classes. In particular, through the study of scientific literature and case studies, four degrees of relationship between Classes and Challenges arise - very strong, strong, moderate and weak/absent. Therefore, Key Messages have been developed for Action Classes characterized by “very strong” relationships with each Challenge.
Furthermore, in accordance with the classification of strengths and weaknesses, *Key Messages* have been divided into four categories - Institutions & Law, Economic & Financial Resources, Communication & Participation, Planning & Technology. In detail, each of them includes several recommendations. The Key Messages of the first category suggest that laws and regular intra and inter-institutional meetings can determine the success of the adopted measures. “Economic & Financial Resources” Key Messages highlight the relevance of feasibility study for the actions to implement and the need to promote public-private partnerships for financing the undertaken actions. The “Communication & Participation” category includes recommendations about the public awareness on sustainable mobility benefits and participation in the planning process. Finally, Key Messages of the fourth category suggest on the one hand to promote regular updated planning and continuous monitoring of the implemented actions undertaken and, on the other hand, to use ICTs for managing mobility of goods and people.

Therefore, in order to provide public decision makers with practical information and demonstrate the applicability of the proposed recommendations, the *Key Messages* are associated with the analysed case studies.

**Conclusions**

The main aim of the study is the development of a decision making system – the *Key Messages* - based on the integration between urban and mobility systems in order to mitigate the negative impacts caused by the current model of urban mobility and to promote a more sustainable mobility model.

Considering the literature review and the analysis of case studies, one of the key results is that, due to the urban system complexity, the integration of land use planning and transport planning is the approach that provides more guarantees about the efficiency of actions. Furthermore, there is also a need to innovate transformation processes, stakeholder roles and operative instruments in the urban context. It is necessary to create linkages among several networks of stakeholders – technicians and politicians, institutions, several parts of market and population – in the decision-making process in order to simplify the sharing of actions to be implemented and to guarantee their effectiveness.

The Key Messages highlight also the relevance to plan future scenarios through ICTs that should allow to reinforce strengths and reduce weaknesses of urban contexts. The role of ICTs should thoroughly be investigated considering also the most recent studies on the topics of Smart City and Smart Mobility (Papa, Gargiulo and Galderisi 2013).
In this study the Key Messages have been defined only for consolidated and stratified urban areas. In the future it would be preferable to develop them also for suburban and peri-urban areas, new housing and mono-functional developments (industrial, commercial, etc.).

References


Accessibility and built environment surrounding metro stations: a GIS-based comparison of Naples line 1, Milan line 3 and London Jubilee line

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Keywords: Accessibility to transit, GIS, Urban rail system, Service area.

Introduction

This study fits into the research field of integrated land use and transport (LUT) planning. The use of urban policies based on this approach are considered an effective strategy to mitigate the negative externalities of car dependence, create more sustainable urban communities and advance economic competitiveness (Papa 2010; Suzuki et al. 2013). Research in this field has shown that urban environments with high densities, mixed and diverse land uses, located within an easy-walkable distance to transit stations yield a number of transport benefits such as reducing work trip distance, increasing the use of public transport and encouraging walking and cycling (Nahlik & Chester 2014).

In the last decades, there has been a growth of interest in the concept of accessibility, with many studies published in the academic press discussing how to measure accessibility and how to use this concept for evaluating integrated LUT strategies (Curtis 2010; Coppola et al. 2014; Salas-Olmedo et al. 2016). Furthermore, land use and transport researchers interested in the analysis of the built environment and its association with mobility and accessibility have significantly benefited from the increased availability of digital spatial data and the emergence of Geographic Information Systems (GIS) (Lin et al. 2014). The aim of this study is to develop a GIS-based method for evaluating accessibility and the built environment surrounding metro stations and to apply this method to examining and comparing spatial accessibility to urban rail stations in three different urban contexts. To this aim, the paper review academic literature on integrated LUT planning and define a set of indicators able to describe urban environments that support transit use. The methodology is applied to the urban rail stations of the Naples Line 1, the Milan Line 3 and, the London Jubilee line. We select these lines according to the following criteria: i) they were opened in the same period; ii) they connect the city center with the outlying parts of the city and iii) they have a similar number of stations. Furthermore, we believe that the cities in which these lines operate represent three very different urban contexts. In particular, we select the city of London as an example of a mega city with global importance; the city of Milan as an example of a major European city and the city of Naples as an example of southern European city. The reminder of the paper is organized as follow. The next section details data sources, indicator selection, and spatial accessibility calculation. The third section compares and discuss differences in the results for the three case studies. The last section summarizes the contributions of this paper and propose some suggestions on future research directions, offering some insights to this end.
Data and Methods

This section details the data used in this study along with their sources and formats and the methodology developed to evaluate accessibility and the built environment surrounding metro stations.

Selecting indicators

In general, accessibility can be defined as the ease of reaching valued destinations (El-Geneidy and Levinson 2006). However, it is a broad and flexible concept that varies greatly depending on the research discipline and aim. Based on an extensive literature review this study identifies four spatial factors that influence accessibility to transit station: i) proximity; ii) urban densities, iii) land use diversity and iv) design of urban space. The aforementioned factors were subsequently transformed in twelve measurable indicators able to describe urban environments that support transit use, as reported in Table 1.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Indicators</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>How dense is the land use surrounding the transit station?</td>
<td>Population density</td>
<td>Bach et al. 2006</td>
</tr>
<tr>
<td></td>
<td>Jobs density</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Activities density</td>
<td></td>
</tr>
<tr>
<td>How diverse is the land use surrounding the transit stations?</td>
<td>Land use mix (entropy)</td>
<td>The City of Calgary 2004</td>
</tr>
<tr>
<td></td>
<td>Land use mixed-ness</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Job-housing balance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jobs proximity to transit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Activities proximity to transit</td>
<td></td>
</tr>
<tr>
<td>Does the design of the urban environment around transit station</td>
<td>Average block length</td>
<td>Renne and Wells 2005, Evans and Pratt</td>
</tr>
<tr>
<td></td>
<td>Density of intersection</td>
<td>2007</td>
</tr>
<tr>
<td></td>
<td>Route directness</td>
<td></td>
</tr>
</tbody>
</table>

Collecting data

Spatial data in GIS format and non-spatial data (statistical data) were collected from different sources, including the Italian National Institute of Statistics (ISTAT), the UK Office for National Statistics (ONS), OpenStreetMap (OSM), the Italian National Geoportal (ING) and the open-data websites of the city of Naples, Milan and London (ODN, ODM, ODL, TfL). Table 2 summarizes the data used in this study along with their sources and formats. Data were organized and stored in a spatial database.
Performing GIS-based analysis

In this project, a desktop GIS package ArcGIS 10.4 is selected as a platform for the implementation of the built environment indicators detailed in section 2.1. In order to perform our analysis, a GIS-based procedure was developed, consisting of the following four steps:

1. **Estimating population and jobs for a regular grid cell.** The use of data from multiple sources and the variable size of census tracts might be problematic when estimating population and jobs within walking distance of a transit station (Papa and Bertolini 2015). Consequentially we select a 100 × 100 m grid as the basic spatial unit of our analysis (fig. 1). Then we allocate jobs and population to grid cells using the area-ratio method (Gutiérrez and García-Palomares 2008);

2. **Creating a walking network from OSM data.** OSM provides free vector geographic databases using contributions from Internet users. It has been extensively used as a source of spatial data for many researchers. However, the accuracy and the completeness of OSM data depends, among other things, on the number of contributors (Haklay 2010). In order to accurately model walking routes to transit stations, some topological corrections were made to the original data while some missing street segments where manually added. Furthermore, street segments classified as “motorway” were removed from the network;

3. **Defining station catchment areas.** Station catchment areas are broadly based on an understanding of how far people are willing to walk to take transit. One key aspect to take into account when defining station catchment areas is the delimitation of the station radius of influence. Different radius have been used in the literature. In this research a radius of 500 m were considered to reflect an 8 min walking time (Pagliara and Papa 2011). Using the Network Analysis tool, a catchment area around each station was created and overlapped with the grid cell layer, the street network layer and the building layer (fig. 1);

4. **Calculating built environment indicators.** Using the Spatial Join Analysis tool, the following information were associated to each station: population and jobs (by sector); buildings footprints; street segments length; Euclidean and network distance from cell centroids to the associated station. After these operations, accessibility and built environment indicators were calculate for each station. Subsequently, these values were aggregated for each line.

---

### Tab. 2. Data Sources.

<table>
<thead>
<tr>
<th>Data</th>
<th>Format</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Census tract</td>
<td>Spatial</td>
<td>ISTAT, 2011; ONS, 2011</td>
</tr>
<tr>
<td>Population</td>
<td>Non spatial</td>
<td>ISTAT, 2011; ONS, 2011</td>
</tr>
<tr>
<td>Jobs by sector</td>
<td>Non spatial</td>
<td>ISTAT, 2011; ONS, 2011</td>
</tr>
<tr>
<td>Street networks</td>
<td>Spatial</td>
<td>OSM</td>
</tr>
<tr>
<td>Stations</td>
<td>Spatial</td>
<td>ODN; ODM; TfL</td>
</tr>
<tr>
<td>Building footprint</td>
<td>Spatial</td>
<td>ING; ODL</td>
</tr>
</tbody>
</table>
Results and discussion

The results of the GIS-based analysis are summarized in Table 3 where, for sick of brevity, built environment scores are reported only for the station areas of the Milan Line 3.

### Fig. 2. Modelling transit station accessibility using GIS.

### Table 3. Accessibility and built environment scores at station level.

<table>
<thead>
<tr>
<th>City Center</th>
<th>Outlying</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Population</td>
</tr>
<tr>
<td>Generale FS</td>
<td>100</td>
</tr>
<tr>
<td>Repubblica</td>
<td>386</td>
</tr>
<tr>
<td>Montenapoleone</td>
<td>486</td>
</tr>
<tr>
<td>Centrale FS</td>
<td>3,85</td>
</tr>
<tr>
<td>Repubblica</td>
<td>0,87</td>
</tr>
<tr>
<td>Turati</td>
<td>0,05</td>
</tr>
<tr>
<td>Porto di mare</td>
<td>31</td>
</tr>
<tr>
<td>Missori</td>
<td>117</td>
</tr>
<tr>
<td>City Center</td>
<td>148</td>
</tr>
<tr>
<td>Lodi</td>
<td>461</td>
</tr>
<tr>
<td>Tibb</td>
<td>0,77</td>
</tr>
<tr>
<td>Brenta</td>
<td>204</td>
</tr>
</tbody>
</table>
Results show a significant decline in building environment attributes, moving from the historical city center to the outlying parts of the city. Built environment attributes of station areas are similar for neighbourhood developed before World War II. Indeed, historical neighbourhoods, as expected, show a high degree of walkability, a good functional mix and relatively high densities. However, some differences still exist, depending on the functional specialization of the area. For example, the Duomo station area, where mainly business and office activities are located, shows a lower population density, a higher level of service activities and a lower land use mix if compared with more residential-oriented areas such as the Lodi station area. Two examples of outlying station areas are Rogoreto FS and San Donato. Low densities, mono-functionality and non-pedestrian friendly environment characterize these station areas. Indeed, these areas represent a typical example of post-World War II urban expansions, characterized by buildings of great dimension with a great degree of functional separation.

Table 4 presents a comparison of the results for the three different case study lines. For the Naples Line 1, results indicate a high level of population density, a high degree of walkability and a medium-low degree of functional mix. For the Milan line 3, results show a lower population density, a medium-high job density and a good functional mix. Similar patterns also emerge for the city of London. To sum up: i) at the line level, the comparison confirms substantial differences between the three analysis contexts in terms of land-use, urban design and proximity features; ii) at the station area level, similar patterns emerge with central areas performing on average better than suburban areas regardless the line considered.

Conclusions

Integrated land use and transport development is crucial for achieving more sustainable urban environments. In this study, we presented a method for analysing accessibility and the built environment surrounding urban rail line and applied this method to the Naples Line 1, the Milan Line 3 and the London Jubilee line. We believe that this methodology represents a useful framework for integrate land use and transportation planning and benchmark accessibility to transit in different urban contexts.

The results of this research supports an approach to integrated LUT planning where transit stops are centrally-located within dense, mixed-use activity centers. It also calls for site-specific solutions, especially for suburban areas, in order to alleviate accessibility problems and support
e-agorà|e-ἀγορᾶ for the transition toward resilient communities

Transit use by creating dense, mixed and pedestrian-friendly environments around transit stations. We believe that this methodology represents a useful framework for integrate land use and transportation planning and benchmark accessibility to transit in different urban contexts. Further developments of this research will be oriented towards: i) the development of a composite indicator of accessibility (Lin et al. 2014); ii) the assessment of the effectiveness of the selected indicators and iii) the application of the methodology for the whole city network.

References


A GIS-based and socially participative procedure for the location of high vulnerability territorial functions

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Key-words: waste management, dangerous plant location, GIS, NIMBY, Campania region.

Introduction

The localization of high vulnerability territorial plants has always catalyzed a hotly debated issue, involving a large and diverse number of bodies: governmental institutions (national, regional and local authorities) as well as concerns of the local community that, generally, contrast with the administrative choice. Therefore, the process of localization of a Municipal Solid Waste treatment plant (MSW) may take a long time. Often, the decision-making procedure is based on a top-down process without the involvement of the local community, which is made aware of the decision to locate the plant in the bordering areas only in the final phase. Consequently, the resident community, living in the involved areas, reacts by instigating urban unrest that exposes the safety and livability of the city system.

This study describes a methodology aimed at identifying the optimal location for an urban solid waste treatment plant. The methodology is based on the definition of variables geared towards social and territorial safeguarding and outlines a procedure aimed to get collective participation, which can prevent social conflicts and the onset of the NIMBY syndrome (Bobbio 2011). The NIMBY syndrome (Not In My BackYard) is perhaps the best-known phenomenon of social contrast expressing a "localized" refusal, related to a use of land that is disapproved by the local community.

In order to avoid such conflict, in this study we propose a procedure to identify the areas for the locations that is based both on a Geographical Information System (GIS) and on the opinion of the local community according to a "bottom-up" model. The procedure has been tested in Campania region (Italy) where in 2008 a grievous waste crisis occurred. In this area, the selection of sites for the localization of plants takes into consideration the combination of parameters that built the GIS in an innovative way.
Methodology

In order to explore the factors and the conditions for localizing a MSW plant, this study has been developed by using a GIS considered as an environment for a new territorial knowledge (Fistola 2009). This choice has allowed us to identify localization solutions based on objective spatial data. Furthermore, in order to prevent conflict caused by “not-shared” solutions, the study provides a procedure geared towards collective participation.

The territorial variables have been acquired by consulting official repositories available on national and local institutional websites; they have been analyzed and elaborated using the open-source GIS techniques and have been divided into “cluster variables” and “independent variables”. In the case study, the Basic Territorial Unit (BTU) coincides with the municipalities of Campania.

The spatial analysis procedures, implemented in the methodological definition, led to the assignment of specific parameters derived from each spatial variable for each BTU. The combination of parameters has enabled us to select a limited number of BTU that are characterized by high environmental, economic and social compatibility.

Fig. 1. Waste production in the municipalities of Campania.
Furthermore, in order to identify the appropriate areas for the location of the MSW plants, transportation dynamics have considerable relevance. Indeed, the transport of garbage from production points to incinerators entails a significant cost, both financially and environmentally. Transportation costs have been estimated by creating a road network model of the Campania Region within the GIS; the feasible locations have been ranked according to cost, starting with areas that correspond to the minimum cost.

By merging data regarding territorial criteria and the costs estimated for each feasible location, the municipalities corresponding to the “optimal location” have been identified.

In a further step, in order to get a validation of the more relevant variables, for the location process, a survey was conducted using an expert-knowledge method based on the DELPHI logics.

Then, the study examined how to involve local population in the decision process. The benefits to be gained from the mainstreaming of voluntary participatory methods within the process of adoption of territorial plans that provide for the location of MSW, have been widely discussed in literature (Higgs 2006, Laurent-Lucchetti 2007, Regione Emilia-Romagna 2009, Valente and De Rosis 2011).

With reference to these studies, the selection of the techniques which fit the research objectives have been proposed, also considering the peculiarities of Campania region. Among the recent evolution of participatory techniques, the user-centered method has been considered to be one of the most feasible as it refers to the collaboration between the public and the private component in the definition of actionable solutions. The Living Lab approach has been considered as one of the possible methods to promote positive cooperation processes able to prevent the uprising of contrast such as the NIMBY syndrome. In the final part of this study, a questionnaire has been defined mainly to identify both the profile of the final users that could be involved in the decision-making process and their propensity to accept “compensative measure” considered as one of the parameters towards reducing social conflict. The questionnaire is accessible through a web platform so that the administration can activate it during the different phases of the decisional process.
Results and discussion

Finding out a balance among governmental decisions, social and environmental needs is a complex issue. Nevertheless, this study tries to define a scientific process to support the decision-makers in identifying suitable areas for locating high vulnerability functions also considering the involvement of the social component.

The choice of Campania region, as a place to test the methodological process, is particularly significant both in relation to the waste emergency, occurred in recent years, and as an attempt to promote shared solutions for territorial transformation.

In this sense, the study aimed to achieve:

- the definition of a territorial sensibility value;
- the design of a democratic process based on the best available participatory techniques.

Referring to the first point, the spatial analysis developed inside the GIS environment, indicates the ranking of municipalities in Campania where the location of a high vulnerability territorial function could be applicable. The territorial sensibility level has been obtained using the combination of a large set of variables and it refers to four classes of values (fig. 3).

![Fig. 3. Distribution of the sensibility level within local municipalities in Campania. The grey colour indicates the class of high territorial propensity to the location; the black colour indicates the low territorial propensity to the location.](image)

Furthermore, the ranking has been optimized by considering the expert responses during a single round Delphi process.

Regarding the second point, a procedure has been defined to integrate the location process with the adoption of voluntary participative techniques.

The outcome of the consultations is a decision support useful tool allowing the decision maker to operate through socially shared mode. The choice for the localization will be made considering both the purely territorial physical aspects and the expectations of the social component (residents and stakeholders).
Conclusions

Waste management is one of the main environmental issues which affects urban and regional planning especially in relation to the acceptance of the choice for localization of plants. Regarding Italy, in fact, municipal solid waste plants are among the most opposed issues. On the one hand, this is probably due to social scepticism regarding governmental choices; on the other hand, this also depends on a lack of knowledge of the characteristics of the plant. Some examples of success (i.e. the Spittelau in Wien, the case of Copenhagen, Hamburg, Maishima) show the importance of participation during the administrative decision-making process and also indicate the presence of a political leadership as a primary condition towards the promotion of social acceptance.

This study argued that it is possible to define technical procedures in order to support decision-makers to make choices that are compatible with the physical context and with the citizens’ aspirations. The localization of a waste management system remains a complex issue that requires a global re-definition regarding approaches to territorial issues (Battarra et al. 2016). It is possible to state that, in order to achieve shared solutions, some conditions are needed that mainly refer to:

- integration between the public and the private sector;
- analysis of territorial demand intended as an expression of all the users categories;
- promotion of a cultural model based on civic empowerment;
- definition of plans to monitor the plant;
- existence of permanent consultation groups.

The findings of this study show that these conditions can implement an inclusive decision-making process based on a more comprehensive vision.

References


Modelling and Assessing Pedestrian Isochrones around Public Transport Nodes: A People-Centred Perspective towards Smartness

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Key-words: Public Transport accessibility; Pedestrian Mobility; Isochrones; GIS; Backtracking algorithms.

Introduction

The proposed contribution starts with the assumption that nowadays it is more than ever necessary a focus on the individuals and a re-affirmation of a people-centred planning vision (e.g. in the "People Friendly City" concept developed by Busi), to create smart strategies for a sustainable and inclusive urban environments. As reminded by the World Resources Institute (WRI), "a smart city is not an automated city. Being a smart city is about having leaders, businesses, and citizens make smart, informed decisions". According to these assumptions, the contribution presents a GIS-based approach that can help practitioners in assessing pedestrian accessibility in urban areas, with a focus on accessibility to public transport stops and stations (nodes).

This methodology represents an attempt to set up an integrated approach to urban planning and mobility planning, and provides a support in the decision-making process, with the dual aim of encouraging sustainable and non-motorised mobility and of improving public transport attractiveness.

The proposed methodology refers and refines some suggestions already proposed in a previous work (see Rossetti, Tiboni, Vetturi and Calderòn, 2015), and it is divided into three steps:

1) Map the pedestrian permeability/impermeability of urban spaces around the public transport nodes analysed;

2) Discretisation of the map and application of an algorithm to calculate the pedestrian access time to the public transport node;

3) Map those access times to create detailed pedestrian isochrones, and calculating how many residents in the neighbourhood are well served by the public transport system.
Methodology

The first step of the analysis consists in building a map that associates the characteristics of the urban space and of land use to the possibility and the speed of pedestrian movement: how is it possible to map pedestrian permeability/impermeability of an urban space?

In the last decade, Geographic Information Systems (GIS) based approaches for the assessment and management of accessibility have grown considerably (see. Hull, Silva & Bertolini, 2012), and the crucial role of GIS techniques for the analysis of accessibility is now consolidated.

First of all, there is a need to collect many cartographic information and GIS informative layers regarding pedestrian mobility for the study area, with particular reference to the road network, the location of pedestrian paths and sidewalks as well as the presence of physical barriers in the area that prevent pedestrian permeability (e.g. barriers, buildings, railway lines, water ...).

In this sense, GIS and the introduction of Topographical Databases in cartography are extremely useful as they allow us to have a homogenous and very detailed cartographic map, made up of a multitude of geo-referenced and self-consistent informative layers. In the Lombardy Region the technical specifications approved by D.G.R. n. 6650 of 20th February 2008, constitute the standard for the production of the Topographic Database at municipal level (DBT), based on national specifications defined in 2006 by Intesa GIS between the state, regions and local authorities.

Particularly, from a Municipal DBT it is possible to extract all those informative layers useful to determine whether a pedestrian can cross an area or not. Furthermore, other useful information can be added to those layers from the municipal masterplan (in our case informative layers from the Services Plan of the Piano di Governo del Territorio – PGT), as the location of green areas and public services.

Then, the proposed assessment methodology bases on the detailed discretization of the area being analysed in a uniform grid of cells. The grid is created using the ETGeowizard tool, a free extension of the ArcGIS software. The Vector grid tool of the ETGeowizard automatically creates a polyline or polygon vector grid using user defined extents and cell size. In this case, a polygonal shapefile was created around each public transport node analysed, using a cell size of 3x3 m. In the attribute table of the vector grid, the ET-Geowizard tool creates two types of Identifiers for each record: a field named ‘ET_ID’ containing the identification number of each cell, and a field named ‘ET_Index’ that contains the field and the record of the cell in the matrix. This is a crucial field, because it makes possible the link between the shapefile and the computation algorithm that is described later in this paragraph.

Therefore, we proceeded to make a discretization of the study areas in a grid of 3mx3m square cells: each cell has been connected to the information of the land use informative layers (from DBT and PGT) contained in it. On the basis of those layers a pedestrian permeability value (with the relative pedestrian crossing speed) was associated to each cell.

Within the grid, a calculation algorithm can be applied. This algorithm, on the basis of the informative layers that overlap each cell, assigns each cell a pedestrian crossing time and evaluates the existing connections between the cell in question, and the cells adjacent to it. This model allows the creation of thematic maps that show the timing of pedestrian access to each cell. But how does the model work?

The model is based on a uniform grid of squared cells, interconnected according to the following scheme: from the X cell it is possible to move to the A cells (using the time needed to cross that cell) and to the B cells (with the cell crossing time plus a $\sqrt{2}$ factor). The crossing time is an attribute of each cell, assigned according to the pedestrian permeability previously defined.
The mathematical algorithm determines the time needed to reach each cell of the matrix, starting from an assigned cell, and determining the path with the shortest travel time. The algorithm is used to search for access time to the destination cell, and bases on a group of recursive algorithms known as ‘Backtracking algorithms’ (Wirth, 1976), widely applied within the Information Sciences to solve optimization problems. The method applies a kind of floodfill starting from the destination cell and following a backwards path, and tracing the total time as a strategy to exit the recursive procedure.

```
procedure TryNext(i,j:integer;TotalTime:real);
begin
  if Matrix[i,j].time> TotalTime then
    begin
      Matrix[i,j].tempo:= TotalTime;
      // destinazioni di tipo “A”
      if i>1 then TryNext(i-1,j,TotalTime+Matrix[i,j].CrossingTime);
      if j<ny then TryNext(i,j+1,TotalTime+Matrix[i,j].CrossingTime);
      if i<nx then TryNext(i+1,j,TotalTime+Matrix[i,j].CrossingTime);
      if j>1 then TryNext(i,j-1,TotalTime+Matrix[i,j].CrossingTime);
      // destinazioni di tipo “B”
      if (i<nx) and (j>1) then TryNext(i+1,j-1,tempo+Matrice[i,j].CrossingTime*1.41);
      if (i<nx) and (j<ny) then TryNext(i+1,j+1,tempo+Matrice[i,j].CrossingTime*1.41);
      if (i>1) and (j>1) then TryNext(i-1,j-1,tempo+Matrice[i,j].CrossingTime*1.41);
      if (i>1) and (j<ny) then TryNext(i-1,j+1,tempo+Matrice[i,j].CrossingTime*1.41);
    end;
end;
```

Importing the algorithm’s results again in the GIS, and joining them to the GIS grid through the ET-index field, it is possible to map the results, highlighting the pedestrian isochrones to access Public Transport node from each point of the map. Finally, an optimal catchment area from the Public Transport node can be defined (literature values – e.g. Festa, 2009 and Bonotti et al., 2015 - suggest a 5-minute walking isochron), or, better, contour or potential accessibility measures (see i.a. Curtis and Scheurer, 2010; Geurs and Van Eck, 2001) can be applied. Contour measures define catchment areas by drawing one or more travel time contours (i.e. isochrones) around a node and, then, adding up the number of opportunities (jobs, residents, facilities, ...) within each contour. Potential measures are very similar to contour measures although accessibility levels are considered to decay with distance of opportunities from origin. Thus, potential measures reflect the distance deterrence of accessibility. In our case, demographic data were considered. Data from the Civil Register of the Municipality can be geo-referenced and linked to each cell of
the grid, by linking the address of each inhabitants to a GIS based street map that include point-shaped building numbers (as proposed by Paolillo, 2010).

Results and discussion

The methodology was applied to three case studies related to three metro stations, which belong to different urban morphologies, in the city of Brescia: Vittoria station (located in the ancient city centre), Marconi station (located in a mixed residential and service area very close to the city centre) and Europa station (a more recent neighbourhood, where the university campus is located). Obviously, pedestrian permeability varies considerably depending on the urban morphology. Each study area was discretized in a grid of 296x385 cells of 3 meters each side, and to each grid, the whole methodology previously described was applied. Figure 2 presents the resulting maps, in terms of pedestrian access time to each metro station.

![Pedestrian Isochrones around the three metro stations analysed.](image-url)

The creation of isochrones allows to link to each cell of the grid an "access time" to the metro station. Furthermore, we can define the accessibility considering the ability of each station to attract metro users (in terms of resident population). Similarly, we could have analysed the same station’s ability to provide access to opportunities and services (schools, pharmacies, doctors’ offices, public offices).

In our case studies, we linked to each cell of the grid its number of inhabitants, after having geo-referenced the demographic registry of the Municipality of Brescia. The following graphs (Figure 3) analyse the inhabitants distribution by distance from the attraction point (metro station). The graphs highlight with a dotted line the distribution according to the Euclidean distance, while the continuous line shows the distribution of the population according to the access time calculated by the model.
Furthermore, to define a more accurate accessibility measure, it is possible to ponder the population according to the distance from the metro station.

Conclusions

To sum up, the proposed methodology is based on a very punctual and detailed discretisation of the analysed territory in a uniform grid of cells. In this grid a calculation algorithm is applied. The algorithm, basing on the land use informative layers which intercept each cell, assigning each cell a pedestrian travel time and assesses the existing connections between the considered cell and the cells adjacent to it. This model allows the creation of thematic maps that highlight the pedestrian access time from each cell to the Public Transport node, to define optimal catchment areas. Accessibility measures can be assessed considering the number of inhabitants served by those catchment areas.

The proposed methodology was applied and calibrated on the case study of three stations of the light railway in Brescia (Vittoria, Europa and Marconi).

The results can provide a useful framework for decision support, for example within the context of the Sustainable Urban Mobility Plans (SUMP), instruments that guide the strategies identified by the European Commission to achieve results in the field of sustainable mobility.

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Households’ willingness to pay in good and bad economy. The case study of Naples

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Key-words: hedonic price; economic crisis; real estate; regression analysis; geographical information system.

Introduction

There is no debate that the 2008/09 economic crisis has severely affected housing market in Italy at national, regional and city level and Naples has been one of the most hit cities of the country. Indeed, data from the Italian Revenue Agency show (Fig. 1) that between 2006 and 2014 the normalized transactions number of housing units in Naples has extraordinarily decreased, going from over 9000 to less than 6000, and the same has occurred to the average house price that experienced the fiercest fall between 2009 and 2010 (-24%).

In this context, the paper aims to measure the impacts of the 2008/09 economic crisis on the housing market of the city of Naples using the hedonic price approach. The application of this method allows estimating the price of significant housing characteristics, whose relationship with housing price can be expressed as follows (Wen et al. 2005):

\[ P = f(HC) \]

The goal is to understand how homebuyers’ preference for specific housing characteristics has changed between 2008 and 2015 in order to identify (1) those features which have maintained their relevance before and after the crisis, (2) those which were considered significant during good economy but not during bad economy, and finally (3) those which become of interest for homebuyers only when the market was declining.

Our case study is the city of Naples, whose housing market has suffered great negative consequences due to the economic crisis, as previously described. We have identified a sample of 60 proprieties sold in 2008 and 123 properties sold in 2015 distributed over the entire municipal territory, and for each of them we have collected data about nine housing characteristics. Then, we have used a hedonic price method (OLS) to establish which housing characteristics were significant in determining propriety values in 2008 and 2015 (Corsini 2009), and we have compared the two results obtaining two main findings: the Neapolitan residential real estate has substantially changed during the seven years of reference; homebuyers have partially changed their preference for the considered housing characteristics.

The paper is structured as follows: paragraph 2 includes the description of the
methodological steps followed in this research, from data collection to the application of the hedonic price method (HPM); in paragraph 3 we describe and comment the results obtained using HPV both at 2008 and 2015; in paragraph 4 we provide some concluding remarks and we propose possible further research.
Methodology

In this section we provide the framework within which the hedonic price model has been applied to our case study in Naples. This framework is partially based on a PhD thesis (De Ciutiis 2008) where the hedonic price method was updated and used to predict the impacts of an urban transformation by interpreting the variation of housing price.

Based on the hedonic price theory (Lancaster 1966; Rosen 1976) developed in the economic field, the basic assumption of hedonic method applied to the housing market is that the market value of a house is influenced by a bundle of interior and exterior attributes that cannot be sold separately. Through an operation of regression, the sale price is decomposed into various features that determine it. In this way the model provides information about the relative contribution of every considered feature (Cebula 2009, Gargiulo 2008). The selection of those features represents a key element in the methodology used in this study, which includes the following steps:

1. Theoretical framework and variable selection;
2. Data collection for both 2008 and 2015 samples;
3. Data elaboration;
4. Application of the hedonic price method.

According to the scientific literature on real estate valuation, the market value of a housing unit depends on three main types of housing characteristics: location, structure and neighborhood characteristics (Forte et al. 1979; Rosato et al. 2006, Chin and Chau 2003), which are often described using dichotomous variables to indicate their presence or absence (Saphores 2012; Lin 2009; De Ciutiis 2008; Wen et al. 2005).

In this study we have selected nine housing characteristics, distinguishing between building and urban features, as shown in Table 1. The lack of open access data on the number and types of real estate transactions in the area of Naples was overcome by a face-to-face data collection campaign with real estate agencies spread on the territory of reference. In order to facilitate the procedure, a survey questionnaire was developed and presented to real estate agents, and each of them provided information about 3 to 5 housing units sold in the years of reference, excluding the rented ones and those with a mortgage. In particular, data about the sample at 2008 refers to a previous study (De Ciutiis 2008) including 60 housing units; on the other hand, the sample at 2015 includes 122 units. The elaboration of data collected through the questionnaire allowed the five building features measurements, while urban features measurements have been obtained in GIS environment using appropriate queries, as described in table 1.

<table>
<thead>
<tr>
<th>Typology</th>
<th>Housing characteristics</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building features</td>
<td>Building typology: presence of a high-quality building (BF1)</td>
<td>Survey questionnaire</td>
</tr>
<tr>
<td></td>
<td>Building facilities: presence of both elevator and heating system (BF2)</td>
<td>Survey questionnaire</td>
</tr>
<tr>
<td></td>
<td>Housing quality: presence of a renovated housing unit (BF3)</td>
<td>Survey questionnaire</td>
</tr>
<tr>
<td></td>
<td>View: Presence of at least one window or balcony with a view of the sea (BF4)</td>
<td>Survey questionnaire</td>
</tr>
<tr>
<td></td>
<td>Light quality: presence of a housing unit with natural light</td>
<td>Survey questionnaire</td>
</tr>
</tbody>
</table>
Two separated linear regression functions were constructed for the two samples of data based on this formula:

$$P = \beta_0 + \sum \beta_i (HC)_i + \epsilon$$

where \(P\) is the housing price per square meter, \((HC)_i\) are the nine housing characteristics, \(\beta_i\) are the estimated coefficients measuring households willingness to pay for each housing characteristic, and \(\epsilon\) is the random error. Using SPSS.20 as the statistical program, the model’s estimation method was the ordinary least squares method (OLS). Before proceeding with the application of the method, data were controlled in order to detect potential outliers: five outliers were eliminated in the sample at 2015 and one in that at 2008.

**Results and discussion**

The regression for the 2015 data provided a model whose adjusted \(R^2\) was 0.474, which indicates a good fit between model and data. Even higher fit was that for the set of data at 2008, whose adjusted \(R^2\) was 0.787 (Tab. 2).

Table 3 and 4 show the estimated coefficient and significance test results for both sample at 2015 and 2008. The VIFF values, all far smaller than ten, indicate the absence of multicollinearity between the nine independent variables, while the t-values indicate the level of significance of each variable: at 2015, four housing characteristics are significant at the 95% confidence level, including two building features (BF1 and BF2) and two urban features (UF2 and UF3), and one building feature (BF4) is significant at the 90% confidence level; at 2008, six housing characteristics are significant at the 95% confidence level, including four building features (BF1, BF2, BF4 and BF5) and two urban features (UF1 and UF4). Only one housing characteristic (BF3) is not significant in the model.
Looking at the sign of the estimated coefficients, just the variable “presence of noise” has a negative influence on housing price. Furthermore, another interesting result about the differences in households’ willingness to pay before and after the economic crisis is given by the values of the betas: for example, the presence of both elevator and heating system (BF2) would increase by 1452 €/mq housing price in 2015 and by 826€/mq in 2008, as well as the presence of a panoramic view (BF4) would increase by 568 €/mq housing price in 2015 and by 1649 €/mq in 2008.

Two main findings have emerged when comparing the regression results for 2008 to that for 2015. The first is the sensible reduction of the adjusted $R^2$ value that almost halved after the economic crisis, and the second refers to the different types of housing characteristics that significantly affect housing price in good and bad economy.

The substantial decrease of $R^2$ value – from 0.78 in 2008 to 0.47 in 2015 – suggests that the Neapolitan housing market has experienced a destabilization during the eight years of reference and, moreover, that some new elements, not considered in the model, may have a significant role in the definition of property value at 2015.

The other interesting difference between the 2015 and 2008 data set concerns the housing characteristics: from 2008 to 2015 the number of housing features significantly influencing housing price has decreased – from six to four – and, while Building typology and facilities are common to each set of data, the predictors View and Light quality were identified as significant factor in 2008 but not in 2015, as well as the two urban features Noise and Amenities have replaced Green areas and Accessibility. These differences suggest a strong change in households’ willingness to pay before and after the crisis; during good economy, Neapolitan home buyers preferred housing units with sea view and with a lot of natural light, while these housing features are not significant anymore during bad economy. Furthermore, after the crisis, the presence of green areas and metro stations does not increase the housing price as it did in 2008 because homebuyers consider more important the level of noise and the presence of public and retail amenities.
Conclusions

In this paper we have applied the hedonic price method to the housing market in Naples and we have considered two data sets, one for 2008 and one for 2015, in order to investigate the change in households’ willingness to pay before and after the 2008/09 economic crisis. The results of the regression analysis prove that worsened economic conditions have significantly changed the Neapolitan housing market. In particular, the strong decrease of the adjusted $R^2$ indicates a smaller reliability of the adopted model and suggests that further research could be conducted to identify any other factor that may have a significant impact on housing price during bad economy.

Furthermore, looking at the $t$-values of each of the nine considered housing characteristics, homebuyers’ have partially changed in their preference: two building features have maintained their relevance before and after the crisis (BF1 and BF2); four characteristics were considered significant during good economy but not during bad economy (BF3, BF4, UF1, UF4); two become of interest only when the market was declining (UF2 and UF3). Based on these findings, further research could be conducted to identify those characteristics that could help prevent property values from dropping.

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SMGI - Social Media Geographic Information and collaborative mapping: exploring new trends in spatial analysis
Social Media Geographic Information Visual Analytics

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Key-words: Volunteer Geographic Information, Social Media Geographic Information, Image Analysis, Passive Volunteer Geographic Information, Instagram.

Introduction

The use of Social Media Geographic Information in a planning process would improve our knowledge on urban and landscape development and support decision-making. This paper makes use of an environmental disaster that has happened recently in one of the most important social economic areas in Brazil to understand how this type of information could be used as a systematized planning input. Researchers seek to understand if it is possible to establish a connection between SMGI posts and the level of affection to shared content. In order to do that, we tested a passive SMGI analysis. Our best results so far relied on a proposal for image analysis from Instagram posts.

Analytics gathered from Social Media Geographic Information (SMGI) improve comprehension of community values (Borges, Jankowski and Davis Junior, 2015b). There are several information attributes made available by ordinary citizens within social network environments such as location, texts, videos, preferences, images and audio. The development of a systematic methodology to analyze information posted by ordinary people would contribute to landscape and urban planning processes. This paper presents a new methodological direction to investigate image collection from Social Media.

In Volunteer Geographic Information (VGI), citizens act as sensors. Its development leads to innovative models using social networks and is being denominated Social Media Geographic Information. Campagna (2015a) understands it as a deviation from a traditional vision of VGI and states that it may be used for both leisure and professional reasons. Ideally, it would allow integration and sharing of the resulting information flow.

In spatial planning it is highly recommended that citizens be heard. Acknowledgment and comprehension of the most important value variables for a group of people are keys to landscape and urban planning. After a serious environmental disaster happened on November 5, 2015 in the Quadrilátero Ferrífero (Iron Quadrilateral) region in Minas Gerais, Brazil, a case study using SMGI from an passive perspective was developed. The strategy of investigating passive SMGI was the analysis of Instagram images.

The purpose of this research is contributing towards identification of collective values, aiding local image reconstruction as well as subsidizing a landscape recovery plan in a new hazard area. The hypothesis pursued is determining whether it is possible or not to establish a connection between SMGI posts and the level of affection to shared content.
Methodology

A "passive VGI" analysis from Instagram messages was performed using LETICIA API11, a courtesy of LABIC (Laboratório de Imagem e Cybercultura - Laboratory of Image and Cyberculture of Federal University of Espirito Santo, Brasil). Messages since the day/time of the incident were downloaded aiming at analyzing values, behaviors and profiles of the posts. The expectation was to identify the genius loci (the essence of the place and its symbols) through the collective description and investigation of images, videos, text and geolocation of posts.

According to Borges, Jankowski and Davis Junior (2015a) the hashtag (#) is the main way to attach a category or a subject to a message in a social media environment. The authors point out that a semantic analysis should follow the potential words used by the group of people that is the research agenda’s focus. This could also help by indicating the profile of people related to the certain topic. Hashtags were selected in two ways: firstly, by researchers’ intuition #mariana #riodoce and secondly using a platform called Tagboard (available at tagboard.com), a real time search engine that favors the investigation of a hashtag, it was found a third tag: #sosriodoce. After a locational analysis of posts, from the three tags, the last was defined as most appropriate as they have a better rate of onsite posts. The download was done from November 5, 2015 to November 27, 2015.

Posts were collected and selected within a 10km distance from the affected area (Rio Doce River) to perform an image analysis was proposed to separate drawing, landscape and everyday life images. We imported photos into ArcGIS 10.2 and sliced the photos into 5 different colors. The reason why we choose five is based on studies of mental maps on semantic applied to cartography, that states the human capacity to understand and read the differences (Bertin, 1977).

A statistic analysis to show the standard deviation overall of polygons’ areas was next step. Finally image classes were defined regarding its standard deviation pattern in order to separate them into three image pattern: everyday life, landscape and meme (broadly spread multimedia content via internet).

Results and discussion

The everyday life (resulted in many small polygons in the picture (Figure 1 C) and the standard deviation among the shapes’ areas is low. The landscape photo segmentation resulted in large shapes, but also in small shapes in some parts, what results in medium standard deviation of polygon’s areas. The drawing memes resulted in very large areas in contrast with very small areas in the segmented representation, what presents a high standard deviation among the shapes’ areas (Figure 1 I).

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The images selected were automatically identified (everyday life, landscape and meme) and confirmed by a manual visual classification. Then the statistical analysis was performed to confirm the results.

A, B and C represent respectively 'everyday life', 'landscape' and 'meme' standard deviation of polygon's areas (Figure 2). The statistical results show fragmented images of everyday life with many polygons. The standard deviation found amongst everyday life's areas has a low reference. The landscape results into medium areas in the picture when compared to everyday life and image memes. The drawings or memes result into big areas with high standard deviation.
The quantitative analysis of the procedure applied at #sosriodoce dataset sample shows that the results confirm our first manual analysis with an overall confusion of 10%. Landscape was confirmed as the most challenging class as it has the highest mistake rate. Landscape images essentially mixes results with Everyday Life. This confirmed the insight that a second filter should be proposed to better separate Everyday Life and Landscape classes of image posts.

**Conclusions**

Passive SMGI is useful for understanding citizens’ values and increase knowledge for spatial planning. It represents a rich universe of information for research purposes as it needs less motivation efforts to get people involved as well as less investment in publicity.

A connection between SMGI passive posts and the level of affection to shared content shall be further investigated using a broader sample. The right choice of a hashtag (a dataset primary characteristic) can determine the success of genius loci catching. An analysis of number of “likes” could also be carried out by image categories and correlating them to location.

Further investigations into image classification methods should be done. Image classification was very efficient to separate drawings from the other two categories of everyday life and landscape. Confusion between everyday life and landscape is explained by the fact that it is commonplace to have people in landscape pictures. A second filter and/or image classification should be considered. We can suggest color pattern analysis as a possible path to follow.

The genius loci (the essence of the place, and its symbols) can be further investigated through the collective description of images, videos, text and geolocation of posts. The automatic process of the image classification can benefit the exploration into the values and behaviors of citizens involved in SMGI passive posts.

It is clear, especially in Brazil, that social media is used as a mechanism to manifest social and cultural issues. Memes with impact images or drawings with a critique were broadly shared. They represent the collective thought. Quantitative identification (using same area’s standard deviation value) and qualitative investigation of memes repetition should lead to good insights about collective values and thoughts. However, in the directly affected area a majority of posts refer to reality, meaning that it is also used as a mechanism to register occurrences.

In passive analytics, the aim is to capture information on society’s values and behaviors. That involves other issues that should be further analyzed: Does the sample correspond to reality? Does the profile of posters refer to local people? Can this investigation be performed in different geographic areas? Is this methodological proposal efficient in identifying collective behaviors? Or is it only a registration mechanism? Or maybe it is both?

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Beyond social networks contents: how Social Media Geographic Information may support spatial planning analysis

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Key-words: SMGI, VGI, Spatial Planning, Data analysis, Data visualization.

Introduction

Since the last 20 years, Information and Communication Technologies (ICTs), the Internet, and more recently the Web 2.0 platforms have fostered the entry of novel technologies into people's daily life. Current innovations are easing the production, the sharing and the access of multimedia contents that are autonomously generated and consumed by millions of users worldwide through web platforms or social networks sites, namely User-Generated Contents (UGCs) (Krumm et al. 2008). The wealth of UGCs, daily disseminated through the Internet, is potentially transforming the Web in a novel source of digital Geographic Information (GI) (Elwood et al. 2012), inasmuch most of the shared contents embed a spatial reference, thanks to the availability of global positioning system (GPS) and sensors in handheld devices, as well as, because of the advanced functionalities for georeferencing offered by geo-browsers or location-based social networks, utilized during contents' production. This phenomenon is enabling the forecasted convergence of social media and GIS (Sui and Goodchild 2011), facilitating interactions and the building up of constructive dialogues regarding places and social issues among users. Indeed, the broadening of the GI collection, use and diffusion, from a small group of experts to potentially the whole community, may trigger major changes to maps production and consumption (Engler et al. 2014), leading toward new scenarios of cartographic interactivity (Roth 2013) and, eventually, guiding the renaissance of GI (Hudson-Smith and Crooks 2008). At the same time, the contemporary ICTs diffusion and GI availability may foster noteworthy innovations in spatial planning methodologies and practices, potentially allowing new modes of working, communicating and participating. Commonly, georeferenced UGCs are referred to as Volunteered Geographic Information (VGI), stressing the voluntary role hired by users for freely collecting and contributing GI related to the geographic world in a bottom-up approach (Goodchild 2007). Particularly, a VGI subset called Social Media Geographic Information (SMGI) (Campagna 2014), namely GI implicitly and/or explicitly produced and shared through social network sites, may disclose notable opportunities for spatial planning analysis, allowing not only the collection of quantitative GI but also the extraction of qualitative data regarding users' perceptions on phenomena in space and time. However, the opportunities for using SMGI in spatial planning methodologies have to deal with major challenges related to data accessibility, management, quality and analysis. In fact, SMGI owns Big Data nature because of huge data volume, fast cycles of production and consumption, as well as, heterogeneous, unstructured and often noisy data streams, and, unfortunately, the traditional spatial analysis methods and techniques may be not fully suitable to address these hurdles to
fully exploit this information in practices. Despite in literature an increasing number of approaches is proposed, the access to SMGI by the public is still rather limited (Lazer et al. 2009) and common methods and tools to take advantage of this information still lack. In the light of these considerations, the paper investigates the SMGI data model, assessing its inherent differences from traditional vector datasets and focusing on the additional featured dimensions. Afterwards, a number of analytical options, which may be accessible to planners and practitioners to enrich the spatial planning knowledge basis through SMGI, are discussed. In this regard, several examples are provided with reference to a number of case studies carried out by the authors, wherein SMGI is proficiently used to support urban and regional planning analysis. Finally, a critical discussion is drawn from the results, arguing the potential relevance of SMGI for supporting spatial planning and identifying future research agenda.
Methodology

The wealth of SMGI, offering insights on users’ concerns and freely accessible through the Internet by social media Application Programming Interfaces (APIs), may disclose opportunities to monitor opinions and perceptions of users about experienced phenomena, as well as, their movements and behaviours in urban environments. However, major issues may limit these opportunities, such as the lack of user-friendly tools to collect and to manage huge unstructured datasets and the particular data model of SMGI, which may be barely processed through standard methods without a loss of information.

While the former issue is starting to be addressed by new tools emerging to deal with Big Data, the latter issue may need the formalization of novel analytics methods in order to fully exploit the contents embedded in the different dimensions of SMGI. As a matter of fact, SMGI is inherently different from usual vector spatial datasets, which contain exclusively spatial and thematic attributes. SMGI data model features spatial, temporal, user and multimedia dimensions, thus extending the range of analytical opportunities. In addition, in certain cases, SMGI supplies a preference dimension too, namely the social networks community’s appreciation about a topic, expressed through scores, stars or likes/dislikes, thus further expanding the analysis options (Campagna et al. 2015). Moreover, any web platform used to create and disseminate SMGI may present specific features regarding contents’ production and sharing, causing issues in integrating and analysing information collected from different sources. Particularly, the multimedia dimension (i.e. text, picture, audio, video) makes it difficult to properly investigate this information by means of traditional query languages, exclusively. In order to better explain the particular nature of SMGI, Figure 1 shows the graphical representation of a general SMGI data model, identifying the available analytical dimensions and exposing the differences from traditional vector datasets.

From an analytical perspective, any framework should include not only common spatial analysis methods, but also new tightly integrated methods in order to deal with temporal, user and multimedia dimensions. In this regard, the authors propose a framework to fully exploit SMGI, namely SMGI Analytics, for enriching the knowledge basis about the local context and for supporting spatial planning practices. Operatively, the framework consists of several analytic methods, which may be used in different scenarios for investigating spatial and temporal patterns, as well as users’ behaviors, movements and preferences. In the next section, the methods are briefly described with reference to results obtained from several case studies conducted by the authors using SMGI collected from different social media platforms. Despite the differences in the studies’ purposes, the first step, required to conduct investigations on SMGI, is always data collection, which is carried out by querying social networks APIs by means of natural language, temporal, spatial and/or user queries. With regards to the case studies presented in
this paper, SMGI data are collected from Instagram, Foursquare, Booking.com and TripAdvisor through spatial and temporal queries, exploiting the functionalities of ad-hoc tools, developed by the authors, to access, extract and manage this kind of data directly in GIS environment.

**Results and discussion**

The SMGI Analytics framework consists of several methods, which may be used to elicit knowledge useful for different planning scenarios, such as:

- **Spatial analysis of users’ interests.** SMGI may be used to investigate the patterns of users’ interest in space by density and/or clustering functions. Overlying official information and SMGI may offer hints to public authorities to understand which places attract the major interest and how they are perceived by users. An example is shown in Figure 2A, where Instagram SMGI is used to detect clusters of highly visited areas in the Poetto Beach of Cagliari municipality, meanwhile Foursquare SMGI is used to identify the venues potentially causing the attraction phenomenon within the identified clusters (Floris et al. forthcoming).

- **Spatial statistics on users’ preferences.** SMGI collected by spatial units may enable the spatial statistic analysis of users’ preference. An example is given in Figure 2B, where the hot-spot analysis is applied at the regional scale in Sardinia (Italy) on SMGI collected from Booking.com and TripAdvisor social platforms, to quantitatively study the distribution by municipality of positive users’ assessments and to investigate the reasons behind users’ preferences for certain specific destinations or areas (Floris and Campagna 2014).

- **Multimedia contents analysis.** SMGI multimedia contents might be analysed to extract further useful insights. However, albeit currently available texts analytics may enable the investigation of natural language texts, the extraction of knowledge from other multimedia contents is more difficult thus far.

- **Temporal analysis of users’ patterns.** SMGI may allow studying when specific destinations, neighbourhoods, public spaces, or other services are used during different time periods. An example is shown in Figure 3, where Instagram SMGI, related to a public space in the Cagliari municipality, namely the Regional Park of Molentargius and the Poetto Beach, is examined to identify users’ utilization patterns of these areas during different periods (Massa 2016). The temporal patterns of weekdays and weekends show notable similarities, while patterns of monthly distribution expose evident differences between summer and winter.

- **Users’ behavioural analysis.** SMGI may enable the investigation of users’ behaviours in space and time. Moreover, the user dimension might be used to segment local community’s contributors in groups according to common demographic characteristics, preferences and habits, leading toward the potential application of user profiling into spatial planning methodologies (Massa, ibidem).

- **Combination of several analytical methods.** A combination of SMGI Analytics methods may foster to gain further insights about what people discuss and perceive, as well as, how they interact, move and behave both in space and time, allowing in detail investigation of urban environments and local communities (Campagna et al. ibidem).
The aforementioned SMGI Analytics methods, as well as the provided results provide a picture demonstrating how this type of information might be proficiently used in spatial planning domain to enrich the available knowledge basis with further information usually excluded from practices. As a matter of fact, SMGI might be used to elicit information, not only about the physical geography of places, but, overall, to gain insights about the perceptions, the concerns and the habits in space and time by the involved community, adding a multifaceted perspective for spatial planning and decision-making.
Conclusions

The contribution discusses the increased availability of SMGI over the global Internet and the opportunities that this type of information may provide to support spatial planning analysis. Currently, the wealth of information enclosed in SMGI may be used to investigate both quantitatively and qualitatively urban environments and local community preferences and habits, greatly extending the range of analytic options. Nevertheless, in spite of notable opportunities for analysis, it is necessary to be aware that SMGI should not be considered representative of the whole local community. As a matter of fact, social networks are differently used by diverse population groups, which may strongly affect the phenomena under observation with their preferences and cultural biases. Social networks' growth trends suggest that in the future a wider diffusion of these services might occur across all population groups; however, at the time being, different analytical approaches, built upon several platforms, might be required to investigate local context and users' dynamics, appropriately. Furthermore, a number of issues should be further investigated and better understood including the issue of privacy and reliability of shared information. However, early results may be considered very promising and may open alleys for future research streams oriented at fully exploit the SMGI potential in spatial planning practices.

References


Introduction

Nowadays, urban planning and urban studies are increasingly based on the extensive use of digital geographic information. Traditionally, these processes utilize digital data, created by public administrations or private agencies within institutional or legal frameworks, called Authoritative Geographic Information (A-GI) (Ball 2010, 1; Goodchild and Glennon 2010, 233). The development and the use of A-GI is greatly fostered by the implementation of Spatial Data Infrastructures (SDIs), which allow planners to access and to share A-GI according to well-established frameworks in order to better support the planning processes. At the same time, the development of Web 2.0 and the diffusion of geobrowsers and GPS (Goodchild 2007b, 5-8) allowed citizens to act as voluntary sensor for producing and sharing geographic information called Volunteered Geographic Information (VGI) (Goodchild 2007a, 2-3).

In addition, last years have faced a wide diffusion of georeferenced multimedia contents, produced by millions of users through social media platforms (e.g. Facebook, Instagram and Twitter), establishing a new source of spatial data, namely Social Media Geographic Information (SMGI) (Campagna et al. 2015, 42-47). SMGI is an implicit VGI (Craglia et al. 2012, 7-10) and shows the distribution in space of people's perceptions about facts (Campagna 2014). Consequently, a city planner could “listen” what the citizens feel and communicate in the different places (Campagna 2014); therefore, SMGI could be used to extract useful information for urban planning (Campagna et al. 2015, 42-47). However, still now, there is a lack of a common analytical framework to investigate this new source of data.

The aim of the paper is twofold. On the one hand, it proposes and deepens the analytical framework developed by Campagna et al. (2015, 42-47) as a common methodology to analyse effectively SMGI. On the other hand, the long abstract explores if SMGI, singularly or integrated with A-GI, may be used to support urban analyses and planning, especially with regards to urban public space analysis. The actual case study of Expo Milano 2015 is presented in order to investigate these two perspectives.
Methodology

A potential analytical framework to investigate SMGI is proposed by Campagna et al. (2015, 42-47), wherein several methods are supplied to analyse SMGI both singularly or integrated with A-GI. Mainly, the provided methods concern:

- Spatial analysis of user interests;
- Temporal analysis of user interests;
- Spatial Statistics of user preferences;
- Multimedia content analysis on texts, images, video or audio;
- User behavioural analysis;
- A combination of two or more of the previous, such as spatial-temporal analysis.

In addition, it suggests the use of GIS for carrying out these analyses (Campagna et al. 2015, 42-47). The framework is recent and it was utilized successfully at the regional or local scale, but it was never applied at large scale of the public space. Hence, the paper applies the methodology for the first time in the analysis on the urban scale to support urban planning.

Case study: Expo Milano 2015

The authors selected the actual case of the World Exposition Expo Milano 2015 to prove the efficiency of the analytical framework on urban scale. Expo’s site has a regular structure such as the traditional design of roman cities and different accessible typologies of spaces compose it. Consequently, the site is similar to an urban public space in a city centre and its analyses could give suggestions on the urban space analysis. In this study were used SMGI data from Instagram, a recent Social Media platform principally based on sharing photos and images, which has been seldom used in SMGI analysis research to date. The investigated information were all contents localized into the Expo’s site. The dataset comprised 128,805 records (red points in Figure 2.1) published from 63,125 users. In addition, A-GI were integrated with SMGI in order to describe the different typologies of Expo’s spaces (Figure 1) and to ease the analyses.

Fig. 1. SMGI and A-GI.
Results and discussion

With the aim of extracting useful knowledge from SMGI, the number of published contents (N. photos) and the number of users (N. users) were identified as two possible indicators of visitors’ interest (or popularity). Below the results are discussed.

First of all, a spatial analysis was conducted on the N. photos and N. users in the different typologies of spaces and the results (in percentage) were compared to their total value on the entire site (Figure 2). The exposition areas “Countries” and the “Free spaces” show the highest popularity. In detail, the interest toward “Free spaces” (squares, and pedestrian paths) is concentrated (97.47%) exclusively in the space surrounding the “Tree of Life”, one of the principal attractions of Expo. Therefore, this place may be considered as the only free space really utilized and appreciated by visitors, meanwhile, other free spaces were probably seeing exclusively as passages. Consequently, for the urban public space analysis it is not obvious the fruition of unbuilt areas, squares and pedestrian paths, although they may obtain more identity and utilization thanks to the presence of attractive elements inside.

![Fig. 2.](image)

Secondly, the results arise from a spatial-multimedial analysis conducted on the SMGI dataset. The authors visualized samples of photos to understand the objects of interest, finding the three likely major reasons of popularity: external design, food brand, technological or attractive elements inside. These identified patterns could lead not only visitors but also citizens, in general, to prefer some sites, places or shops instead others; suggesting new knowledge on what city’s areas are preferred and lived majorly by the people, thus supporting urban space analysis. Moreover, the places were also studied according to the temporal component of SMGI, relying upon a spatial-temporal analysis. For this purpose, the authors created and utilized a new indicator called difference of popularity:

\[
\text{difference of popularity} = \left( \frac{N.\text{photos}_T}{N.\text{photos}_{T,J}} \times 100 \right) - \left( \frac{N.\text{photos}_J}{N.\text{photos}_{T,J}} \times 100 \right)
\]

Where: \(I\) indicates four time intervals analysed (10.00-13.00, 13.00-16.00, 16.00-20.00, 20.00-23.00), \(T\) represents the total time considered, \(j\) the typology of space investigated and \(J\) the entire Expo’s site. Therefore, the difference of popularity investigated the increasing or diminishing interest for each typology of space compared to the total site’s interest, according to time (Figure 3). The charts in Figure 3 show how the visitors’ interests and uses are mostly in the principal exposition areas (column left) and in other spaces (column right) during the day and in the evening events in the night (central column). Therefore, the analysis could give the possibility
to monitor the citizens’ perception of an urban public space in real time, fostering the elicitation of knowledge about how the persons live and use the spaces. Conversely, spatial-users analysis was used to study the dynamics of visitors and site, selecting the users with more than one expressed interest (published photo). For each of them was calculated the ratio between the envelope’s surface of their photos with the envelope’s surface of the entire site; the Figure 4 shows these values. The 77% of multi interest users have a ratio minor than 10% (small areas). Accordingly, it could possible to assume that the visitors enjoy only a small portion of the Expo site. This result may suggest some clues on the urban public space’s design or Expo’s design, such as the presence of a big number of attractions in a small part of the entire area or a difficulty of movement (caused by queues), which may be two possible causes of the obtained output.

In addition, a temporal-spatial statistic was measured using the Emerging Hot Spot Analysis to gain further information on visitors’ dynamics within the Expo. The method divided the Expo site in regular cells and identified the cells whose N. photos probably depended spatially by the number of surrounding photos. In Figure 5, there are clusters of cells and the pavilion, inside them, with spatial dependence. Therefore, it is possible to use this analysis to investigate if a place in an urban public space is attractive on its own or if attraction is partially due to near popular areas. Lastly, the results above described are resumed in Table 1 It identifies for each type of analysis the obtained output, showing the relationships existent between the adopted framework and the new extracted knowledge for Expo and eventually for urban public space.
Comparison between SMGI and empirical information
SMGI does not ensure quality and credibility of results due to its particular nature. To address this issue, the authors compared the results obtained from SMGI analysis with data provided by empirical information (e.g. official surveys), showing how SMGI could give reliable outputs.

![Fig. 5. Clustering of cells with spatial dependence (left) and the pavilion inside (right).](image)

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Results of Expo</th>
<th>Results of urban public space</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spatial analysis</td>
<td>Possible trend of visitors’ interests</td>
<td>Possible way to use the free spaces</td>
</tr>
<tr>
<td>Spatial-multimedial analysis</td>
<td>Possible reason of visitors’ interest</td>
<td>Possible reason of interest of places</td>
</tr>
<tr>
<td>Spatial-temporal analysis</td>
<td>Possible interest and use of places in space and time</td>
<td>Monitoring</td>
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<td>The use of the site by visitors</td>
<td>Suggestion on the urban public space’s design</td>
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<td>Temporal-spatial Statistic</td>
<td>Spatial influence of visitors’ interests</td>
<td>Possible use of SMGI to know spatial influence</td>
</tr>
</tbody>
</table>

Policy of publication
The authors also studied the policy of data publication by Instagram, showing how the social platform changed the rules for georeferencing data during the study, de facto decreasing the spatial accuracy of SMGI and thus limiting the potentiality of investigation. Further studies may face the relations between technicians and companies like Facebook, which hold the entire datasets without no one standard or agreement.

Conclusions
SMGI is a new source of information made available by recent advances in ICT and Web 2.0 technologies. Often, SMGI precision is not known and the potentialities for using this kind of information may depend on the agencies/companies that publish it. Despite these issues, SMGI may provide useful information for urban planning. In this regard, an innovative analytic framework to investigate SMGI (Campagna et al. 2015, 42-47) is introduced and applied on an Instagram dataset for exploring urban public context. The paper shows as the methodology may be able to extract effectively information from these data, analysing also SMGI in an integrated way with A-GI. In addition, the obtained results could give innovative suggestions on:
- the relation between visitors and Expo’s site;


- the relation between citizens and urban public space;

In conclusion, SMGI and the proposed analytical framework may represent a way to gain new knowledge, useful for integrating traditional data and supporting urban space analysis.

**Acknowledgment**

The research was conducted by the precious contribute of all four authors. In addition, Campagna and Rabino has selected the theme; Campagna and Massa have lead the acquisition of data; Campagna, Gallo and Massa have operatively treated and investigated the dataset according the analytical framework and Campagna and Gallo have interpreted the results.

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The use of SMGI in supporting tourism planning practices: an innovative approach for the municipality of Cagliari

Roberta Florisa, Pierangelo Massaa, Michele Campagna

Key-words: SMGI, Spatial planning, Tourism planning, Users' perceptions, Data analysis.

Introduction

Tourism is commonly recognized as a spatial (Peroni 2007) and soil consumption (Boccagna 2010) phenomenon, which comprises the travel to and around a destination, with the purpose of exploiting particular natural or non-natural attractions, accommodations, general and specialized services (Smith 1991). It may generates positive and negative impacts within the social, cultural and environmental domains (Buhalis 1999). These impacts may become more evident when tourist activities are not adequately developed and planned (Briassoulis 2002).

In Sardinia, the tourism sector is one of the major driving forces of regional economy and mostly affects coastal areas, which have usually been considered as locations to be planned in a special way, due to their fragility, for the number of activities and possible land uses (Hospers 2003). As a result, various interests, such as those of residents, developers and environmentalists, may meet in coastal areas and come into conflict. Thus, the Regional Executive Committee decided to prepare the Regional Landscape Plan (RLP) together with the Regional Plan for Sustainable Development based on Tourism (RPSDT), in order to preserve cultural and natural landscape and to promote sustainable development based on tourism. The RPSDT focuses on the relationship between economic benefits and environmental impacts of tourism services supply; however it lacks of a global strategy of sustainable development, as well as of an effective stakeholders’ involvement and of a deep analysis of tourists’ behaviours.

Understanding tourists’ behaviour and psychology may help in assessing some of the problems that planners and decision-makers need to solve for the tourism planning implementation (Briassoulis ibidem). Indeed, good planning process needs to engage local communities and recipients directly in its implementation (Zoppi 2012).

In the Digital Information age, tourist preferences data, available on online forums and reviews, are generated by users and may provide relevant knowledge for planning practices (Campagna et al. 2015). Moreover, the integration of this information, namely Social media geographic information (SMGI), with official data, or Authoritative geographic information (A-GI), may represent an opportunity to enrich tourism strategies with a broader, deeper and more multifaceted knowledge of the places.

In the light of these premises, the paper aims to demonstrate the potential of SMGI for supporting tourism planning practices, and the benefits derived from informing local initiatives with a pluralist user-oriented view on strategic development issues. An innovative approach, applied to a case study concerning the municipality of Cagliari, is presented, by which tourists’ preferences are discovered by processing and analyzing publicly available social media data.
Methodology

The methodological approach builds on a preliminary analysis regarding the tourists’ social networks’ contents for the Sardinia region, in order to identify the spatial distribution of tourists’ preferences and the relationships between the quality of tourist lodging services (TLSs) and their geographic locations. Effectively, the study is carried out through the following four steps:

- Data collection from Booking and TripAdvisor and geocoding;
- Preferences’ dynamics analysis;
- Geographically weighted regression (GWR) model (Fotheringham et al. 2002) estimation;
- Complementary SMGI extraction from Instagram and Foursquare.

The first step consists of the construction of a database based on rankings, which are drawn from tourists’ ratings extracted for the period May 2012-May 2013 from Booking.com and TripAdvisor. The dataset includes both quantitative information concerning the TLSs’ scores and qualitative information related to TLSs’ inherent characteristics and tourists’ textual reviews. The main issue is to manage this huge amount of information. Thus, the study requires the adoption of a mixed methodological approach. The second step includes the implementation of a spatial analysis of users’ opinions and attitudes, relying upon spatial statistics methods and spatial, temporal and textual analysis, in order to identify clusters of TLSs showing high concentration of users’ preference at the regional level. Afterwards, at the local level in the destination of Cagliari, analyses are developed in order to discover through the investigation of textual contents why tourists prefer some destinations rather than others (qualitative analysis), meanwhile, a quantitative assessment, regarding the location of tourists’ preferences and the factors that contribute to this phenomenon, is implemented integrating SMGI and available A-GI.

In the third step a spatial regression is used for modelling the preferences phenomenon and testing the reliability of the hypothesis derived from textual analysis, in order to identify leading success factors of destinations and make appropriate decisions in terms of policy. Finally, in the last step we evaluate in more detail the study area, identifying the points of interest (POI) as perceived by tourists and local community through social network contributions. This step is carried out by extracting a complementary SMGI dataset from Instagram, related to the period May 2012-May 2013, processing data by means of a spatial clustering analysis and extracting Foursquare SMGI in order to identify the most attractive venues within the detected clusters.

Results and discussion

Geocoding is run on the extracted addresses of each tourism lodging service (TLS) collected from Booking.com and TripAdvisor within the Sardinian region. A unified database of 992 records is finally defined. The analysis’ results reveal that the spatial distribution of the tourists’ reviews on the TLSs is divided into five types of accommodation: bed and breakfast (15.7%), agritourism (6.0%), hotels (42.0%), residences and resorts (7.3%) and tourist houses (29.0%). The analysis of the tourists’ preferences related to the coastal and inner areas of Sardinia revealed that a 92.0% of tourists’ reviews concerns TLSs located in the coastal areas, while less than an 8.0% are related to the inner areas. Possibly, this may indicate that thus far only a few tourists are attracted by inner areas, which allow discovering a less popular side of the island, characterized by its significant natural and cultural heritage and tradition-related resources. For each TLS, the database includes a score record that is the average of six attributes, namely geographic position, services’ proximity, price/quality ratio, staff quality, room cleanliness and TLS’s perceived comfort. Data are normalized and ranked by the same scale in order to identify the locations
most affected by Tourists’ positive preferences incidence (TPPI) in Sardinia. Results confirm that the municipalities located along the coastal area attract tourists, while the inner areas are less attractive.

Afterwards, integrating SMGI and A-GI and carrying out spatial analysis, textual analysis and statistical techniques, the study investigates the potential reasons behind the tourists’ preferences toward certain locations (qualitative analysis). The SMGI-based analysis assesses the success factors, namely the determinants (explanatory variables) of the high TPPI rates (dependent variable), concerning the Cagliari municipality, which is considered among the best-selling destinations by different tourists’ typologies. The spatial clusters of preferences are detected by hot-spot analysis (Getis and Ord 1992). The location of each TLS allows detecting sites where the preferences of tourists who visited Cagliari are focused on. Firstly, a threshold distance of 1,700 meters is identified and the spots by census tract summarized. The darker areas, located in the inner areas of the municipality, show high concentration of the TPPI phenomenon (hot spot), while the lighter areas, located in Pirri, that is a peripheral residential area, represent locations where the phenomenon is less intense (cold spot) as shown in Figure 1.

The next step focuses on each review’s content in order to understand what tourists think about Cagliari. Hundreds of textual reviews on TLS are processed by means of simple text analytics, identifying the most used words and consequently the spatial or physical aspects more attracting users. While most of the words refer to municipalities physical factors, such as ‘city centre’, ‘beach’, and ‘church’, other words are related both to leisure sites, that is ‘restaurants’ and ‘shopping’, and to TLS’ supplied services, such as ‘staff’ and ‘room’. Moreover, a number of keywords concerning accessibility, such as ‘proximity’ and ‘walking’, are frequent too, potentially indicating a correlation with TLSs spatial location. This is not the kind of information we usually find in land use-related planning documents, but it may be powerful in supporting design and decision-making.

The spatial relationships and the explanatory factors behind observed spatial patterns are modelled using the GWR. The aim of the regression is to discover what factors contribute to the TPPI rate. The model is applied to a sample of 150 TLSs spatially distributed over 100 of the 1359 Cagliari’s census tracts. The dependent variable is the score of the TPPI, normalized as fraction of the comments that are positive for a location belonging to a census tract. For each census tract, a measure of the set of independent variables, concerning topography, transport infrastructure, cultural heritage sites, and socio-economic features, is calculated. The results of
the statistical tests for measuring redundancy (Variance inflation factor or VIF test, Mennis 2006) suggest that the following candidate variables are included, normalized by the total census tract's area:

- number of historical buildings in the TLS’ census tract;
- number of restaurants and facilities in the TLS’ census tract;
- proximity to the historic center of the municipality;
- distance from the airport;
- hectares of natural protected areas in the TLS’ census tract;
- distance from the municipality's beach.

A spatially-lagged explanatory variable is added to control for spatial autocorrelation of the dependent variable. The presence of spatial autocorrelation (Anselin 1988) related to the value of the normalized TPPI, is detected through the Moran’s test (Moran 1950).

Tab. 1. GWR model: influence of each explanatory variable on dependent variable.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>z-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPPI_lag [19]</td>
<td>0.0663</td>
<td>0.0307</td>
<td>2.1621</td>
<td>0.0306</td>
</tr>
<tr>
<td>Constant</td>
<td>0.0031</td>
<td>0.0102</td>
<td>0.3012</td>
<td>0.7633</td>
</tr>
<tr>
<td>N_restaurants</td>
<td>-0.0390</td>
<td>0.0300</td>
<td>-1.3013</td>
<td>0.1932</td>
</tr>
<tr>
<td>Proxy_historic_center</td>
<td>0.4748</td>
<td>0.0585</td>
<td>8.1146</td>
<td>0.0000</td>
</tr>
<tr>
<td>N_hist_buildings</td>
<td>-0.0273</td>
<td>0.0313</td>
<td>-0.8724</td>
<td>0.3830</td>
</tr>
<tr>
<td>H_natural_areas</td>
<td>0.0027</td>
<td>0.0096</td>
<td>0.2834</td>
<td>0.0777</td>
</tr>
<tr>
<td>Distance_airport</td>
<td>0.7661</td>
<td>0.0340</td>
<td>22.5511</td>
<td>0.0000</td>
</tr>
<tr>
<td>Distance_beach</td>
<td>0.5470</td>
<td>0.0383</td>
<td>14.2922</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

The result of the local Moran’s index is quite significant at the second order of contiguity in respect of results obtained using a threshold distance of 2,500 meters: adjusted R-squared is less than 40%, the p-value of the dependent variable’s coefficient is very significant (1.0 10^-8) and the value of the Moran’s index is 0.024. The very low p-value indicates that the spatial autocorrelation of the dependent variable is highly significant. The results regarding the goodness of fit of the spatial regression, shown in Table 1, are significant: R-squared, namely the measure of the size of the variance of the dependent variable explained by the set of the explanatory variables, is as high as 86%, indicating that variables in the model are able to explain about 86% of the TPPI’s variance. The results of the GWR are quite significant for the description of the spatial distribution of TPPI. The coefficients of the variables related to the distance from the airport, to the proximity to the city centre and to the proximity to the beach, which concern the TLSs’ location, show positive signs and are almost always significant (p-values less than 5%). The variables related to the restaurants and to the historical buildings are not very significant, for the p-values are bigger than 10%, while the hectares of natural protected areas show a positive sign and a 8% significant coefficient. Overall, these findings suggest that the spatial interest of the tourists is quantitatively influenced the geographic locations and the services supply.

Finally, the last step concerns the complementary extraction of SMGI from Instagram and Foursquare, eliciting further knowledge related to specific public spaces in Cagliari municipality, namely the Poetto beach and the Regional Park of Molentargius. Integrating data from multiple sources may allow detecting POI in the study area, easing to understand the reasons behind the GWR model explanatory variable ‘proximity to the beach’. Data collection is conducted for the
period May 2012-May 2013 and results in a dataset of 34,776 geotagged photos. Then, a cluster analysis by DBSCAN algorithm (Ester et al. 1996) is run on the dataset, identifying 220 clusters of interest in the area. The results confirm the major interest of users toward the coastal area, probably because of the presence of popular venues. In order to gain further insights about the users’ preferences, a Foursquare SMGI extraction is carried out identifying the type of the most visited venues in the clusters.

The extraction results in a dataset of 177 POIs, which are assigned to clusters and evaluated in terms of typology and specific degree of attractiveness, as shown in Figure 2. The obtained results demonstrate the SMGI opportunities to supply information related to the geography of places, while enabling at the same time a more detailed characterization of the public spaces with information usually not available to planners.

Conclusions

This paper discusses a methodological approach for exploiting SMGI, a novel source of information that may be integrated with official information and used in tourism planning, in order to take into account a multifaceted tourists’ oriented view on strategic development issues. The findings, providing insights on the Cagliari’s tourism dynamics, might be effectively implemented into planning policies whose objective is to increase the tourists’ satisfaction and foster sustainable development policies. With reference to the results obtained for Cagliari destination, several policies may be identified, such as:

- improving protection of the municipality of Cagliari’s natural areas, since the coefficient of variable ‘H_natural_areas’ is positive and significant;
- improving the accessibility of the Cagliari’s historic centre, since the coefficient of variable ‘Proxy_historic_center’ is positive and significant;
- the accessibility of the Cagliari’s beach and increasing the supply of facilities for tourist reception since the coefficient of variable ‘Distance_beach’ is positive and significant;
- improving the range of offered amenities along the beach, since users and tourists may be attracted by a diversification of services, as suggested by the identified clusters’ area (Instagram) and successful detected POIs (Foursquare).

In conclusion, users’ preferences knowledge in supporting the tourism planning processes may represent a significant implication for future research in the field of social sciences and tourism.
management. As a matter of fact, the proposed case study emphasizes the importance of the stakeholders (users or tourists) within the inclusive processes. In this regard, their behaviours may strengthen or discourage the existing power relations fostering more democratic and transparent processes. Early results are promising and disclose challenging research opportunities, which may bring innovation to tourism planning, design and decision-making.

References


Real society in virtual space: a new platform to share responsibilities

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Key-words: civic media, We-government, urban regeneration, participation.

Introduction

The engagement activities promoted by public or private stakeholders and oriented to involve people in decision-making processes about the city transformations rarely imply or lead to share responsibilities among all players involved in these activities. Indeed, a clear attribution of responsibilities in acting and pursuing common objectives is not needed when the proponent's goal is to gather a wide support to decisions already made, or when the domain of choices deal with topics too specialized to be understood or interesting for a general public, or when short term negative consequences causing oppositions and protests are functional to a substantial advantage on a long term perspective.

On the contrary, sharing responsibilities is a precondition to succeed in urban regeneration processes, integrating top-down and bottom-up initiatives. In these cases, an active and a proactive involvement of each part of the society, ranging from public authorities to informal groups, is required to implement concrete actions finalized at increasing the local well-being despite the scarcity of economic resources. Finding concerted and effective solutions to local problems (mostly rooted in the social-economic context than in physical environment) is strictly related to the enhancement of the available material and immaterial resources and based on a widespread awareness of their value [Rogers, 2004]. Implementing these solutions rely on the shared will to invest time and resources by all stakeholders involved in the regeneration process, because they choose to act or not to act according to the direct consequences of their actions on their role in the community and in their personal, professional, and civic networks. In order to achieve significant results in improving the life quality at least at neighbourhood level and strengthen the community resilience, personal motivations and specific goal of individuals and organizations must be conveyed into a common vision aimed to harmonize them.

Public administration and civil society are strictly interconnected in any regeneration actions and transformation of the territory, because public programmes devoid of citizen support have low impact and bottom-up proposals must find their political and administrative framework to implement [Noveck, 2009]. Therefore, in parallel to conventional communications tools and protocols, public administrations and citizens are increasingly using new technological applications and social networks seeking new forms of collaboration [Castells, 2009].

1) How can we connect real life (with its own dynamics, players, roles, perspectives, plurality of goals, etc.) with a virtual space where each player is able to represent, document and improve his own contribution to the city transformations and to the wellbeing of communities and of the society?

2) How to enhance the existing relationships using a digital media without compromising mutual trust and sense of responsibility among local players?
State of the art

Until now and for different reasons, Facebook and Second Life have been the main instruments used to test new communication procedures between PA and citizens [Evans-Cowley, 2010], but they are not designed nor intended for this purpose.

Facebook is a social network based on sharing contents about users’ personal life within groups of friends. Using Facebook for institutional informative campaigns, public consultations or discussion groups about local issues is a misuse of the instrument that finds its own limits in the fact that it has been developed for different type of activities in a different relational context based on friendship and not on civic/territorial networks, public/private partnerships and multi-level social structures. In fact, Facebook allows to provide information and optionally to discuss on topics, but between communicating and planning there is a huge difference regarding procedures, players, responsibilities and objectives.

Second Life is an online virtual world application where it is possible to create 3D models of build environments and a virtual representation of users (avatars) acting within these models. It has been used in some experimentation to recreate spatial models of areas of interests in order to facilitate people involved in participatory workshops in understanding the volumetric structure of their neighbourhood [Foth, 2009] [Hudson-Smith, 2009]. In these cases, there are three problems: the first one is that the city is an integrated system, strictly dependent from its territory and the “island model” of a part of the city disconnected from the rest precludes an accurate frame of the context; models representing the reality and fictional models can coexist in Second Life; and finally, urban regeneration projects involves primarily the functional and relational aspects of the city and these cannot be represented in a 3D model [Gordon, 2009].

The experimentations reported in the literature in reference to Facebook or Second Life show a low level of involvement, but above all the absence of tangible results as outcome of participation paths [Evans-Cowley, 2010]. In our opinion, in addition to the misalignment of the purposes of these tools with the purposes of engagement activities, there are other assumptions defining an unrealistic social model conveyed by these tools.

1) The illusion of one-to-one relationship between public administration and citizens, both seemingly individual users in technological platforms. The relationship of the PA as a whole is primarily oriented to specific intermediate structured bodies as organizations, associations, business, institutions, etc. Agreements involving a mutual assumption of responsibilities between PA and other parties aimed at the realization of programs and projects in the city are always signed between legal entities [Linders, 2012].

2) The misunderstanding between area-based initiatives and network-based initiatives at local level (Lawson, 2010). Mark out an area of interest and assume that in that area there is a homogeneous community to consider the target group is a deviant simplification of the reality. Indeed, each citizen is placed in multiple personal, professional, civic or territorial networks simultaneously at different scales, and these networks involve a myriad of people or groups that may carry very different values, objectives and types of interaction [Gilchrist, 2009]. The model of citizens as isolated individuals inserted into one spatially defined community leads to an underestimation of the operative potential of existing real networks at local and urban level.

3) The levelling of the contributions of each actor potentially involved in local regeneration. This assumption does not reflect the balance of power among different actors at local level and their different capacity for action.
Methodology

We are developing an urban data platform focused on the public dimension of actions made by each public or private player in the city and aimed to support new form of interaction among Public Administration, organizations, institutions, and business to cooperate actively in local initiatives, regeneration programmes, transformation projects. This platform is named FirstLife and it is a map-based social network where users can contribute by creating new geo-referenced and timed entities (places, events, news, groups, insights) or by adding new contents to the existing ones.

In FirstLife, users can:

- search information at different scales, from city blocks to neighborhood to the metropolitan area;
- share news and experiences with other users and manage discussions or focus groups;
- enhance local resource mapping places, activities, projects, stories;
- organize operational groups to work for a project or to cooperate in local initiatives;
- manage and promote events and projects, institutional and private;
- document their activities over time in a participatory way together with people involved in them.

In other words, make public their contribution to the life of their city as a citizen, association, institution, local administration, business, etc.

FirstLife users can be individuals (citizens), and collective users (organizations, association, administration, business), because our goal is to provide a virtual space adherent to the real composition of society and to offer a web application to facilitate group coordination and self-organization to act together, relying on transversal networks and public/private partnership.

FirstLife has been developed following a participatory approach involving different kind of stakeholders in defining needs, expectations, users cases and applicative scenarios. These inputs has been interpreted at technological level and translated into platform functionalities and features. The engagement of local players in the design process of our platform has been structured in three phases, followed by a fourth step to finalize and spread the use of the platform through their existing networks.

In the preliminary phase, we organized a living lab opened to public and private actors (associations, local authorities, university, companies and professionals) to collect input and define the requirements of a new web application intended to support real communities and co-production processes at a local scale. In this occasion, participants have worked on five topics: services accessibility, group coordination, local promotion, events management, and activities documentation. We have organized mixed team with members belonging to different sectors of society (third sector, university, municipality, professionals, etc.) and we have invited them to take into account perspective, competences, roles, and needs of others. We started to build and spread the awareness about the limitations of the existing social network in relation to public goals and we collected inputs to orient the FirstLife developments.

As second step of the participatory process, we carried out a verification protocol on our design choices. Within the framework defined by the principles of public utility and public interest of the platform and the requirements previously defined at a theoretical level, we asked for an assessment about the social acceptability and usability of the platform features implemented on the basis of our design choices from the perspective of the usage scenarios of each player. In this phase, we have organized a series of meetings reserved to people interested in FirstLife or we were collaborating with. We presented the current status of the platform, we tested new functionalities and we collected suggestions or critical aspects related to the platform usability. Another important goal of this phase was to gather uses cases from our potential user, in order to model features to be responsive to the expectation and needs expressed by local players.
In the third phase, still on going, we started the experimentation by organizing a number of workshops where we work with groups on how to use the entities and functionalities available on the platform in connection with some scenarios proposed by participants. Those scenarios are related to their roles, activities at local scale and public goals. We are considering both homogeneous groups with members characterized by similar objectives and ways of acting in a public dimension (local authorities, private actors, non-profit organizations) and mixed groups of different types of players linked by acting on the same neighborhood or city area. During the workshops, we invite participants to think about what people usually mean by public or private information, appropriate and inappropriate uses of most common social networks, parallelsisms and divergences of global virtual life and local daily life. Then, we work with them on two different lines: thinking yourself in the space (of your neighborhood or your city) and thinking yourself trough time (permanence, transiency, continuity, discontinuity). Our objective is to contribute in creating awareness about the importance of the public dimension in the everyday activities of everyone. Consequently, which are the specific context and features of FirstLife and how to use it.

The step four is in progress, at the same time we are continuing the experimentation phase. It consists in two parts:

1) using FirstLife as a tool in ongoing or planned projects of different type of players (especially public entities and non-profit organization);

2) activating participants in becoming “territorial agents” to disseminate FirstLife (approach, logics and goals) within their personal, professional, and civic network.

Results

The early results of the development process of FirstLife in terms of people engagement show a high level of interest in participating to model a tool for managing the interactions among different stakeholders on an urban scale. We consider the conversion rate (meant as number of adhesions to the FirstLife project compared to the total number of actors involved in the participatory process) as a parameter to evaluate the level of interest. Until now, we have organized about 50 meetings, workshops, design-labs, and focus groups mostly concentrated in less than 4 months, involving more than 600 people in total, in addition to those involved in experimental project carried out in high schools and Universities courses (about 700 students). We start from this base to extend the participatory activities to others players in the city during the next months, especially for the fourth step of our engagement strategy.

In addition, we have defined specific ways to cooperate for each type of players. For instance, we are activating official protocols of cooperation with the Municipality of Turin (the city where we are testing FirstLife) and with a part of the district authorities, requiring a formal commitment of the public administration to support and facilitate the dissemination of the platform in connection with specific programs, projects, and initiatives.

At the same time, we started the application of FirstLife to various local projects aimed to strengthen social cohesion and enhance local resources and innovative experimentations at the neighborhood level, cooperating with three groups of non-profit organizations and public agencies in three districts of Turin: Mirafiori Sud, Borgo Campidoglio, and Aurora.

Conclusions

Participation will always be a problem, but having a platform which is a model of the social reality and does not introduce distance among local players is a requirement for any complex
process at local level. Furthermore, addressing sensible issues as in urban regeneration process can push local actors in criticism and pointless complaining. We are implementing a web application intended for PA and privates to participate and make visible their contribution to the city life and urban improvement, avoiding tools for private use or pointless discussion. Moreover, through the engagement activities we are building the right use of the platform with users we intent to engage.

Representing on the map the interactions between different types of players and thus communicate explicitly and intuitively the shared responsibilities correlated to the implementation of projects, initiatives, or programmes remains an open question. We are still working on these issues on two fronts:

• continuing the participatory process of involvement and choices verification
• studying the integration between the map-based main interface with concept map of collaborations associated to the geo-referenced entities.

In future developments we will work in order to make commitments and roles explicit in dynamic entities created through participatory processes at urban level.

References


Online tools for public engagement: case studies from Reykjavik

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Key-words: e-participation, e-governance, participatory budgeting, public participation.

Introduction

With the ubiquity of Internet technologies and growing demands for transparency and open data policies, the role of social networking and online deliberation tools for public engagement in decision-making has increased substantially in the last decades. Across the globe, officials and non-governmental organizations respectively or jointly have introduced online platforms in order to involve the public at different stages of policy initiation and implementation and at various degrees of participation - from information to consultation to collaborative decisions (Habermas, 2001). The nature of such platforms is still experimental and their success varies; power to influence ultimate choices is hardly ever delegated to the citizens, the rhetoric of direct democracy and citizen empowerment often serving to disguise the factual lack of political and administrative will and dedication to public participation (Papacharissi, 2002). Partnerships with civic organizations could be key for more efficient management of time and resources, as well as better outreach and access to participation. However, experience in establishing such public-private partnerships is still lacking, and the implications for personal data protection and misuse of online media for political steering should be considered. What is more, attention should be focused on the cognitive limitations and psychological predispositions of those engaging in participation online, as research in recent years reveal a positive correlation between reported use of social media and levels of civic engagement, but the causality behind this has not been studied enough (Boulianne, 2015, Ruckner, 2016).

The aim of this paper is to assess the benefits, challenges and successful methods for public engagement through different online media using example of Reykjavik in Iceland. With Iceland being one of the most digitally connected countries where almost 98% of people have access to Internet in their homes (We are social, 2016), choosing online tools seems like a logical choice for involving public in participatory democracy. Moreover, Iceland makes a good case study as the ideas about new ways to connect people together to participate in democracy, politics and civic life were born there after its economic collapse in 2008. Since then Iceland have developed open source tools and methods to promote online, democratic debate and to increase citizens’ participation in their community and worldwide. After the economic crisis, many citizen initiatives emerged in an attempt to tap the potential of digital platforms to increase access to information, transparency and accountability.
Methodology

The research presented in this paper was developed within the framework of the international winter school Co-Creating Urban Spaces: The Transformation of the Given City organized by the COST Action People Friendly Cities in a Data Rich World (TU1204) in March 2016 in Iceland. Using Reykjavík as a site for in-situ exploration, participants - early career investigators, architects and entrepreneurs working in the area of urban development, social innovation, engineering and design - were given the opportunity to explore various local approaches to urban innovation and community engagement through lectures and field work on real case studies. In this paper we present the analysis of how social media are used by different public bodies to enhance public participation in deliberative democracy. We collected and reviewed published information on the subject and carried out a field base assessment, involving structured interviews with different government representatives and urban policymakers.

Public e-Participation in Reykjavík

Although various options of interaction between public bodies and citizens' groups are offered in Reykjavík, in the paper we focus on the following four: (1) Reykjavík Facebook page; (2) citizens of Breiðholt Facebook closed group; (3) online forum Better Reykjavík; and (4) e-deliberation platform/consultation forum Better Neighborhoods.

Reykjavík Facebook Page
This page started 3 years ago and today has more than 10 000 friends from all over the world. It serves as a forum to improve communication between Reykjavík and its citizens. Although the page has an Editorial Board composed of city officials who publish city news, it is not only a one-way communication as the Board provides answers to all comments and questions. However, questions posted on this page are not treated as formal requests, but rather this page serves as a sort of informal communication bridge: everyone gets a reply and city professionals always put their names under their replies, so that users know who answered their question or addressed their comment. The page is not used to consult citizens or to collect their ideas, but to promote offline citizens’ participation.

Citizens of Breiðholt Facebook Closed Group
The neighborhood of Breiðholt in Reykjavík has a citizen organization who is responsible for Facebook closed group started a couple of years ago with a few hundred members. Today it represents a communication pathway between the public bodies and their citizens with more than 5000 members where Breiðholt citizens can bring practical and fun ideas or suggestions that potentially can improve the quality of the neighborhood. When it was started, communication via the page was mostly negative (e.g. negative remarks about neighborhood shortcomings), but after introducing some rules, as well as people started noticing things are turning for better, the group turned into an active media for constructive comments and information flow on various neighborhood topics.

Better Reykjavík
Better Reykjavík is an online consultation forum where citizens are given the chance to present their ideas on different issues regarding their city. This effort is a result of an open collaboration between Reykjavík City Council and the Citizens Foundation, a non-profit organization based in Reykjavík, who created the platform. Today this platform enables citizens to voice, debate and
prioritize ideas to improve their city, creating an open discourse between community members and city council and also giving the voters a direct influence on decision making. Forum is opened for anyone to read it, but only registered users can participate by presenting their ideas, viewing other ideas, arguing issues, voicing their opinion and by rating ideas. The best ideas chosen by the forum participants are then formally address by the city officials in the following manner: each month, five top rated ideas in all categories (i.e. tourism, operations, recreation and leisure, sports, human rights, art and culture, education, transportation, planning, administration, environment, welfare, various) with up to one top rated idea in each category are being presented in front of the appropriate committee.

Better Neighborhoods
Better Neighborhoods platform is based on ideas on participatory budgeting – promoting public participation in decision making beyond what is normally seen in a representative democracy. Citizens can submit their ideas on projects that they think will improve their neighborhoods and the city officials evaluate costs and feasibility of each project followed by citizens voting on the ideas. Each voter is empowered to decide how to distribute the total budget amount to projects that are relevant to him/her and this helps citizens to understand the realities of budgeting. The budget amount for this project has stayed the same during the last four years (i.e. 300 million) and in 2015 corresponded to 0.35% of the city total budget. The percentage of people who voted dropped from 8.1% in 2012 to 7.3% in 2015. The projects that can be proposed have to enhance the quality of the residents’ surroundings, increase possibilities for recreation and social gatherings or opportunities for games and leisure, encourage cycling or improve conditions for pedestrians and public transportation users. Unlike in the case of Better Reykjavik, here ideas can be posted only once per year when the call for ideas is opened.

Assessing citizens' satisfaction
Although Better Reykjavik won the European award in the e-Democracy Awards in 2011 and Better Neighborhoods won Nordic Best Practice Challenge in the category Public Communication in 2014 (Iceland’s Citizens Foundation 2016), the city officials wanted to heard their citizens’ thoughts. Therefore, they asked Institute of Public Administration and Politics, University of Iceland to conduct online survey on a sample of 2500 citizens of Reykjavik with the purpose of assessing how Better Reykjavik and Better Neighborhoods are perceived in public and what their contribution to participatory democracy in Reykjavik is. This analysis shed new lights on this matter as previous results dated back from 2009 and only showed that 26% of Reykjavik citizens tried to influence their municipality decision making process using online tools (Report 2016). The results presented in the report had showed that around two third of people living in Reykjavik was familiar or at least heard of Better Neighborhoods and Better Reykjavik. When looking at background of citizens who use these online tools, they present groups of people who are generally more active in terms of political participation and activity, i.e. university-educated, with higher salaries. Namely, the further assessment showed that 43% of citizens with university education had heard about Better Reykjavik compared to only 16% of those who had completed only primary education. Moreover, citizens between 30-60 years are more familiar than residents belonging to the youngest or oldest age groups, which is interesting finding as this option does not particularly appeal to the younger generation often called the computer generation. When it comes to investigating people satisfaction level, this study had included only citizens who had at least heard of these tools, politicians and city officials. 67% of citizens were satisfied with Better Reykjavik compared to 69% of those satisfied with Better Neighborhoods. When it comes to politicians, 47% of them were pleased with Better Reykjavik and 67% with Better Neighborhoods. Finally, around a half of the city officials were happy with both efforts, compared to 40% for Better Reykjavik and 20% for Better Neighborhoods who were not.
Results and discussion

In order to compare the aforementioned tools, we used a framework for systematic analysis and comparison of e-participation platforms proposed by Poplin et al. (2013) called the participatory cube. The model is based on previous theories developed by Fung (2006) and Ferber et al. (2007) and incorporates the established ladder of citizen participation proposed by Arnstein (1969). To compare across different e-participation tools, the authors identify three measurements of analysis: the decision power vested in participants, the interactivity of communication, and the provided access to the space of participation. Figure 1 shows that when analyzing our case studies using the participatory cube framework, it reveals little variability in level of interactivity between Better Reykjavik and Better Neighborhood, whereas social media score as a less participatory mode of communication, represented by Facebook closed group of the Breiðholt community (restricted to specific themes and allowing consultation only) and the official Reykjavik Facebook page. Namely, despite of the freedom to participate in social media, dialogue is one-sided and there is no opportunity for consultation or taking part in decisions. One might say that Better Neighborhoods scores the highest on a ladder of participation because it allows the transfer of power from government to citizens, although in a limited area of city budget and only for projects of minor importance.

Based on the analysis, we identified some general recommendations for success across the above dimensions of participation online. With regard to interactive communication, supportive measures should include visualization and use of rich media (e.g. virtual worlds, simulations, audio and video content), real-time interactions (e.g. Q&A sessions, chat, texting, web conferencing), and opportunities for participants’ collaboration and self-organization online (e.g. profiles, groups, discussion forums). The space of participation could be expanded through the provision of multilingual and disability-friendly interface, support and alternatives to those with limited access to online platforms, protection of personal data, statistics and tracking for underrepresentation.

Improved outreach could be achieved through social media, online publicity, and local multipliers. Stronger decision power could be vested in participants online by facilitating learning and deliberation (e.g. wikis, web conferencing, and discussion forums) and transparent voting and selection procedures. Last but not least, crucial to the positive outcome of e-participation is the predefinition of participants’ impact on final decisions and their engagement in the implementation and evaluation of proposed ideas. With view to the analyzed specific case
studies, we iterate the need for mixed use of different media, for example the seamless integration of Facebook communication for promotion of citizens’ ideas and voting. One of the few but significant shortcomings of the Better Reykjavik forum is the delayed feedback and lack of transparency when processing and adapting citizens’ ideas to legal and technical requirements.

**Conclusions**

The benefits of e-participation include the potentials of overcoming time and space constraints, ease of access to information and participation and non-discrimination, and the possibilities of crowdsourcing collective knowledge, and using playfulness to increase participation and attractiveness to young people. In this paper we presented best practices of public engagement in Iceland that was initialized by non-profit organization and later on adopted by the local government. Our conclusion is that participatory decision-making on matters of public concern justly consumes time and resources, and thus online tools should be applied with consideration of scale and efficiency, i.e. on burning issues for a majority of citizens or small-scale local platforms, and in combination with meetings in real time and space. However, the budget and workforce allocated to managing online engagement tools should be proportionate to other political and administrative efforts to bring to execution proposed ideas and act on collected feedback in order to satisfy the needs expressed by the communities and not undermine their beliefs about their power to influence decisions.

**Acknowledgment**

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e-agogà|e-agòpû for the transition toward resilient communities


Comparing Traditional Maps with Twitter-Derived Maps: Exploring Differences and Similarities

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Keywords: social media; twitter; urban planning; GIS; visual analytics.

Introduction

Nowadays, data generated by the users of ICT social media are easily available raw data, which often include a geo-information and provide lots of information on individual and collective life. This huge quantity of information is expected to offer opportunity for innovation in urban and transport planning (Bawa-Cavia 2010; Chua, Marcheggiani, Servillo and Vande Moere 2014; García-Palomares, Gutiérrez and Mínguez 2015; Hahmann, Purves and Burghardt 2014; Kokalitcheva 2014; Lanzerotti, Bradach, Sud and Barmeier 2013; Kwan 2016; Neuhaus 2011; Zachariadis et al. 2015). Nevertheless, the application in the planning practice presents some points of discussion. Miller and Goodchild (2015) outline how data-driven geography should consider the necessity of filtering user-generated data because of their messiness and the need for integration with other information because data have no answer for everything. In particular, they remarks that social media data are not a sample of the whole population but the whole set of data produced by a self-selected population. In order to understand how social media data can be used to integrate, or even to substitute, traditional data, this paper describes the outcomes from a comparison between traditional official maps and maps derived from the analysis of Twitter data in Pampulha, a neighbourhood of Belo Horizonte, Brazil. The comparison focuses on land uses and transport infrastructures, considered as the basic elements for the elaboration of an urban plan.
Methodology

Available data for the case study

Pampulha is an administrative region of Belo Horizonte, Brazil, grown on the surrounding of a man-made lake built in the early 1940s. Pampulha is a neighbourhood particularly attractive for both its citizens and tourists, due to the architectures of Oscar Niemeyer, gardens by Burle Marx and paintings by Candido Portinari, but also for hosting the Universidade Federal de Minas Gerais (UFMG), the “Mineirão” Stadium, the Mineirinho Arena, the Zoo, a small airport, industrial zones, different urban gardens and a military area. This mix is resumed in the official land use map (Figure 1).

With regards to the transport planning of the city, the official map provides information on the capacity of roads expressed in term of number of vehicles which can pass in one hour. In order to make a comparative analysis, this research makes use of Twitter data, collected between March 26th and July 22nd, 2015, from the whole metropolitan area of Belo Horizonte. Collected data are only geo-referred tweets, whose amount is 929,281 tweets sent by a total of 41,317 different users.

Methodology

The first step consisted in filtering raw data in order to obtain a reduced database containing only the tweets of users who sent almost one tweet from Pampulha neighbourhood. All following analysis were performed on this filtered database, which resulted in 42,991 tweets sent by 5,173 different users.

A second step consisted in calculating the density of tweets, which was processed by applying the quartic kernel function (Silverman 1986, p. 76, equation 4.5). Through this function, sent tweets...
were grouped in areas with the same level of density. The same function was applied also to the official land-use map, providing a map showing a level of density in both the cases: density of land use for the traditional map, and density of Twitter activity for the tweet footprint map (Figure 2).

The third step consisted in elaborating a map containing the possible movements of Twitter users. Thus, data were elaborated to correlate the subsequent tweets of each single user. Physical and temporal distances between each couple of tweets were calculated in order to select only those couples which implied a movement of the user in a specific speed range.

![Fig. 2. Quartic Kernel function applied to the traditional land-use map (on the left) and to the footprint map of tweets (on the right).](image)

Then, those couples were used as origin-destination points and overlapped to the actual road network as provided by MapQuest, an OpenStreetMap tool (www.mapquest.com/). Through the shortest path algorithm of the tool itself, a map was created to show the possible paths on the road network that Twitter users could have covered between two subsequent tweets (Figure 3).

![Fig. 3. Application of the shortest path algorithm to the couples of subsequent tweets.](image)
Results and discussion

The comparison between traditional map and map derived from social media data was performed on density parameter. Two main comparisons were developed, one for the land use and one for the use of transport infrastructure.

**Density of land use**

Land-use density map and tweet density map are both generated with the quartic kernel function on the basis of available data. The comparison was performed overlapping and subtracting the two density maps shown in Figure 2, obtaining a further map which illustrates the areas where the two maps provide different information (Figure 4, left). The overlapping of maps provides matching information for the 56% of the area (the white areas in Figure 4, left), while the 42% of area shows light differences between the two maps. A remaining 2% does not match at all (the black areas), so that a deeper investigation is required. The area with more differences of information between the two maps covers the plots of UFMG and sport facilities (Figure 4, centre and right).

Differences are mainly due to the nature of maps: the traditional map illustrates the building or plot density while the tweet maps show the density of (tweeting) people. The grouping mode at the basis of the maps produces different outcomes, which strongly affect both the resulting maps. For instance, the traditional map considers as a high dense area the whole area covered by the university campus, although the South-West zone of the campus is partly un-built. Something similar happens between the soccer stadium and the campus area. This is a green area that, in official maps, appears as a high dense area. The tweet density map shows more details on the use of the area than official maps, highlighting the presence of people in specific areas and offering a more actual view of the use of space. Nevertheless, official land-use map can be more reliable if the planning and decision-making processes should have to consider the possibilities for a future use of the area instead of actual one.

**Density of use of transport infrastructures**

The density function applied to the official map of transport infrastructures highlights the areas with more vehicles capacity, while the application of shortest path algorithm to sub-sequent tweets provides information on the possible use of road infrastructures. The overlapping of the two information sources shows consistencies when considering the tweeting traffic, which lays...
on high-capacity roads, confirming the possibility for many people to pass by those roads. Nevertheless, it shows also divergences. This is the case of the three areas (A, B and C) (Figure 5), in which the high capacity of roads does not correspond to the presence of a large number of people. The roads in A and B are on the North of the lake, while C is a very large roads that goes outside Pampulha. Therefore, some considerations should be done on the use of these high capacity roads.

If C is a crossing road, it is possible that tweets are not representative of the traffic on that road because not sent during the crossing of the neighbourhood. In that case, the analysis should be widened in order to include all the tweets sent from the surrounding of the area. Furthermore, it should be considered as a possibility that the road in C was not usable in that period. Also in that circumstance, the tweets could not provide usable information. Third option, the high capacity is really over-estimated with respect to the need of people.

**Conclusions**

The comparative analysis between traditional official maps and maps generated by the analysis of Twitter data confirms the need for a strong filtering of raw data, especially to avoid simple correlations instead of cause-effect relationships (Miller and Goodchild 2015; Masala and Pensa 2016), but it shows also interesting opportunities for integrating and improving the traditional methodologies of planning and decision-making. In particular, the use of Web social network data provides useful information on the actual use of land. Although tweets are sent by a self-selected population, they represent a mirror of a specific reality. Finally, data do not provide unique information. This implies a stronger effort from planners and decision-makers in detecting useful information. Thus, data-driven approaches should provide data to the actors involved in the decision-making, allowing the actors to play with data in order to explore different combinations and discover correlations, cause-effects relationships and the best strategies for converting actual dynamics into elements for a well-working spatial system.
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Mapping the food system in Turin

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Key-words: Food system, Urban Food Planning, Crowdmapping, GIS.

Introduction

Food, as a topic of study, has been for years object of surveys and analysis of human and social sciences in general and of geography in particular (Colombino, 2014). Among the most recent and interesting scopes on the subject, above all regarding its applications, there is the food-city relationship and the relative social, economic and environmental implications. This theme, defined Urban Food Planning by the Anglo-Saxon scientific debate (Morgan, 2009) has been increasingly popular in the last fifteen years both in the geographic studies and in the urban and territorial planning activities. This contribution can be seen in a wider theoretical debate reflecting on the importance of food in urban development (Pothukuchi and Kaufman, 1999), through inclusive and shared food policies (Sonnino, 2009).

Pondering on the relationship between food supply and urban spaces poses a first important question on the knowledge we have of the food system structure, its dynamics and working procedures. Paradoxically, in fact, food systems are the less visible among the various urban systems, in that they are dispersed in their own pervasiveness (Steel, 2008). However, it is this pervasiveness that makes them such remarkable instruments not only for analysis, but also for landscape, political, social and urban planning and so, in other words, for the transformation of the city itself. From this perspective, it is then necessary not only to identify, define and analyse the elements and their relations (actors, resources, flows, spaces...) but above all to represent and communicate them, increasing their visibility and perception both toward the public and the civil society.

Due to the ability to represent synthetically, selectively but systematically, the elements and dynamics on a territory, cartography is considered one of the most effective instrument to represent the existing phenomena, at the same time suggesting questions, solutions and directions. The role of maps in representing and connecting spatially referred data makes of them a privileged tool of research-action (Pain, 2004) whose aim is not to produce a representation of the world which pretends to be objective, but to collect information and data, to interpret and represent them, offering theoretical and operational tools to actors, stakeholders and policy makers of the researched field (Magnaghi, 2001).
In the last years, the impulse to participate and share data has increasingly gained more and more importance in the field of cartography (for food systems, too), through the diffusion of a shared cartography which, together with the official top-down representations, offers descriptions from the base of the territorial dynamics, a process usually called crowd mapping. Even some scholars argued against the sameness of neo-geography and democratization (Haklay, 2013), what is clear is that the divide between those who collect and those who use data is partly overcome.

But the experimentation on which this work is based can’t be considered a proper action of crowd mapping since it is more an exercise on mapping the food areas in Turin. The activities were supported by the Laboratory of Analysis and Urban and Territorial Representation (LARTU) of the Polytechnic of Turin, and are part of the Modulo Innovazione of the Corso di Laurea Magistrale in Design sistemico.

The main objective of the survey – started in October 2014 and ended in November 2015 – was to contribute to the Turin Atlas of Food, taking a census of all the spots in which food is produced, transformed, sold and consumed in the different districts of Turin, from the centre to the extreme suburbs.
Methodology

The data survey has been collected totally on the field, using the ArcGIS On Line software available on a Campus license recently bought by the Polytechnic of Turin and the Collector for ArcGIS app. It was then possible to collect and update data on the field using mobiles and/or tablets and it was interesting for students to use their private devices (either smart phone or Tablet iOS and Android, with integrated GPS, georeferencing any information), which became “field” instruments, apt to collect alphanumerical and cartographical data.

Students have collected and classified the food spots based on a methodological grid. The grid has allowed to classify each point on the basis of:

- the phase of the supply chain (production, distribution, consumption);
- the type of the element: for example urban garden, wholesale store, market, supermarket, bar, restaurant, street food, etc;
- the presence in loco of the processing and consumption (in order to intercept those hybrid elements, such as, for example, a fish or wine shop where you can eat your products after being purchased);
- an explicitly characterization organic, local (with direct reference to the short chain and Km0 concepts), regional (Piedmont supply chain) and ethnic.

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<th>Phases of the supply chain</th>
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<th>Is there processing? (yes/no)</th>
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The LARTU, initially dealing with the experimentation and the procedures of data collection through mobile devices, has then followed the modelling and realization of the used data base (geographical and alphanumerical, coherent to the survey data regarding the agribusiness chain) and has eventually tested it.
The students have then been taught the use of Collector, GeoDB and the “field” procedures to produce thematic maps for single markers, in order then to show collectively to professors and colleagues what were the impressions and suggestions during the survey and the analysis of the study area.

Results and discussion

In total, in a year work, more than 100 people - both students and researchers – surveyed and classified more than 6358 spots, the majority of which being bars, pubs and ice-cream parlors (2180), retailers (1418); restaurants and pizza restaurants (1183); takeaways (543).

The survey results have been further analysed both in relation to the urban agribusiness chain and in respect to some characteristic typologies, showing how:

- in urban spaces, agribusiness production locations concentrate on the border of the county seat, that is areas in which agriculture survives, often mixed with other kind of urban texture;
- transformation locations (in a wider sense, including a series of craft or semi craft activities in which food is used as a raw material, as fresh food or as ingredients in various forms in laboratories and kitchens to become a finished product) are about 3648;
production locations consist of retailers, which is the most widespread typology (in total 1418), followed by district minimarkets and supermarkets (485), big iper and supermarkets (119), markets (57), wholesale stores (29). The territorial coverage is relatively different among districts, some of them having certainly more services (the centre, but not only), while others less (with some cases of nearly “food desert” in the extreme north and south suburbs); small retailers disappear considerably in the suburbs, presumably due to the higher competition of the wholesale distribution in this area.

The locations of food consumption are the more widespread category, in particular in the historical centre and in the adjacent districts, which in fact have been for some years now the core of the evening and night “movida” in Turin.

As for the peculiarity of the categories, the survey shows that:

- the concentration of ethnic elements is particularly high in the districts which in people’s mind are tagged as “multi-ethnic”. However a considerable concentration of these locations has been recorded in areas where small shops or restaurants are run by South Americans, particularly Peruvians. As a whole, ethnic food locations recorded in Turin are 611; the most numerous categories are kebab shops (Turkish and North African, 159 in total), followed by Japan (862), China (59), Middle Eastern countries (19), Africa (10), India (10), United States (10), Peru (7), United Kingdom-Ireland (6), Mexico (6), Rumania (6);
- the concentration of elements explicitly characterized by local or biologic products is higher in areas where people from the high and medium class live, and much less in the popular districts, revealing that for different reasons – economic and cultural – local and biologic food is still a class interest and choice.

Conclusions

The spotting of the agribusiness chain is a fundamental exercise for urban food system planning, since it allows a punctual and territorially exact survey about the resources. Moreover the possibility to match the survey data with the socio-economic markers of the respective areas allows further investigations on the relations between food and other urban issues and so to ponder on food and the various urban policies. These actions, when conveniently transformed in other scales, and properly implemented and managed are useful not only to fulfil knowledge gaps but also to show the plurality of actors in the food system, including the weakest (if rightly employed), stressing their roles, needs and perspectives, using professionally managed multimedia equipment, but open to the widest possible community.

This is the founding idea of the wider project, a theoretical – methodological framework on which the experimentation was then based.

The Atlas of Food is a research-action project, which is being implemented by an interdisciplinary research group based in Turin, including geographers, planners, IT experts, agronomists and designers of the Polytechnic and University of Turin and of the University of Gastronomic Sciences.

The Atlas of Food involves six different departments

- Department of Cultures, Politics and Society (CPS) of the University of Turin;
- Department of Agricultural, Forestry and Food Sciences (DISAFA) of the University of Turin;
- Department of Computer Science di INFORMATICA of the University of Turin;
e-agorà for the transition toward resilient communities

- Interuniversity Department of Territorial Sciences, Project and Politics (DIST) and Laboratory of Analysis and Territorial and Urban Representation (LARTU) of the Polytechnic University and University of Turin;
- Department of Architecture and Design (DAD) of the Polytechnic University of Turin;
- University of Gastronomic Sciences (Pollenzo, CN).

The core of the project is the realization of a multimedia, interactive, participated Atlas, currently centered on the city of Turin, but replicable and scalable in any other urban/metropolitan food system.

The general objective of the Atlas is to develop and implement an interdisciplinary methodology of food system analysis and assessment at a metropolitan scale, through traditional charts and maps, participatory mapping and a strict relationship with social networks, notably, an innovative social network developed at the University of Turin (First Life project) for field action, leading to an innovative interactive Atlas of Food.

The Turin Atlas of Food has the following specific aims:

- to provide an open access tool, collecting and representing data, information and ideas about the food system at the city-region scale. The web platform represents the main deliverable of the project.
- to support the public-private network which is working on establishing a food commission, through analysis of the food system, development of scenarios and suggestions for the food strategies, aiming at enhancing the sustainability, equity, participation and resilience of the food system;
- to increase the awareness of the actors of the food web about food, fostering the visibility and sharing of the issues linked to the different phases of the food chain;
- to provide a platform where the stronger and weaker actors of the food chain can virtually meet, reciprocally know, share ideas, creating an opinion making critical mass that is able to address food policies;
- to monitor the food system regularly with a participatory approach, reporting changes, trends, opportunities and threats.

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Crowdmap applied to Geotourism: Case Study of Chapada Diamantina BA - Brazil

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Key-words: Smart Tourism; Geotourism; Crowdmap; Chapada Diamantina; Waterfall.

Introduction

With the development and internet access large-scale, to use means to have access to information has become everyday practice, especially through mobile computing, either through smartphones or tablets, enabling real-time user interaction with the surroundings. Social media has become easily accessible and popular for citizens who feel encouraged to experiment and interact with digital media. Furthermore, Geographic Information Systems (GIS) allow these interactions to be geotagged enabling collecting information on the user location, preferences among other things, to allow preparation and analysis of complex data by providing knowledge of the environments. The user to assist in the decision making (Borges et al, 2015; Borges et al., 2015.).

The term Smart has been used to qualify potential markets seeking to employ the use of technology to optimize and integrate systems across networks, and through health infrastructure, entertainment, communication, security and other systems that facilitate or improve quality of life, seeking to operate an intelligent way of life, covering many city dwellers as well as the tourists who come to visit and explore. To that end the Smart Tourism, seeks to ensure the user’s interaction with the sites visited by supporting potential new user who could explore the site through technology and the promotion of the territory.

On the other hand the term Geotourism emerged to promote understanding and provide ease of services for tourists to acquire knowledge of geology and geomorphology of a certain place, becoming no longer mere spectators of an aesthetic beauty (Hose, 1995). So the idea is to aggregate scientific knowledge to the natural heritage in an understandable way, valuing it and generating sustainable tourism, rather than denigrate it. In short, the term geotourism can be defined as a form of sustainable tourism with a focus on nature's design (modified Dowling & Newsome, 2006).

The platform Crowdmap© is a product of Crowdsourcing, a term coined together by Jeff Howe in 2006 to refer to the acts by which businesses throw open small tasks to the general public (Howe, 2008). It was launched in 2010, from this date until today, over 20,000 maps have been deployed, and more than 15,000 of those maps are using the hosted Crowdmap© platform (CrowdGlobe, 2012).

The aim of this article is to demonstrate the potential of using Crowdmap© as a tool associated with the concepts of Smart Tourism, to qualify the natural attractions of a region and to investigate how the user interacts with the local landscape, seeking the development of a sustainable local tourism with the participation users.

This kind of method has started with the firsts digital mobile maps, that has tended to focus just on the navigation task, but recent studies have done an emphasized to the need of support on all kind of categories of map-based tasks. In this point, the Crowdmap© does what it is proposed too, once the tourists can interact with the
platform. It is possible to do a number of interesting observations on the use of maps for tourists during a visit in a determinate area and report it for other, possible, tourists. (Brown and Chalmers, 2003).

**A case Study**

For this study was chosen as a case study the region of Chapada Diamantina - BA (Figure 1), in order to apply the concepts of Smart Tourism with the active participation of local user through Crowdmap©.

The Chapada Diamantina is located in the central region in the State of Bahia - Brazil and consists of 58 municipalities. This region is the northern part of the Espinhaço mountain chain, a set of disjointed mountains, stretching from the state of Minas Gerais, towards the north until it reaches the trough of the São Francisco River (Misi & Silva, 1994). Area with a wide range of vegetation that includes savannas, rocky fields, forests and scrublands with great diversity, with terrain characterized by altitudes of more than 500 m, in a very rugged, high, narrow and elongated hills (Juca et al., 2005.; Conceição & Pirani, 2005; Conceição & Pirani, 2007).

Thus, justifies the choice of this region for the case study, since it is a very visited place of great diversity of potential attractions for visitors, but few tourist references and opinions of the users in the virtual world, which is now a widely used platform for tourism. In addition, there is the importance of the region in the Brazilian tourism scene and its extreme relevance, in which its preservation should be done, without a conflict of interest - sustainable tourism x capitalist tourism - stand out.
Methodology

When using the tool Crowdmap©, which is a collaborative platform in which users can interact with the site providing different information about it for other web users. In this way, we seek to ensure the interaction between user and the visited site through an active tourism, in which it was possible for the user to grade the waterfall trails and contribute with information for new users (Borges et al., 2015).

Thus, the methodology was divided into three steps: (1) field stage for mapping the trails and acquisition of GPS data, (2) then processing the data using the software ArcGIS© and (3) lastly construction of platform in Crowdmap© with the data acquired in the previous steps. The field stage was conducted in January 2015 using GPS GARMIN 62s and aerial photographs of the site, made available by the Brazilian Geological Survey (CPRM).
The trails were recorded on five tracks, in which the trails left from the center of one of the municipalities that make up the Chapada Diamantina, known as Lençóis, so track (A) 15.3 km to the Fumaça waterfall; (B) 8.7 km to the Fundão & 21 waterfalls; (C) 8.5 km to the Lapão Cave; (D) 3.8 km to the Ribeirão do Meio creek; and (E) 6.0 km long to Sossego waterfall.

With the user integration using the platform. It was observed a classification of levels defining the difficulty of the trails and comments in relation to the landscape. It then become possible to begin assigning rates to the trails and what are their true levels, because of the large pool of feedback and classifications available.
From the data entered in Crowdmap© it has enabled a systematic analysis of the difficulty levels to create the final rating for each trail. The study is in the process of development, the platform is active and receiving feedback from users.

Results and discussion

With the implementation of the methodology, it has been possible to establish the geotagging of the trails leading to the waterfalls Fumaça, Fundão & 21, and Sossego, Ribeirão do Meio Creek and Lapão Cave, which did not have this data, in addition, after Crowdmap© it was possible to enable the user interaction the place visited, qualifying trails and difficulty levels found on site with other web user.

Being an ongoing study, the first data and platform results are under evaluation, to further assess their contribution to the user viewing the information on the platform and confirm or not the information found on the site, but this is a next stage of the research. To date, presented graphs (figure 5) pictures how user participation is important for the evaluation of future users who want to visit the region, which also pointed to improvements in the service found in the region could be revised or proposed.

Conclusions

The user interaction by Crowdmap© through the evaluation of trails and access shows its great potential for the local tourism, may it be for improvement of services, either by creating new demands that may appear with the accentuation of tourism on local. In addition, user participation that visited the site, enables new users to have a real local concept and update of the conditions of the trails and access to be covered, in a collaborative platform, and instruct the user about the potential fitness level requirement to be able to hike the trails.
Thus, the platform, the user can generate a relevant rating for the authorities and tour guides in relation to the functionality of each trail, aiming at sustainable tourism and more knowledge about the obstacles that will meet on the trail.

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Introduction

In the last decades, Information and Communication Technologies (ICT) are increasingly adopted by many Public Administrations (PA) worldwide. Notably, PA are taking advantage of innovative solutions to offer better services and to ease communication with citizens (Liu 2015). Furthermore, the uses of ICT can play a crucial role in increasing accountability and transparency in PA (Avila 2010). However, as debated in Smart City literature (Aru 2014) there are also possible drawbacks in using new technologies, such as socio-technical misalignment within cities (Warshauer 2004), technodeterministic conditions (Calzada 2015), enlarging digital divide (Mongomery 2013). Therefore, as Jiménez (Jiménez 2014) suggested, it is crucial to consider that:

- technology is a tool not an end (on the basis of defined targets)
- citizens needs in the city must be identified as the primary target for action (citizens involvement)

At this point some questions emerge:

- How to involve citizens and identify their needs as targets?
- How can we design technologies in order to fit with citizens needs?
- How combining offline and online environments can help creating a smarter balance for inclusiveness?

According to the principles of design for social innovation (Manzini 2015) our work aims to make administration more transparent and accountable and to facilitate participation of citizens. Notably, in the research applied, citizens are enabled to directly report problems and proposals. They are thus transformed in human sensors whose information can be visualized on an interactive map combining crowdsensing with crowdmapping. The ICT solution must be usable from mobile but also via traditional channels (text messages, call phone) to increase accessibility of disadvantaged citizens.

The research process involves an interdisciplinary team from the Academia, composed by urban planners, architects, computer scientists, geographers, legal experts, with the direct participation of local administrators and citizens.
Methodology

The research area is Mirafiori Sud District in the southern urban area of Turin. Since 2013, the Politecnico di Torino established strong connections and institutional relations with the local administration and stakeholders in the Mirafiori Sud neighbourhood. Therefore, that successful collaboration over the years among the Politecnico di Torino and the Mirafiori Sud District in the field of urban regeneration has being ensuring the study significant impact and results. Nowadays, the District represents a paradigmatic picture of a post-industrial city in Europe and North America. In the next future, the southern area of Turin – and particularly Mirafiori Sud - due to its high potential in terms of social and economic development, will be the target of several strategic transformations, with an interesting mix of private top down initiative, public support, facilitation and bottom up social enterprise experiments. Furthermore, Mirafiori Sud is an active neighbourhood in order to overtake the actual situation of crisis. A rich and lively network of local associations support them in this sense (Guiati 2014). Methodology adopted uses an iterative process that consists of two phases in order to assess a very dynamic framework for steady improvement of performance as the case study knowledge increases. The first phase (2013) has set up a pilot project called Crowdmapping Mirafiori Sud to recognize context and specify method. It has involved citizens with different age and technological skills through a participatory approach in mapping informations about their neighbourhood. The second phase (2015) is implementing an innovative solution to perform the study to make citizens interact with public administration. The MiraMap project has a more structured approach in term of IT system in order to directly involve public officers in the reporting process. The pilot project Crowdmapping Mirafiori Sud (www.polito.it/mapmirafiorisud) was granted with 5x1000 funds from Politecnico di Torino and has involved the academic (including students) and the local community in a participative and inclusive process to identify and categorize on a geographic web-based map the obstacles/barriers which prevent vulnerable categories to access and use public space. In order to allow an easy crowdsourcing of data and the total transparency of their diffusion (Hagen, 2011) the open source platform Ushahidi has been adopted and customized. The adopted research process pointed out the following six levels of inquiry in order to better recognize the context and specify method for the next phase:

1. **Kick off.** A necessary phase of identification, contact and meeting with the local actors and representative of the categories identified as 'vulnerable'.

2. **Definition of Criteria.** Thanks to an interaction with local actors through a series of transect walks, a reflection on criteria, categories, standard identification of the phenomena to be signaled, have been set up for a coherent achievement of a data base.

3. **Set up.** Starting from inputs acquisition from the local actors, the Ushahidi platform has been set up, then a website was designed to host all information and news. An email address and a telephone number were also provided, to allow civil society and public administration to promptly access to informations and send their posts. The iXem Labs, Department of Electronics and Telecommunications of the Politecnico di Torino, created a dedicated system based on the open-hardware Arduino plus a GSM/3G shield to send SMS direct to an email address.

4. **Training.** With the support of the Fondazione della Comunità di Mirafiori Onlus, a group of 30 inhabitants was selected for collecting data on the area, and stimulating the ‘crowd-mapping’ effect.

5. **On field data collection.** During June and July 2013 the group formed by the university students and the involved citizens made several data collections in the neighbourhood, sending information direct from mobile phones, app and computers to the Crowdmapping Mirafiori Sud website, email and numbers. Once the information was
received, it was checked for approval and then, if appropriate, was made visible on the map.

6. On line. Once the data collection was completed, outcomes were published, widely presented and made available to all the stakeholders involved and to the local administration.

7. Monitoring and evaluation criteria of ex-post impact. The criteria have been set up on the basis of the Community Impact Assessment/ Evaluation (CIA/CIE) methodology that evaluates in a descriptive manner the impacts - monetary and non-monetary - derived from the project in relation to the various actors involved.

Notably, the pilot project made evident citizens’ strong expectations for a more active participation of the local institutions. The second phase MiraMap (www.miramap.it) which is currently ongoing, has moved from these insights. It engages both citizens and the local administration in a report process of critical issues as well as positive trends and resources within the administrative area. Thanks to a wider collaboration, which includes the Computer Science Department of the Università degli Studi di Torino, the request of a more sophisticated IT approach have been settled in connecting a new local social network based on a web interactive map (First Life) with an open source Business Process Management system (BPM). Methodology inherited from the first phase have been run to better respond to the project's goals:

1. Preparatory phase. After an official launch of MiraMap, a series of meetings had place with the administrative executives to set up the data management and the features of the digital platform. Result is a collaborative platform which integrates social network features to the administrative workflow.

2. Operational and training phase. Weekly meetings with public officers are ongoing in order to test the platform both in terms of usability and administrative procedures. We are adopting a fragile methodology to be more efficient in providing requested features.

3. Data collection use and validation of the platform. On-going phase to implement the platform both by providing data and by testing new projects and practices undergoing in the neighbourhood.

4. Impact Evaluation. The simulation starts from the assumption that in such processes it is strategic to structure also the phases of monitoring and assessment of the effects on the subjects involved and on territorial and administrative levels.

**Integrating technology for MiraMap**

To facilitate communication between citizens and public administration, two environments have been designed and integrated: one for citizens using First Life as interface - the Social Network environment (SNenv), and the other based on the BPM system for local administrative staff in public Institutions - the BPM environment (BPMenv). The SNenv is based on First Life: an innovatove social network based on a map that aims at harnessing the ‘network effects’ for the achievement of sustainable change in the cities through bottom-up social innovation. Business process management system (BPM) instead, is a set of activities to define, optimize, monitoring and integrating management processes. The two environments have different functionalities to fit with differences in users roles. In the SNenv users are citizens and they can freely sign in: all the registered users visualize, modify or add information in First Life. The second group of users is administrative staff and, thus, sub-roles and tasks are defined apriori and are grounded in the local institution organization; to guarantee efficiency of completing processes, tasks in the BPMenv cannot be delayed and they have temporal constraints for the execution. Therefore, Miramap’s architecture is the result of integrating two systems with different functionalities. An
architecture overview can be seen in Figure 1. First Life’s architecture is composed by an interactive geographical map interface as frontend and a backend for managing and searching geographical data. The interactive map is created with AngularJS, Ionic, Leaflet and OpenStreetMap. Depending on the category of Point of Interest (POI) chosen, the frontend offers different kinds of interfaces for visualizing or inserting/modifying the data. Moreover, the classification uses two dimensions in line with those used by the local administration: categories (green areas, safety, animals, mobility, etc.) and typologies, inherited from the pilot project (problems, positive realities and proposals). In order to set up an instance of First Life for MiraMap, a new kind of entities has been implemented: reports. Differently than standard entities of First Life, such as places or events, reports do not appear immediately on the map but they are first moderated by the administration. The information added by the citizen is forwarded to the BPM creating a new case to be processed. The user is informed via mail. Differently than in the standard First Life, POIs are associated with a status: reported, verified, closed, that depend on the evolution of the report in the workflow. The BPMenv information relies on BonitaSoft which is a design tool to model workflow and an engine which creates instances of workflow (cases) executing the steps of workflow (activities), using HTML forms where it is necessary to get information from users. It is managed by administrative staff to handle problems reported by citizens and, to make public the procedures that have been carried on. The administrative staff has been structured in three working groups on creating the workflow: the Public Relation office (PRo); the Technical office (To) and the Operational office (Oo). Furthermore two macro-types of reports have been defined: report managed by the PRo and report managed by the To. At each step of the workflow (approval, verification, conclusion) the staff can reply to the citizen, so the report on the map is not only changed in status, but its reply is shared on the map.

The possible operations in MiraMap can be summarize as follow (see Figure 1):

1. Citizens are the crowdmappers wich fulfill a report form and submit it to the FirstLife server;
2. the backend calls the BPM, through API, creating a process instance which enables the administrative staff at handling the report;
3. when the instance is created it is notified by email to the group responsible of the duty and to the citizen who submitted the report (at each step of the process the citizen will be notified by email);
4. the person in charge can access the report details and start the workflow;
5. by API each step of the process is communicated to the FirstLife backend and it is visualized in the interface as a change of status of the POI.

Conclusions

The pilot project Crowdmapping Mirafiori Sud had experimented a possible application of participative methods and techniques, via:

- the set up of a low-cost smart system accessible to everyone;
- the set up of a partnership constituted by Civil Society, Public Administration and representatives of Non-Profit Sector right from the early stages, to guarantee administrative social and technological transformation;
- the training and capacity building process referred to the use of the technology to identify, map and report existing or potential problems;
- the capacity of all the players involved to promptly access data and to offer an immediate and transparent response to reports received;
- the availability of a decision making support tool, not only in response to single/specific problems, but also for planning district scale interventions;
- the CIA method shows that the platform and the connected strategies/actions have no negative physical territorial and social impact: no stakeholder is penalized by the use of the platform, aimed at supporting administrators in the government of the territory.

MiraMap moves from these achievements and intends to provide a technologically advanced solution whose implementations concern: a more complex administrative process and a social network customization to support bottom-up co-design, opening up new opportunities for citizen-to-citizen co-production of services [Ostrom 1990].

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Introduction

Territorial planning has been interested in the representation of space since the seventies (Dennis, 1970), when it recognized as essential the support of the social actors in decision-making. The participatory construction of spatial representations evolved ever since: Starting from the paper representation, which is very expressive but has low usability and lacks scalability, it moved to the use of GIS systems (Steiniger and Hunter, 2013) and of digital instruments for managing geographic data and generating dynamic maps. The idea was that of allowing the user to view information "on demand"; however, digital maps have lower capacity to describe the perception of the area because they focus on the visualization of specific types of data and they are semantically disconnected.

An interesting research topic for planning theories is therefore that of investigating the possibilities offered by Web 3.0 and integrating them with traditional representations for improving the effectiveness of public policies and supporting the construction and upgrading of planning instruments. Notice that Amin and Thrift (2001) discussed the idea that the traditional means of investigation and spatial analysis are insufficient to represent the new complexity of the urban issue and, more specifically, unable to relate phenomena and emerging urban forms that characterize the territory.

This paper focuses on the theme of the spatial representation of cities and the territory, reflecting on the prospects for innovation in the expressive means that serve the study of the city. The described research concerns project "Mappe di Comunità 3.0" (http://ontomap.dyndns.org/), funded by the Fondazione CRT. The project focuses on the definition of a methodology that implements a synergistic exchange between institutional territorial knowledge and the knowledge of the citizens, achievable thanks to the mediation of communication provided by a semantic representation of territorial knowledge. That type of representation supports the description of data and of its properties in a unified language. Moreover, it enables the sharing of information on the Web by providing an integrated perspective on territorial data.
Methodology

Harper (1988) defines visual sociology as the recording, analysis and communication of social life through photographs, movies and videos. There are four fundamental aspects of visual sociology in this interpretation: (i) analytical purpose and type of knowledge that the researcher seeks to bring to light; (ii) importance of the recording medium; (iii) exploitation of pictures for representing a culture; (iv) analysis of the images produced by a culture to understand it.

Our work applies the methodological perspective of visual sociology to the collective production of virtual maps through a web-based tool. The images consist of geographic, visual and semantic maps, close to the community maps because of two characteristics: the purpose-identification of local heritage, and the method-self-representation. Through a traditional community map the inhabitants of a place have the opportunity to represent heritage, landscape and knowledge in which they recognize themselves and that they wish to pass on to the new generations. The map highlights the way in which the local community sees, perceives and attaches a value to its territory, to memories and transformations, and specifies how it should be in the future.

Traditionally, community maps consist of cartographic representations developed by the community, based on a participatory approach (Parker, 2006). The project Mappe di Comunità 3.0, closer to the PGIS practices, investigates the possibility of a new representation mode of those maps, using digital media and the semantic representation of spatial knowledge to promote a new account of the territory aimed at producing planning scenarios useful for Public Administrations (PAs). The main result of the project is the OnToMap web-based application, which supports the consultation of spatial data, the creation of virtual, interactive maps reflecting individual information needs, and the reporting to the public administration (PA) and urban planners of critical issues or new proposals by annotating the geographical areas and the elements visualized in the maps.

Figure 1 shows a portion of the OnToMap user interface (in Italian) and the right side of the page shows the form for adding annotations (“Nuova segnalazione”) to the current map.

OnToMap uses an ontology of the territory as the main metaphor for the human-computer interaction in information search, visualization and sharing. Ontologies, defined by Gruber (1995) as “an explicit specification of a conceptualization”, describe objects and relations in an application domain. GIS typically use ontologies for supporting the integration of heterogeneous information sources (e.g., see Fonseca et al., 2002; Buccella et al., 2011). Differently, OnToMap
exploits an ontology to mediate the specification of information items with the different perspectives on data held by users:

- Regarding the representation, the ontology supports the integration of heterogeneous geo-data, originated from different sources, and manages them as linked data\textsuperscript{12}, i.e. data items connected to each other through hypertext links in the Web. Moreover, it describes relations among information items to express spatial and thematic associations, as well as different levels of abstraction in their description (from general concepts to specific ones).
- From the viewpoint of information retrieval, the ontology provides the user with a graphical tool for browsing the information space as a graph of connected concepts. This supports semantic information retrieval and visualization in the maps.
- Finally, from the crowdsourcing viewpoint, the ontology supports the description and classification of new information items, which can be included in the existing knowledge base for immediate usage.

Figure 2 shows a portion of the ontology underlying the OnToMap system. The representation directs the interpretation of the territory, which is read in the project according to three constitutive dimensions: natural (Natural perspective), artificial (Artificial perspective) and normative one (Norms). The natural dimension refers to the physical elements unaltered by humans; the artificial one includes the man-made elements; the normative dimension considers the technical and design aspects related to the sphere of competence of PAs, explaining in space the territorial government regulations, expressed as institutional and planning constraints. These three observation levels take into account issues related to different domains of representation of material aspects, represented with GIS techniques, socio-economic aspects, highlighted by semantic relationships, and perceptual aspects, typical of the voluntary construction of knowledge. Therefore, the ontology is the means used to provide a unified description of the territory, which abstracts from specific data representation formats and supports data integration. However, it also plays the role of an "inter-lingua" between human stakeholders, who might be interested in the analysis of content under different points of view and in retrieving information at different levels of detail: e.g., a geographical item could represent at the same time a service for the citizen, a cultural heritage element, etc.

\textsuperscript{12} As reported in \url{http://linkeddata.org/}, "Linked Data is about using the Web to connect related data that wasn’t previously linked, or using the Web to lower the barriers to linking data currently linked using other methods."
Results and discussion

We tested the OnToMap application in the Urban Project Atelier at the Faculty of Architecture of the Polytechnic of Turin, in the academic year 2014/2015. Students (51 divided into 15 groups) of the course used the application in classrooms equipped with computers and Internet access under the supervision of the research team that accompanied the creation of the maps. The students used OnToMap to experiment with new modalities of representation for describing the territory of the project, from an analytical to a projectual point of view. The students created 15 Analyses and 15 Project Maps: the interpretation of these products was verified according to four reading criteria:

1. mode of use of the tool to read the territory,
2. semantic elements useful for the construction of the territorial representation,
3. semantic elements used for representing the concept of territorial identity,
4. representation mode of possible projectual scenarios.

The representations generated by the students using the OnToMap application are articulated on two distinct levels: a spatial one, linked to the direct drawing on the virtual map, and semantic one, connected to the use of the concepts defined in the ontology. It is useful for the purposes of the research to understand how the two representations relate to each other, producing visions that are similar, different or integrated. The maps become the starting point for the construction of an index of perception of a social group (here, the group of students of the urban design Atelier).
The experimentation has indeed proved that some territorial elements, selected, viewed and edited through OnToMap by students, are recurrent in most of the created maps (Figure 3). We can therefore deduce that the highlighted territorial elements reveal the expectations and vision of a given social group, with a proper and specific cultural background.

Conclusions

OnToMap was used with the objective of stimulating territorial interpretations, bringing to light new and innovative points of view of the territorial reality in an analytical and projectual perspective. The ontology underlying the system supports an articulated spatial representation, enhancing spatial planning with a more comprehensive territorial reading. However, the experimentation identified missing concepts that users could not directly add because this task requires technical expertise. This limitation, intrinsic of knowledge-based systems, must be addressed by supporting a participatory approach to the specification of semantic knowledge. A specific work can be directed precisely at the construction of a shared and participated spatial ontology, with the purpose of representing not only the territory, but also the community that perceives it, empowering the community to express their own views. If, as assumed by visual sociology, visualization is a practice of power (Faccioli, 2010) that allows the definition of social and cultural differences by explaining them visually, working on visualization means deconstructing the different layers of meaning of images produced. This operation strongly refers to the construction of a conceptual model of knowledge that is also visual, such as that of ontologies. The OnToMap project fits well into this perspective, combining visual, spatial and cartographic representation with conceptual and semantic representation.

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THE FRIENDLY CITY [LA CIUDAD AMABLE]. Andalusian Public Space Programme Awareness raising, training and interventions regarding cities, public space and sustainable mobility

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Introduction

In 1998 the signing of the Kyoto Protocol marked the beginning of awareness about shared responsibility for the quality of urban environment, to fulfil commitments that affect the quality and sustainability of the urban environment in which we develop our daily activity. In Europe, in 1994 the Aalborg Charter reinforced the idea of a joint commitment, that was later formalized through guidelines like the European Sustainable Development Strategy, and in Spain, the Spanish Sustainable Development Strategy, the Strategy for Urban Environment and, in 2009, the Spanish Strategy for Sustainable Mobility.

At a regional level, the Andalusian Plan for Climate Action or the Environmental Sustainability Program City 21, together with the Andalusian Strategy for Urban Development in 2011, proposes an impetus for a new culture of mobility and accessibility, incorporating sustainability criteria and efficiency.

After two decades of Real Estate bubble, the Andalusian Ministry of Public Works and Housing (Consejería de Fomento y Vivienda), from 2012 has prioritized regenerating the consolidated city, responding to the need to rehabilitate the existing city and to guarantee decent housing to the less favoured and most affected sectors of the population – public housing, substandard housing - and to avoid consuming more territory, to densify the city and to work for a more sustainable territorial model: from speculation to a rehabilitation culture.

But the city, as a complex organism, is mainly formed by residential tissue but also by connective tissue, the public space – and of neuralgic places – the city equipment – where human relationships materialise.

With this aim, the Friendly City Initiative (La Ciudad Amable) or LCA program – promoted by the Ministry of Public Works and Housing (Consejería de Fomento y Vivienda), through the Department of Rehabilitation and Architecture (Dirección General de Rehabilitación y Arquitectura), under the responsibility of a big group of technician and the management of Gaía Redaelli that was responsible of that Department from 2012 until 2015, opened a new path in intervention policies on public spaces to share a universal model where the public space is the collective courtyard of a Sustainable, Inclusive and Intelligent City.

The purpose of LCA program is to raise awareness, teach and spread the values and intervention techniques on public space, sustainable mobility, and in general, about improvement in the quality of the urban space and its social, cultural and economic activation in order to guarantee a different urban European model and a real Right to the City.
Fig. 1. The LCA program web site as an important dialogue with the local community
Methodology

The Friendly City is an initiative promoted by the Andalusian Ministry of Public Works and Housing which aims to create a new approach in government policies on intervention in public space. In fulfillment of this aim, LCA program has carried out awareness-raising and training actions to spread the values and methods associated with intervention in public space as collective place, sustainable mobility in the modern city and, in general, with improving the quality of urban space and reactivating it socially, culturally and economically. As part of the same process, the Regional Ministry of Public Works and Housing has provided local governments with tools to plan interventions in public space from a more rational point of view in terms of social organisation and the environment.

Bilateral relationships with town and city councils is a crucial part of this process, both as regards training and the interventions proposed. The Friendly City has created a channel for training municipal technicians (responsible for urban planning, the environment, mobility, public planning, etc.) as well professionals involved in the sector, all geared towards improving public space and, in particular, its intersection with urban mobility and social participation. The initiative has also provided the regional ministry, municipal councils and professionals with the opportunity to jointly define projects to improve the urban landscape and living environment in towns and cities.

The Friendly City initiative was created in 2013 to complement the Andalusian Public Space Programme and is structured around three different but complementary lines of action. The first line consists in Training municipal technicians, professionals, teachers, university students and the public in general. The second line focuses on Creation and promotes municipal projects on public space and sustainable mobility. The final line revolves around Dissemination and actions designed to reactivate urban space; a website provides citizens with access to the lectures delivered as part of the training line, while a digital platform guarantees that the parties involved in the initiative can remain in contact at all times.

In the Training phase, more than 700 technicians participated in the formative actions with a pool of experts exposing Best Practises in public space policy, between Sustainability Mobility and Social Participation with cheap interventions. More than 20 meetings were done all over the Andalusian territory, both with internal administration technicians and external ones. Three conferences in the Andalusian Schools of Architecture were organized in order to facilitate and debate about a new formative line in Spanish academicals itinerary on the “Architecture of Public Space”.

After this phase, the municipal projects presented during the Creation line aim to respond to the demands formulated through the following categories:

01. Environmental Islands
Projects on a delimited urban sector aimed at reinforcing sustainable urban mobility and road hierarchy and recovering public space for collective use.

02. Habitable spaces
Projects concerned with reactivating and improving the environmental and landscape quality of a public space or specific urban pattern.

03. Sustainable lanes
Bike lanes in urban areas to connect residential areas with workplaces, shops and miscellaneous activities, addressing the growing social demand arising from citizens’ changing mobility habits.

In addition to the aforementioned actions, the social integration and public participation aspects of the initiative are articulated by creating training spaces to provide technicians (municipal and those responsible for formulating proposals) with the appropriate methodologies and participatory skills. Interventions in public space are also supported by creating participatory spaces in the various towns and cities to guarantee the social sustainability of the actions.
undertaken. All of this is complemented by awareness-raising activities and the promotion of sustainability and environmental improvement values to encourage better habits and urban maintenance.

**Results and discussion**

As a result of this process, between 2013 and 2015 numerous municipal councils of towns and cities throughout Andalusia planned experimental interventions in public space to improve the lives of their citizens. Altogether, 394 municipalities were involved in the initiative, representing 50% of the 776 towns and cities in the region, and 760 professionals of urbanism, architecture, mobility experts, etc. In the Creation phase, 204 councils submitted intervention proposals to the regional ministry for approval and a pool of experts selected 52 projects for co-funding with ERDF European financing. From 2015 the collaboration between Regional and Local Government selected young architects within the ones that took part in the formative actions in order to develop the architectonical projects and the participative actions within citizens. More than 24 interventions have been completed until nowadays and the others are under construction and/or under project programmed for the next future.

The initiative has focused on promoting:

01. Urban and environmental quality
e-agorà for the transition toward resilient communities

The improvement of the environmental quality of towns and cities and the health of citizens by mitigating the effects of urban heat islands, creating living areas, reducing noise and the impact of direct sunlight, protecting biodiversity, etc.

02. Reactivation of public space
Proposals for alternative uses, collective activities that promote reactivation and the use of public space by citizens.

03. Sustainable mobility. Accessibility and connectivity
The generation of pedestrian areas and the promotion of non-motorised travel to ensure greater safety for the most vulnerable uses (children, the elderly, people with reduced mobility, etc.); the limitation of motorised traffic and parking spaces; traffic calming; non-discriminatory access and use of public spaces, schools, facilities and housing.

04. Public participation and social integration
The capacity to channel citizens’ needs and demands through mechanisms that encourage them to participate in drawing up and implementing the proposals; the use of public space to encourage the integration of social sectors at risk of exclusion.

05. Employment
The capacity to mobilise local labour in the construction, maintenance and reactivation of public spaces; urban reactivation through the creation of jobs in sectors like tourism, retail, culture and the new information and communication technologies.

06. Energy efficiency
Energy efficiency measures in using and maintaining public spaces and urban services (materials, lighting, water cycle, waste collection, public transport, etc.).

For the innovative methodology between a regional government and local community upon Public space policy, in 2014 ONU-Habitat declared the LCA program Best Practise in City Sustainability Development. The program were presented in Medellin meeting (April 2014) as a New Urban Agenda possible path on Public Space and because the repeatable methodology in other regions and polycentric city system. In 2016, the Bienal Española de Arquitectura y Urbanismo - promoted by the Spanish National Ministry of Public Works and the National Architect Organization – recognized the LCA program has finalist in the Investigation section. The Bienal recongnized the innovative action that applies an investigation and academical formative methodology to a public regional and practical policy.

Fig. 4. Las Cabezas de Sanjuan avenue with shadows elements. Architect Sara Tavares. Photo: Pablo Díaz.
Conclusions

After the first two years of implementation of the program, it's important to evaluate it in order to make it better and to reproduce it in other geographies. The University of Seville is doing it by PhD and investigation European programs and should be very important to measure the contribution of LCA Program to reduce Climate Change (more sustainable mobility and densification of existing city) and to promote a real Inclusive, Intelligent and Sustainable City in Europe 20/20 and the New Urban Agenda.

It is important that the parties involved in participatory processes are able to recognise the effectiveness of their work throughout the entire intervention in the public space. The results of participatory processes should therefore be carefully analysed and the conclusions drawn transferred to and shared with citizens.

The initiative can be replicated on different scales, even on a larger one than the region of Andalusia, as the strategy and materials can easily be adapted to the scale of the area in question. The environmental and the social aspects of LCA program are definitively the first keys in a new way of thinking in Public Space from the relationship between regional and local governments in a real Inclusive, Intelligent and Sustainable Europe.

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Introduction

The configurational analysis has been largely debated in the last years, gaining a wide audience and the recognition as a useful tool of urban space analysis. Multiple studies and researches have demonstrated the reliability and the innovation of the method, proving its potential in complementing more common and traditional methods of territory analysis. In order to understand the efficiency of configurational analysis as a planning tool, this paper proposes an experimentation on the city of Milan. The city appears an interesting case study as it has a complex structure, actually difficult to read, has suffered strong changes over time (De Finetti, 2002), and has never been approached with this type of analysis.
Methodology

The configurational approach to the analysis of urban settlements was introduced by Bill Hillier in the middle of 80s under the name of Space Syntax. The configurational analysis focuses on space, assumed as voids and defined by obstructions – walls, blocks and buildings - that constrain the vision; it studies the topological relations between the elements that compose the urban grid. The configurational approach is therefore based on the relevant role it attributes to the grid and its paths, appraised as the primary element in determining the patterns of both natural movement and socio-economic behaviour of humans (Hillier, 1996). Among the several configurational techniques so far introduced, distinguishing each other for the way of discretizing the urban space, the so-called linear analysis and visibility graph analysis are by far the most used. The research this paper is concerned with uses the linear – or axial - analysis, which consists on reducing the space into the set of longest and fewest accessible lines that cover all the convex spaces (Hillier et al, 2014). During the last decades, many measures for explaining social behaviour have been developed by Space Syntax researchers; one of the most fundamental configurational indices is integration, defined as a measure of topological mean depth of a spatial element to all the others, computed counting the number of turns along the shortest path between them. Integration was proved to correspond to the distribution of retail activities and its higher values in the urban grid correspond to the so-called integration core, which is a spatial indicator of the centrality of the system. Another relevant indicator is choice, which measures the frequency of an element along the shortest paths connecting all the couples of others. Both those parameters can be regarded as centrality indices, as they identify the most accessible spaces as well as the most used spaces in the urban grid. By computing integration at two different scales (on the whole map and fixing the radius) and correlating them, it is possible to understand the relation between the parts and the whole in an urban system.

Results and discussion

In order to carry on the analysis of settlement genesis of Milan, three different dates have been chosen, suitable for representing the development of spatial expansion of the system over time: 1704, 1884, 2014. Every map has been analysed by Space Syntax and the respective integration cores have been identified in order to determine the evolution of urban centralities over time (Cutini, 2001). In the first two maps, the centrality was unique and showed the urban guidelines of those times. The third map, the more recent one, represents a multi-centrality that account for the new urban approach based on a functional mix (Oliva, 2002).
In order to face urban issues by a configurational approach, it is necessary to verify if Space Syntax is well suited for the city of Milan. In general terms, since integration is expected to correspond to the actual distribution of retail activities, its value has been compared to the actual activities density, taking a sample of 30 streets, homogenously distributed and provided with a wide range of integration values. The correlation appears positive versus global integration as well as versus local integration, computed taking account of the lines within a circle of radius 3. In order to filter these outcomes from local factors, the sample has been divided into 10 groups of 3 elements. As a result, the correlation, as it is shown in figure 4, appears narrow and exponential.

Once the suitability of this approach for the city of Milan was verified, the configurational analysis has been used to face several different issues of urban planning, especially referred to different kinds of accessibility. In fact, Space Syntax is able to analyse pedestrian, cycle and vehicle movement networks; below is the map of cycling accessibility: the accessibility is computed by angular segment analysis and the radius is set to 5000 meters, which corresponds...
to more or less 30 minutes by bike (Lars-Göran, 2009). From the integration map (Figure 5, left), it is possible to observe the more accessible areas within a radius of 5000 meters, as well the better chosen ones can be identified from the choice map (Figure 5, right). Using these two maps, the most attractive areas for cyclists can be identified and this information might be useful in a possible decision-making process on localizations of public services that encourage sustainable mobility.

Other useful urban applications of Space Syntax consists of combining different configurational indicators in order to satisfy specific hypotheses and conditions. An example refers to a scenario for the location of areas for libraries, where two requirements are assumed:

- libraries have to be far from traffic flows, and hence located in areas with low value of choice;
- libraries have to be easily accessible, and hence located in areas with high values of integration.

These two requirements can be met in two ways:

- selecting - by a specific query - elements showing both low choice values and high integration values, assuming arbitrary thresholds (Figure 6, left);
- creating a complex index, resulting from choice and integration indicators, suitably weighted (Figure 6, right).

This kind of scenario can be implemented into a Geographic Information System (Jiang et al, 1999) to integrate the configurational results with the geographic information that indicate the locations of the existing libraries in the city, as shown in Figure 6 (right).
Another relevant and innovative issue in urban planning is the resilience of the urban grid, here regarded as the capability of an urban system to absorb changes in their structure without suffering significant variations in its configurational state. In order to study the resilience in the case study of Milan, a punctual analysis has been carried out: in the scatterplot of synergy (correlation between global and local integration), a group of dots appears particularly separated from the cloud of the dots of the whole system, as characterized by high values of local integration and (relatively) low values of global integration. Theoretically, it means that the corresponding streets are rather segregated from the whole system, and still well integrated in the local neighbourhood. The presence of such areas has a negative effect on the resilience of the city, as it makes the grid more disaggregated. The selected dots correspond to Bovisa neighbourhood (figure 7), which is defined as self-supporting quarter in Milan with a specific identity in its urban configuration (Erba et al, 2000). Therefore, this scenario demonstrates the capability of Space Syntax to support the understanding of the inner geography of the city of Milan.

![Fig. 7. From Synergy scatterplot to Integration Map.](image)

**Conclusions**

In this study, the configurational analysis is shown as an excellent planning tool for the diachronic analysis of the system and for the reconstruction of the evolution of centralities over time. Furthermore, Space Syntax techniques are well suited for the interpretation of the distribution of activities and centralities within the city of Milan. The configurational analysis reveals to be an efficient tool to support the decision-making process of several measures at urban scale, with a particular reference to those involved with to the theme of accessibility, usefully supporting the present and future planning of public spaces. The results show that the Space Syntax approach actually enhances the capability of strategic decisions about the design and planning of urban spaces. Possible future developments are plenty, such as adding some other historical dates that correspond to relevant urban transformations of the city; or, considering other socioeconomic variables to compare with the integration value, such as the distribution of status of social network like Facebook or the distribution of traffic flows over the whole map. Furthermore, it can be possible to create other - secondary - indices from the aggregation of two or more configurational parameters in order to point out specific elements of the system.
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Configurational Approaches to Urban Form: Empirical Test on the City of Nice (France)

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Introduction

Configurational analysis can be seen as the adaptation to urban space of complex network approaches already developed in social network analysis (Freeman 1979). Its central idea is that elements of urban form should be analysed with respect to the relationships that they establish with all other form elements within a given scale of analysis. In twenty years of research on urban form using configurational analysis, a certain variety of approaches and of more specific techniques has been developed. The main goal of this paper is to give a systematic overview of the different techniques and approaches and to test selected techniques in their ability to recognise different urban forms within the city of Nice, France.
Methodology

Configurational analysis is a street network approach to the analysis of urban form. Compared to the classical approaches of urban morphology (Caniggia and Maffei 1979, Conzen 1960, Castex et al. 1980), it privileges the analysis of the network of urban streets over the analysis of the built-up areas or of the parcel structure of land. Thanks to the assumptions of the theory of natural movement (Hiller and Hanson 1984), it bases the relations between form elements on the linkages created by the potential movement of pedestrians (usually shortest paths) within urban space. By doing so, configurational analysis goes beyond the geometrical relations linking a form element to its immediate neighbours and determines its configurational properties by taking into account the re-lations established with all other elements within a given scale of analysis. This allows a multiscale network-based analysis of urban fabric and of overall city layout (Levy 2005). At first view, scientific literature identifies two broad families of approaches to configurational analysis (Porta et al. 2006a, 2006b). The first is based on metric distances on physical networks and uses a primal graph of the street network, where street intersections are nodes and street segments are edges. Multiple Centrality Assessment (MCA, Porta et al. 2006a) is the most widely used technique of the primal approach. The second approach is based on topological distances on a dual graph of the street network, where linear features (street segments, visual lines, etc.) are nodes and their intersections are edges. Axial analysis of Space Syntax (Hillier and Hanson 1984, Hillier 1996) is a typical example of the dual approach.

According to Porta et al. (2006a) and Ratti (2004) the primal approach should be preferred for configurational analysis. Once problems of edge effects are solved, the primal approach identifies central features within the street networks by means of calculi which are independent from form elements identification, produces indicators which better describe different aspects of centrality and integrates metric distance in the calculus, respecting one of the main properties of physical urban space. For Porta et al. (2006b), the dual approach has great potential in the analysis of street networks but should not be used for configurational calculus, as purported by Hillier (1996).

It seems to us that the differentiation between a primal and a dual model of the street network is a main difference between configurational techniques. But it is not the only one. Two other main methodological aspects should be considered. The first one concerns the entitization of the network, i.e. the way we identify the physical elements of the street network. There are at least four different options: topological elements (defined by connections which are consistent through deformation and magnification/reduction of the urban space), angular elements (defined by directions which are consistent through magnification/reduction but won't resist deformation), dimensional elements (segments of a given length, which won't resist neither deformation nor magnification/reduction), socially defined elements (like street names or any other cognitive and social recognition of form elements, which depend on the social representation of urban space). A second additional aspect to be considered is the way distance between form elements is defined within the network: it can be topological (number of connections, whatever the nature of the connections is), angular (modelling the psychological impedance to change of direction in movement) or dimensional (metric or temporal distance on the network, modelling the physical impedance to movement). Table 1 is a systematic overview of different configurational techniques which are well known in literature (Cutini 2010), by positioning them in the three main methodological dimensions. A few combinations seem more problematic than others (as calculating an angular distance on a primal graph or a dimensional distance on a dual graph). Some techniques mix the options (even distance options could be mixed). More interestingly, primal approaches can easily integrate built-up elements in the configurational calculus (Sevtsuk et al. 2012). Although being mainly network-based, configurational analysis can thus integrate another important aspect of urban form.
We will focus on three particularly well established techniques of configurational analysis: Space Syntax Axial Analysis (Axial SSx), Multiple Centrality Assessment (MCA) and Mark Point Parameter Analysis (MaPPA). The latter seems particularly interesting as it defines form elements by mixing topologic, angular and dimensional considerations: linear features are identified whenever an intersection occurs, a main directional change occurs (as in a winding street) or a given metric distance is achieved (which results in dividing a long street segment in several shorter ones). MCA entitization does not integrate changes of direction, another main difference being the network distance considered in the two techniques (topological vs. dimensional).

Beyond node degree (which has a quite different meaning in the primal and in the dual graph) every technique produces a series of comparable configurational indicators, directly derived from Freeman (1979) which can be calculated at different scales of analysis. Indicators are calculated for network points by the primal techniques of MCA and MaPPA and for axial lines by the dual technique of Axial SSx. The simplest indicator is the reach / node count, quantifying the number of form elements which can be reached from every element within a given radius of analysis. The farness / total depth indicator is a measure of how far a form element is from all other elements in a given radius. By normalizing it through the number of form elements within the same radius, we obtain the normalized farness / mean depth. The integration index of Axial SSx is just a further normalization of mean depth, with reference to values of reference theoretic street networks (Hillier 1996). The betweenness / choice indicator is a measure of how many shortest paths pass through a form element, when considering all shortest paths within a given radius. Reach or closeness (inverse farness) on the one side and betweenness on the other, represent two different and complementary aspects of centrality within a network: being near vs. being between the others.

Different urban morphologies should produce different distributions of configurational indicators among their form elements. Tree-like street networks should thus have very few elements with high betweenness / choice and many elements with much lower values. Grid plans or highly connective irregular plans of spontaneous urban morphologies should have more even distribution both of betweennesses and farness indicators. We will thus test the selected configurational techniques in their ability to differentiate urban morphologies of different known characteristics.
Results, discussion and conclusion

The city of Nice in southern France presents very diverse urban forms due to its particular urban history (Graff 2013) where control of urban form and spontaneous growth have co-existed and shaped different city neighbourhoods. Six emblematic study areas within the city of Nice were thus selected (Figure 1) in order to represent specific patterns of urban form and functioning. This paper will focus on the cases of the city centre, mainly a planned urban grid of the second half of the XIX century, and of the western hills, a spontaneous growth area of the XX century marked by the presence of north/south valleys and ridges and a relatively marked tree-like network structure.

Fig. 1. The city of Nice and its six emblematic study areas.

Five configurational calculi were carried out: Axial SSx, MCA and MaPPA, the latter two with and without buildings. MCA points are street intersections with additional points on segments exceeding 100 m. MaPPA points are street intersections, winding points and additional points on segments exceeding 100 m. When integrating buildings, MCA uses building points projected on the network, MaPPA weights its network points with the number of buildings assigned to them. Three scales of analysis were considered for each calculus: the micro-scale of 400 m/7 topological steps, the meso-scale of 800 m/15 steps, the macro-scale of 1600 m/30 steps. The configurational calculi were carried out on the whole built-up area of Nice and its neighbouring municipalities (including a wide buffer zone to avoid edge-effects). Results are nevertheless analysed locally for each emblematic areas (Figure 2): through maps with a relative colour scale (to identify the internal structure of each area) and through diagrams on an absolute scale defined by the range of the whole urban area of Nice (to compare the study areas among them). Both the dual approach of Axial SSx and the primal approach of MaPPA can differentiate the two study areas, both internally and between them. They highlight however very different central features, above all in the city centre: the longest axial lines vs the many crossroads, which are much more evenly distributed in space. Axial SSx identifies highly skewed distributions (whether exponential or heavy-tailed, however with stronger hierarchy in the western hills area), whereas primal node degree distributions are more symmetrical. These results are direct consequences of the entitization difference of the dual approach. At the micro-scale, Axial SSx determines low values of reach in the western hills, when these are evaluated with respect to the whole urban area. Only the relative colour map can highlight the higher values of the southernmost parts, where the valleys meet. The city centre has a more symmetric distribution of values, like in the primal techniques, the longest lines constantly showing high values. MaPPA and MCA identify...
correctly the internal structure of the two areas both in the absolute and in the relative representation and are a bit more selective (especially MCA) in assigning high values within the city centre. The metric impedance of MCA also contributes to limit high centrality values in the southernmost sections of the western hills, whereas Axial SSx and MaPPA tend to stretch them further up the valleys. At the same time, MaPPA penalizes the most the hillsides, as they are connected with winding streets.

The large-scale betweenness of the Axial SSx fails to differentiate the city centre and the western hills, despite their very diverse network structures: both areas show extremely hierarchical distributions. Primal approaches of MaPPA and MCA (here implemented with buildings) more correctly show the less hierarchical distribution of values in the city centre. The inclusion of buildings contributes even more to the spreading of betweenness values, since the city centre, at the difference of the western hills, is homogenously built up. On the contrary, buildings highlight
the betweenness centrality of thalweg streets, which are much more heavily urbanised than ridge streets.

In conclusion, as already pointed out by Porta et al. (2006a), results of Axial SSx seem more heavily dependent on the choices in entitizing the network. Axial SSx betweenness also fails to detect two particularly different urban morphologies in the city of Nice. Differences in the results of MaPPA and MCA, with and without the integration of buildings, are more subtle. The two techniques share the primal representation of the graph and the choice of adding dimensional constraints in the MaPPA entitization brings topological distance of MaPPA closer to dimensional distance of MCA. Introducing buildings seems to improve the detection of internal structure of case studies, as a further aspect of the morphology of urban fabric is, at least partially, injected in the configurational calculus of the network. Of course, a more systematic comparison of results is needed to confirm these conclusions, taking into consideration the six study areas and using more quantitative ways of comparing configurational results.

References


**Introduction**

Review and analysis of research conducted in Iran and in the city of BandarAbbas indicates that security feeling in communal spaces is considered as a problem and needs of citizens. This paper aims to provide a physical pattern of security feeling in BandarAbbas communal spaces is doing.

Theoretical foundations of the pattern based on reviewing the physical approaches and theories in the security feeling field, especially irregular pattern, pattern vision shelter, defensible space model and a model of crime prevention through environmental design, has been formed. This experimental pattern relying on data obtained from field data collected from 290 randomly selected residents of BandarAbbas in the BandarAbbas communal spaces. Data were collected by using questionnaire. Results of multiple regression test showed: Physical factors; entrance the motorcycles into the communal spaces, the lighting, the suitability of flooring, positioned between the walls and dilapidated or abandoned buildings around the communal spaces, with a correlation coefficient (R=0.46) explain R²=0.24 of total variance of citizen’s security feeling in communal spaces.

Different views presented in the study of the causes for the development of the city and the reason why human societies came together in the city. One of these theories regards the issue of security and safety aspects in the development of the city as effective. While centuries passed from the first emerging of urban communities, cities are engaged in new issues about different aspect of the lives of citizens due to increasing growth of physical width and population. Meanwhile urban security is one of the major issues in the debate to reform and restructure the city. Security in every country is generated when there is psychological security and Psychological security is the result of feeling safe and feeling safe is demonstration of public efforts to run a healthy community. In order to achieve sustainable development, each country needs to feel safe. Feeling safe derives either from the individual or the environment where he lives.

In general, there are two aspects to security: one is the objective aspect which is evaluated by objective environmental and behavioral factors and the other is subjective aspect which is based on the feeling security of the group. Both aspects can affect each other positively or negatively. Therefore, these two aspects should be considered to improve the security of the city (WHO report, 1998: 297). Subjective aspect of security refers to community sense of security and in fact, the reduction of undesirable events will not necessarily lead to an increased sense of security (ibid.).

Ferraro says fear of crime 'emotional response to fear of crime and signs that a person is associated with crime "(Ferraro, 1995). In order to reduce these fears, people may change their behavior in two ways: 1-Limiting behavior, where they are faced with potentially dangerous situations they minimize the risk by avoiding that
particular location and changing that behavior. 2 - Protective behavior in the case that security measures have been developed (Skogan and Maxfield, 1981). Both of these reactions have inferred concepts. Thus it is possible that people who are afraid of crime reduce their presence in the public sphere, thus limit their physical activity, especially if the activity is just walking (Ross, 1993). In this context, the importance of the public sphere is because of their role in sustainable urban development. One of the most important factors threatening the public space is a general feeling of insecurity. Because of the uncertain boundaries and unlimited ownership, public space has the highest risk and vulnerability to insecurity. Hence, it is necessary that the city and its spaces safety and security for all residents and observers. Outdoor spaces are mostly considered as fields, parks, markets and streets that connect them together (Lubuva&Mtani, 2004: 23).
Theoretical frameworks

Evaluation of experts’ opinions on the subject of physical factors affecting security implies that major theories and views expressed in the context generally based on ecological attitude, behavior and environmental quality and ecological design of settlements. Here are some examples based on the goal of the paper:

A - Classical school of urban ecology
The analysis of documents has shown that one of the old schools which focus on security and environment influence on the formation of offense is the school of urban ecology (1916). On the basis of ecological theory about urban crime, the theory of “conducive environment “is presented in which the effects of the environment on committing various crimes are dealt with (Shokoohi, 1365, p 102).

B- The theory of crime prevention through environmental design (CPTED)
This theory influenced by the thoughts of Jeffrey (1971) and Jane Jacobs (1961). But Clark, Kernish, Taylor and Harrell supported this theory by providing the theoretical basis of criminology (Teymoori., 1382: 54). Theory of crime prevention through environmental design examines the form and urban fabric and its relationship to urban crime. Based on the American National Institute on Crime, its definition is "Design and good use of the built environment which can reduce the fear of crime and improve the quality of life (Iranmanesh, 1384: 16; Cozens, PM 2002: 132; Jane Jacobs, 1961: 132). Ms. Jacobs believes that factors such as lit-up and busy places with watchful eyes and high turnout with wide and large sidewalks are effective in shaping safe urban environment and suggests diversity of uses for streets (Kalantari, 1380: 31).

Habermas also criticized modern architecture and believes that “the blocks had doors to the street and yard and garden in their back (Habermas, 1384: 252).
Architect Oscar Newman (1970), has also presented some ideas for the physical design of neighborhoods, so that the crime can be prevented. He believes that physical and social factors are important in most cases. Physical factors include the “size of complex” and “number of families” that share a building public space, the greater participation rate is the greater crime rate is. Social factor means "the amount of income" and "the percentage of adolescents to adults. He believes that the size of building has a major impact on the fear of crimes and social stability, which are as follows: 1 - The use of public spaces in residential complex. 2 - Social relations with neighbors. 3 - The sense of control over public inner-outer areas (Moradi, 1381: 19).

C - Physical irregularities
The main assumption of this approach is that it focuses on irregularities and minor offenses which are mainly based on reactive and work pattern to establish order and security not is considered. In this approach, physical irregularities, such as unhealthy appearance of the buildings and abandoned sites are emphasized using law enforcement and social development (Kelling, Gl, & Sousa, WH 2001, Skogan, W. 1990; Hinkle Cj &Weisburd, D., 2008: 503; Cozens, PM 2002: 132).

D – Sanctuary-prospect theory
Fisher and Nasar, considering Sanctuary-prospect theory of Appleton, offered their general typology for assessing an individual’s perception of the security. They stated that when people express their feeling about their security levels in an environment they consider the level of perspective and haven for possible criminality (secondary sanctuary). Also, to support his argument, he noted the lighting and availability model of Archea which emphasizes the role of visual access to the perceptions of an environment. According to their argument, the amount of
opportunity space can provide to escape from a potential attack plays a vital role in the individual perception of the security (Fisher, BS, & Nasar, JL, 1992; Appleton, J., 1975; Archea, JC, 1985; Appleton, J., 1975). To support this, studies have shown that people generally prefer natural environments with open meadows. Environments with lower structural elements, more sight distance, topography changes and clean water enjoy higher preference and priority for the people (Kaplan, R., & Kaplan, S., 1989; Steinitz, 1989; Zube, et al., 1975; H.Russ, 2005, p.22; Salingaros, 1991: 213). The theoretical physical model of security in urban open public spaces is as follows:

Tab. 1. Theoretical physical model of security Feeling in urban communal spaces.

<table>
<thead>
<tr>
<th>Physical Factors</th>
<th>Cleaning and hygiene of public space</th>
<th>Dilapidated and abandoned buildings around the public space</th>
<th>The suitability of flooring route, and playing</th>
<th>There are various uses of public space</th>
<th>Motor vehicles coming to sidewalks and pedestrian rest areas</th>
<th>Placement between high walls, trees and tall buildings</th>
<th>Access to escape from danger in an emergency in a public space</th>
<th>Light status</th>
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Discussion

The findings of field studies in explanatory manner indicated that eight physical indicators influencing sense of security in public spaces in BandarAbbas are almost all moderate and medium-to low (bad).

The resulted findings of Pearson and Spearman correlation tests showed: there is a significant correlation between sense of security with physical factors (Pearson correlation coefficient ($R = 0.304$) and Spearman correlation coefficient ($R = 0.270$)). As expected, relationship between physical factors with sense of security is direct, i.e. when physical indicators in public spaces are more desirable feeling security increases. According to the theoretical foundations, when physical indicators in public spaces are not favorable the grounds for social problems increase. Because we need to specify the key factors influencing the sense of security in public spaces.
Results of testing the theoretical model show that physical factors such as: motor vehicles coming to sidewalks and other places of rest, lighting status, suitability of the flooring in walking and sport routes and playgrounds, placement in between fences, long walls, trees and high-rise buildings, dilapidated and abandoned buildings around the public space with correlation coefficient of 0.46, form a total of 0.24 of variance in security Feeling in urban communal spaces. As it said, the present spatial pattern of feeling safe is far from the desired level of physical indicators in most cases. This means that the resulted findings of multiple-variable regression with step by step procedure showed that among physical indicators in a multivariate model, physical indicators of: "motor vehicles coming to sidewalks and other places of rest, lighting status, suitability of the flooring in walking and sport routes and playgrounds, placement in between fences, long walls, trees and high-rise buildings, dilapidated and abandoned buildings around the public space" have significant impacts on the sense of security in public spaces. Therefore, in designing appropriate pattern of sense of security, this should be given more importance. In other words, the analytical findings showed that all physical indicators presented in the theoretical model are related with the existing pattern of sense of security. Therefore, in order to gain suitable spatial pattern for the sense of security in public spaces some changes made in the existing patterns of spatial indicators influencing sense of security in urban communal spaces in order to improve and modify them. According to the above findings, the experimental pattern of this article support the previous research.

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Conurbations and resilience. When growth makes us fragile

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Key-words: urban sprawl, conurbation, resilience, configurational analysis.

Introduction

This paper is focused on the conurbations, extensive urban areas resulting from the expansion and coalescence of several neighbouring cities. A special attention will be devoted to the property of their resilience, assumed in relational terms and intended as the capability of an urban system, thanks to its own spatial features, to adsorb accidental events and transformations without significantly changing its inner geography and global behaviour. Such property is today to be considered a key issue, as related to the capacity of the system to continue effectively operating even in case of exceptional occurrences, and, in ordinary conditions, to the flexibility of the road network to adapt to the changing functional asset of the settlement.

Two theses actually run through the paper. The first is that, either in metropolitan systems - characterized by the presence of a dominant urban centre surrounded by a galaxy of minor settlements, gravitating around it - and in ordinary urban coalescences - resulting from the coexistence and merging of an amount of urban centres equivalent in size and importance - the appearance of a conurbation represents a turning point in the development of the involved cities, so as to determine quite a different urban geography, thus drastically modifying the distribution of phenomena occurring on their inside. Besides, it will be argued that the development of a conurbation intrinsically involves the weakening of the resilience of the whole system. Both those theses will be discussed on the basis of the spatial properties of conurbations, and supported by the findings of the researches on the case studies of the metropolitan area of Florence and the Versilian conurbation, along the Tuscan northern seaside. The phenomenon of conurbations and the diachronic analysis of their resilience will here be observed from a configurational point of view, by means of space syntax techniques, stressing the role of spatial relationships within the grid as the primary element of the effects of their development.
Methodology

As hinted above, a configurational approach was here selected as a tool for the analysis of conurbations. What suggested this choice is its assumption of the urban grid as the primary element in the distribution of movement and hence in determining the patterns of human behaviour (Hillier, Hanson, 1984): mainly movement, which is oriented and leaded by the visual perception of the spatial layout, and through movement, also the location of activities, land value and so on. At the root of the configurational approach is the assumption that an urban grid contains, due to the spatial relations between its elements, an intrinsic vocation for attracting movement flows (Hillier, 1996); which is liable to drive movement-seeking activities towards the most crowded spaces and to address the movement-avoiding ones towards the most segregated and deserted.

Several operational techniques – encompassed under the denomination of space syntax - have been so far developed, differing from one another in respect of the way of reducing the grid into a system, and hence on the single spatial element composing it: the line in axial analysis (Hillier, Hanson, 1984), the vertex in visibility graph analysis (Turner et al., 2001), the segment in segment analysis (Turner, 2005), the road-centre line in road-centre line analysis (Turner, 2007), the mark point in Ma.P.P.A. (Cutini et al, 2004). Despite these differences, still all those techniques share the same conceptual basis sketched above; and all provide each element of the grid (either line, vertex, segment, road-centre line or mark point) with a set of parameters suitable for reproducing different urban aspects. Among those parameters, integration and choice value are acknowledged suitable for describing the changes in the inner geography of the settlement. Integration is the normalised value of the mean depth of an element with respect to all the other elements of the grid (Hillier, Hanson, 1984), and should describe its accessibility, that is how easy it is to get to from all other elements; concretely, in fact, it was proved suitable for narrowly reproducing the actual density of the located activities, and hence the distribution of attractiveness, or the vocation of a place to work as an appealing location (Cutini, 2005). Choice, defined as the frequency of a spatial element on the shortest paths connecting all pairs of other elements, is suitable for measuring how likely an element is to be passed through: in fact, several studies attest a strong correlation of choice with the distribution of movement flows (Hillier et al., 1993; Penn et al., 1998; Hillier, Iida, 2005). In other words, while integration reproduces the to-movement potential of a spatial element as a destination, choice measures the through-movement potential of an element as a piece of route (Hillier, 2012).

With reference to the network resilience, three main indices have been so far introduced and tested (Cutini, 2013). A first parameter is the mean connectivity value of the grid, which measures the density and variety of paths connecting each element to all the others. High values of connectivity are likely to guarantee a dense presence of alternative paths and hence the capability of the urban system to absorb a material grid transformation without significantly modifying its relational state (Cutini, Rabino, 2012). A further index takes into account the distribution of shortest paths: being resilient the systems that are provided with a widespread presence of shortest paths all over the grid and, on the contrary, vulnerable those that are characterized by their dense concentration through a small number of spatial elements. On such basis, an indicator of resilience was introduced (Cutini, 2013) as the ratio of the highest choice value and the maximum frequency a spatial element could present, what would occur if it were located on all the shortest paths between any couple of the other elements. In a system of n elements, this index, called frequency index, is expresses as follows:

\[ v = \frac{\text{choice}_{\text{max}}}{(n^2/2 - 3/2 n + 1)} \]

The frequency value obviously varies from 0 to 1, increasing as the resilience of the system decreases. In the extreme case, should a line be located on all the shortest paths connecting all
the couples of lines \((v = 1)\), the system would result vulnerable to its highest degree, in that each of its paths will share (and depend on) that single line.

A further parameter, called ‘synergy coefficient’, reproduces the strength of the correlation between the distribution of integration values at different scales (local versus global). Since integration was proved suitable for reproducing the distribution of urban centrality at different values of radius, a strong correspondence of global and local integration can be assumed as a clue of steadiness of the system. Those three parameters can hence be used as tangible indicators of the network resilience of the whole system and to reproduce its trend over time.

The configurational technique named axial analysis was applied to the case study of Florence and to the Versilian conurbation; in both cases the actual grid consistency at different dates was analysed in order to obtain the respective configurational state and hence its diachronic trend during the making of the conurbation.

**Results and discussion**

The distribution of integration value in the Florence area and in the Versilian conurbation during the last decades are respectively summarized in figure 1 and 2.

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**Fig. 1. The distribution of global integration in the Florence area 1910-2015.**

The results of the analysis of the Florence conurbation clearly shows the progressive shifting of the centrality from the inner core of Florence towards the recent development suburbs on its northern side, following the direction of the progressive growth, due to the presence of steep hills constraining the urban area on the southern and eastern sides. It is worth noticing that the integration core – that is the complex of lines provided with the highest value of integration, over
the 95° percentile –, which in the mid-twentieth century was encircled within the ancient town-walls, in 2015 affects the lines that connect the historic centre to the north-western development. It is also worth highlighting that the distribution of choice in 2015 shows its highest values in correspondence of the motorway A1, which touch the area of Florence on its western side and since the late nineties has been swallowed within the conurbation.

Quite similarly, the recent growth of the Versilian conurbation has involved the extraction of the integration core out of the several cities originating the conurbation (Viareggio, Pietrasanta, Lido di Camaiore, Forte dei Marmi) and its steady collocation along the connections between them, and, above all, in the Versilian seafront promenade, which has became by far the prime integrator of the whole system. The same trend is confirmed by the changes in the distribution of choice value, which in both cases results shifted outward, so as to affect the distributor road connecting the several nuclei. In the case of Florence, this trend is also characterized by the fact that the lines provided with highest choice values, thus arguably most affected by movement, are those composing the motorway A1, whose heavy extra-urban traffic is further increased by local traffic, having origin and destination within the conurbation.

Turning to resilience, its trend in the case study of Florence is here summarized in figures 3. Here a clear weakening of resilience is highlighted by the diachronic trend of three parameters discussed above, which show a sharp turning point around the seventies, as the conurbation begins to emerge. And the findings of the processing of the Versilian case appear to describe quite the same trend.

The results above can be easily interpreted as the effect of the coalescence of neighbouring settlement: their mutual fusion causes the shifting of the centrality from the respective inner cores toward the connection lines between them, which appear becoming the most attractive (movement and activities) elements of the resulting conurbation. Yet, this conurbation appears far more vulnerable (and hence less resilient) in that it is less densely connected than the original settlement; moreover, its global working depends on a limited number of movement paths, namely the connection roads between the pre-existing nuclei, which attract most of movement flows within the conurbation. Any (occasional or permanent) occurrence affecting those few connections is likely to disrupt the whole system.
It’s worth noticing that these results appear narrowly aligned with the outcome of a recent research on the area of Naples, which shows how the development of the conurbation in its southern side, between the slopes of mount Vesuvius and the seaside, has gone determining a progressive increase of the spatial vulnerability of the area (Cutini, Di Pinto, 2015): also in the Naples area, such as in Florence, a motorway connects the urban cores of the conurbation, catalysing centrality and attracting movement along a limited number of paths and hence worsening the resilience of the system. what here raises very high concern, in view of the presence of the permanent threat the volcano constitutes to the densely populated area around. In Naples, the actual presence of a serious and imminent threat does hence strongly materialize the clear effect of the making of a conurbation on the resilience of a settlement, as it was observed in our Tuscan case studies.

Conclusions

The results on our case studies, discussed above, can be summarized in the following conclusions.

- The growth of urban centres up to their merging and coalescence in a wide conurbation radically transforms their inner geography, giving rise to a radically different settlement, characterized by a different inner geography.
- The coalescence of the several cities involves the shifting of their centrality from their respective inner cores towards the connection lines between them.
- Each of the original cores remains provided with a merely local level of urban centrality, thus attracting inner movement flows and the location of local activities.
- The progressive making of the conurbation appears worsening the resilience of the global structure of the whole settlement, as based on a limited number of connecting paths.

It may be argued that the completion of the conurbation, with the progressive saturation of the interstitial area, is likely to determine the complete transformation of the geography of the system, and to eventually reinforce the resilience of the whole settlement; what will allow to regard its present vulnerability as a transitory condition. This phenomenon, not yet perceivable in the considered case studies, could be observable in the foreseeable future.
References


e-γορά for the transition toward resilient communities

IMPC- ICT Models: Planning for inclusive Communities
**Virtual Environments as a Technological Interface between Cultural Heritage and the Sustainable Development of the City**

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Key-words: Virtual Reality and Augmented Reality; ICT; Heritage Management; Interactive Environments; Spatially Distributed Narrative Design.

**Introduction**

This paper presents experimental work that uses immersive technologies for engaging users and local communities in the design process of architectural interventions on historic, fragmented environments in an effort to re-activate historic urban niches that have been forgotten. The presented virtual environment hosts reconstructions of the Paphos Gate neighborhood which were produced based on archival material and via 3D data acquisition (LiDAR, UAV and terrain Structure-from-Motion techniques), in order to explore the associations between the transformation of the monument through the years – from its construction to present day – and the bodily experience of the visitors sojourning in its surrounding part of the city. The objective of this research is the development of a digital platform which through immersion, cinematic language and storytelling enables the evaluation of alternative scenarios and design interventions in the context of the management plan of forgotten open air spaces that used to be popular within the urban fabric. Through the planned operation of interaction booths, installed on site and at the premises of the research organisations participating in this effort, the presented virtual environment will serve as a testing platform for the municipality, the stakeholders, researchers and professionals working in the field to simulate possible urban planning strategies prior to their implementation.
Methodology

Today's fracturing of national and cultural identities and boundaries, exacerbated by global economic and political crises, intensifying migrations of people and consequent hostile tensions across borders internationally and within Europe, means that historic cities are facing acute cohesion challenges of physical, sociopolitical and/or cultural division. The integration of existing and opposing cultures, migrants and settlers, is arguably the most pressing challenge Europe is facing in our era. Occupation and use of resources produces tension due to multiple competing stimuli. The production of these tensions, frictions and pressures that are expressed, and exercised, in the space of the city happens through a continuous process of re-identification. This is where digital technologies of interaction, data management and communication should focus in if they want to contribute to the social sustainability of the smart city. This research builds upon the widely recognised approach to preserving and promoting the role of cultural heritage as a driver for the sustainable development of the city. Heritage can be used to influence positively the social cohesion of neighbourhoods as it could be promoted in such a way that, instead of provoking tensions and division, it would offer spaces of inclusion, interesting everyday experiences and provide a sense of belonging to socially excluded communities. These capacities of cultural heritage along with opportunities for learning and social interaction, offered to their users by heritage places when these succeed in becoming part of the everyday life of a city - i.e., part of the network of its communal amenities and common resources - contribute also to the well-being and quality of life of the citizens.

The experience of historic urban environments remains an ideal context to probe questions of socioeconomic development and cultural identity. The Eastern Mediterranean preserves significant examples of cities whose continuous history can be traced all the way back to Prehistory and Antiquity. In particular, the capital of Cyprus, Nicosia, is considered amongst the most contested urban environments having historically layered pasts and perplexing present-day realities in Europe. Between 2013 and 2014 the part of the moat outside the Paphos gate was excavated in an effort led by the Cyprus Department of Antiquities and the Municipality of Nicosia not only to preserve the history of the area and the medieval fortifications but also to develop and reactivate the neighbourhood. This was an area forgotten and disused during the last couple of decades due to the gradual movement of the commercial and cultural activities away from the old city centre to other parts of Nicosia. The rehabilitation of the historic site of the Paphos gate is co-funded by the EU while the aim of the excavation activity was to unearth and promote the historical continuity of the place from the Middle Ages until today - the gate operated without interruption during the Venetian, Ottoman period and the British rule (Figure 1).
The application of the concept of *gamification* (Squire 2011; Steinkuehler, Squire and Barab 2012) in community design and urban planning, through the use of interactive visualizations of public space, in order to enable participation of local communities - and help individuals that are typically excluded to raise their voice - is an area of design research that is currently attracting significant attention from architects, civic authorities and policy makers, cf.
In the presented research this becomes possible through the ‘virtual world creator’ feature of the platform. The virtual platform allows users to choose, sketch, follow and virtually explore paths and routes inside the projected space in order to offer their personal account of how the specific public space should operate and consolidate their understanding of the complex urban space (Figure 2). The real-time exploration of a projected space extends the participants’ experience of street walking into a journey of exploration, discovery and understanding spatial relations.

The research draws on computational approach to perception, which holds that perception is the result of nervous system activity that modifies and processes raw sensations into reality (Bernstein et al. 2006). Hence the presented research attempts to offer stimuli to specific sensations of the users’ bodies, namely visual stimuli, auditory and bodily movement (via a treadmill that enables navigation in virtual worlds), in order to evaluate projected spatial scenarios. Arguably this is only a fraction of the multifaceted and polyvalent sensorial landscape of the human body, and spatial cognition is not simply a visual process, an issue that has been extensively discussed in the literature (Gaylean 1982; Wiley 1990). Additionally this research recognises the shortcomings of formalisation and the numerous difficulties in transferring the complexity of real-world situations –conditionally- in virtual environments, as well as in engaging the latter in interpretative research activities (Blanke et al 2010; Bowers 1996; Munoz-Cristobal 2015). Nevertheless visualization has been described as the ‘inner landscape of our perceptions’ (Samuels & Samuels 1975; Kosslyn 1983), and this is the starting point of the research presented, which contributes in the discussion about the use of virtual reality in educational activities (cf. McClurg 1992; Winn & Bricken 1992; Regian et al 1992; Bricken 1992; Bricken & Byrne 1993; and Byrne 1993). It should also be noted that the pace of immersive technologies’ development is exponential, currently offering high quality optical resolution (e.g., Oculus Rift offers Full HD resolution), high fidelity surround sound (e.g., RealSpace 3D audio technology and Sennheiser’s 3D audio), accurate body and gesture tracking (HTC Vive, WorldViz Precision Position Tracking system, FOVE’s eye-tracking goggles), while efforts in incorporating other senses are also following this development route (e.g., olfactory, tactile, like the FeelReal mask addition for VR goggles and sensor body suits).

Specifically the real time immersive technology employed in the research is dealing with issues of depth perception, interposition, relative size, height in the visual field, texture gradients, convergence, motion parallax, looming and others. Motion sickness, as a result of the lack of sensory motor integration, is a field of research that is progressing quickly with offerings in the form of walking devices, like the one employed here, the Virtuix Omni and Cyberith Virtualizer, that aim to minimise nausea in user experience. Similarly issues such as perceptual organization (figure-ground processing) and interpreting sound are dealt by state-of-the-art technologies at a satisfactory level and in a convincing, concrete way.
Discussion

This paper presents the contributions of this research to the creation of a life project (Living Lab) involving the development and post-excavation management of a forgotten historic site. This is achieved by means of a participatory process of designing architectural interventions that aims to reintroduce the site into the everyday life of the contemporary city of Nicosia, and by doing so this approach to urban space rehabilitation contributes to practices of collective identity, social cohesion and inclusion (Dodd and Sandell 2001). The overarching goal of this research is to
complement the concept of smart cities with alternative digital methodologies of social sustainability by approaching cultural heritage as a dynamic assemblage of events, activities, performances and identities that relates to space as well as people. Digital methods of urban analysis have been criticized for not integrating notions of bodily movement into space, since computational environments are often considered to be scale-less and body-less (Dyson 1998), and the present research contributes in overcoming this limitation. It does so by means of the human-computer interface it employs, and the interaction with the visual interfaces and digital assets of the platform occurs through a virtual reality gear that enables body motion tracking, as presented elsewhere (Artopoulos, Bakirtzis and Hermon 2015). The issues of spatial cognition and formalisation in setting up the simulations presented are acknowledged and while recognising the limitations of such an approach, the research will hopefully contribute new methods of engaging local communities in planning for accessibility to cultural heritage in historic build environments.

**Conclusions**

The vision of this research is to develop a digital platform which through immersion, cinematic language and creative opportunities offered through participation in the design of public infrastructure in the city will contribute to the reactivation of forgotten open air spaces that used to be popular landmarks within the urban fabric of European cities. In the case of the presented pilot project, the Municipality of Nicosia and Cyprus Department of Antiquities are supporting this effort, and they are currently planning the construction of the proposed walking paths, along with the installation of VR-enabled interaction devices, in the archaeological site of the Paphos gate (Figure 3).

The methodology presented enables the observation and assessment of the successful integration of the heritage site in the urban fabric through a number of recorded indicators, like the degree of information transmission and the successful communication of content, the accessibility of the site and its clear linkages with the rest of the circulation network of the city – e.g., both visual and physical connections, the image of the place, the relevance of the activities planned to take place on site, as well as, whether users recall personal accounts of events that happened on the site, and document associated memories. Data collection involves not only questionnaires but mostly tracking movement information, voice recordings and assessment of the proposed routes and paths across the site, cf. (Artopoulos and Bakirtzis 2016). Positively assessed spaces would justify a sense of connection with the place and would therefore highlight the significance of that simulated space for the social sustainability of the neighbourhood. Community participation in planning is important for sustainable cities and this research is an example of how heritage can complement current ‘smart’ retrofit policies and contribute to the holistic development of historic cities.

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References


Introduction

The Multi-Criteria Analysis is a classic analysis model for urban and environmental studies that intents to understand the main elements that affect a system, separate them in layers, and promote an integration among them through the assessment of the impacts caused by the variation on the relevancy of each one of the components on a synthesis procedure. It is part of the systemic approach origins and its use was expanded by the easier access to GIS tools.

According to Moura (2003), the steps on a Multi-Criteria Analysis (MCDA) are: a clear definition of the goals; the selection of the main suitable variables for the cause of investigation; the database assembly; the organisation of potential surfaces for each variable that indicate its suitability for the cause of investigation; the assignment of weights for each layer indicating the level of relevancy. The result of the integration among the variable elements is a map that indicates a spatial distribution of the values from the worst to the best result considering the cause of investigation.

The problem of facing the decision on the importance of each criteria is a classic question in this method. Some researchers proposed processes, as Saaty in AHP - Analytic Hierarchy Process (Saaty, 1980), as the Delphi Method, proposed by the American Research and Development - RAND (Dankey and Helmer, 1963; Linstone and Turoff, 2002). Others classified the process according axis of investigation, as data-driven evaluation or knowledge-driven evaluation (Bonham-Carter, 1994). And there were authors that worked with the control of the output verifying the uncertainty of the results, based on Sensitivity Analysis (Ligmann-Zielinska, Jankowski and Watkins, 2012).

The paper presents contributions to this step of choosing the importance of each criteria, based on visualisation aspects: the user can test the importance of the decision controlling the results in the case study area. To present the visualisation we discuss the graphics semiology and the rules to arrive there developed in digital representation.

As this work is based on the visualisation improvement of the results to favour the involvement of the different society actors, its main contribution occurs during the calibration of the result according to the expectations e values from the citizens. It is necessary that the participants – whether people of the place, technicians from design professions, technicians from geographic sciences, technicians from information technologies, or people from administrative staff – have total access to the data and are able to understand the transformation of the data into information so that they can transform the information into knowledge. In this sense, the visualisation of the results
is an essential instrument to support the planning activity.

The main contribution of this work is the improvement on the visualisation of the MCDA process for the understanding of the integration among the variables (step performed inside InViTo© environment) as much as for the step of visualization of the results that was possible through the three-dimensional representation performed inside the Grasshopper© environment and visualised with Rhino3D©.

As a contribution from the researcher Stefano Pensa, a project was elaborated based in InViTo© for Multi-Criteria Analysis and with the goal of exploring the areas with urban transformation potential (growth and occupancy densification). First, ten criteria were tested as they were the main components according to the cause of investigation. Then, the user defined the relevancy of each variable through a scrollbar according to a hierarchy of the relative importance of each criterion, and dynamically reaching a map with the integration response. With an authorization from administrator, the user can also insert a new analysis layer using a Json format.

The dynamic cartography can be either the result of the weights variation with the selection of the portions of interest (for example the 30% most adequate areas), or the selection of the areas of interest (for example the result reached for the regions with specific land use). (Figure 1).

The final product from InViTo is the result from the MCDA visualised as 2D maps and their final data present the possibility of been exported and used in other applications. Our contribution is the increase on the results visualisation programmed with GH and visualised in Rhino 3D, and trying different ways of the information representation. The reached results assessment is oriented by the methodology of Semiology of Graphics proposed by Bertin (1967) for the assessment of the power in maps communication.
**Methodology**

The MCDA occurred in the InViTo environment with the possibility of executing the Analysis with the use of a grid that covers the space, or through existing spatial elements such as lots or blocks. Once the integration between the variables happens in InViTo, the resulting numeric data from the MCDA are associated as attributes to the graphic elements and exported in a Geojson file format while a table containing the resulting data is generated and exported in a Csv file format. For its use as an input file inside the Grasshopper (GH) environment, it is necessary to convert the Geojson file to Shapefile format (shp). The conversion happened with the support of the online tool Mapshaper.

To use the shp file as an input in GH, one can import the file using either the @it plugin or the Heron plugin. Both @it and Heron will keep the georeferencing information after importing the shp to GH, but the Heron plugin has the advantage of changing the reference of the Rhino coordinate system to a place closer to a specific area through a tool called “Anchor Point”. This change facilitates the visualisation for the users.

The GH algorithm reads the geographic georeferenced information (grid or spatial elements) and associates the value from MCDA to each one of the graphic elements which can be either a point or a cell in a grid, or polygons that represent elements such as blocks and lots. The values from the Multi-Criteria Analysis are then used as attributes of the “Z” scale to generate different ways of visualisation of the results.

The relation between the values from the MCDA and the geometric parameters from the visualisation format is modelled in a way to allow the control by the user of their behaviour and the relation between them. The user can choose a linear behaviour in relation to the original distribution curve or define a certain exaggeration or smoothness of the extreme values visualizing them in a geometry. The user can also choose a gradient colour to be applied to the geometry of visualization.

Among the ways of visualization, the following possibilities were tested with the aim of analysing their potentials and limitations: extrusion, creation of a surface, and the use of gradient colours. In the simple extrusion visualization, the elements from the layer are elevated up to a “Z” value which refers to the adjusted value from the MCDA. The extrusion can happen either directly from the cartographic element (lots or blocks), or from graphic primitives generated from the grid format. In the grid example of visualization, two circular forms were tested where one of them had its diameters varying depending on the MCDA value, but at the same time its height could increase in the Z direction also according to the MCDA result. In the visualization with the surface, a NURBS mesh was interpolated in points where the “X” e “Y” overlap the centre of each one of the elements from the layer and the “Z” parameter is the adjusted value from the MCDA. A gradient colour can be applied to all the presented ways of visualization.

Once a visualization result is reached, the user can work on the increase or reduction of the contrasts thought the exaggeration or smoothness the behavioural curve. The user can also...
choose other gradient patterns for the colour. The process ends with the user acceptance of the visualization model. The aim is to choose the most eloquent way to better understand the information generated. (Figure 2).

**Fig. 2. The logic in Grasshopper programming.**

**Results**

The results consideration followed the logic proposed by Bertin for the Semiology of Graphics (1967). The author proposed a table of choices for the graphic treatment of the information with the goal of achieving the best possible eloquence through the graphic aspect relatively to the main goals of the communication desired (Figure 3). Bertin (op. cit.) and Bonin (1975) argue that the visual communication is developed from the general to the particular as the assimilation of the total form happens before the observation of the details. Thus, the graphic communication follows a process that is reverse to the spoken and written communication which happen from the particular (letters, syllables, words) to the general (the construction of the sentence and its understanding). According to the authors, at any moment during this process, whether in the verbal and written communication, or in the graphic expression, there is a risk of having some noise in communication.

**Fig. 3. Graphics Semiology – key of interpretation. (Adapted from Bertin, 1967).**
However, the cartographic visualisation is an “Open Art” in Eco’s sense (1962) as even if everybody gets a common initial information, during the process of mental construction we can associate additional information according to our analysis expectations. In this sense, according to Moura (2016) visual communication is initially monosemic in the sense of “where”, “how”, “how much”; but the comprehension of “why” and “what if” must be provided to develop its understanding and decoding. This makes it polysemic.

In order to compare the most adequate results and analysis from the graphics expressions according to specific goals of visualisation, the simulations were elaborated in the following formats: grids (regular or in a circular form), or spatial elements (blocks were used in the shown example). They were done with simple extrusion, increase in the element and extrusion, composition of a surface, and with the use of a gradient colour. (Figure 4).

One can observe that the composition of the use of the graphic element can be characterized as the use of the “form” what the Semiology of Graphics consider to be related to the “associative” information (Figure 4e). As the name infers, the associative makes an association of an information to existing references. That is the case of associating the symbol of an equal sides cross to health related subjects as drugstores. In this sense, the observer mind associates the 3D representation to the heights of the buildings imagining that the growth will happen through the expansion of the building and not according to potential indexes or coefficients that have different ways to occur in the space.

Still in the Figure 4e, “value/intensity” is applied to favour an understanding of ordered scale. When “size” and “colour” are applied to the same base of representation (Figure 4f), the size favours a “quantitative” understanding while the different colours break the notion of order and lead to an understanding of differentiation. It happens because colour is “selective” and indicates a specific meaning for each class.

In the figure 4b, the surface element is treated with “size”, which is adequate for quantitative variables, but if it is also applied a gradient colour of “value/intensity”, it can represent the principle of “ordered.” The treatment “colour” used in the figure 4a with different colours presents a risk of showing slicing classes more than ordered scale. It is important to verify whether or not it is intentional. The figure 4c shows a regular grid (a cylinder) where “size” was applied to represent “quantitative,” and “colour” was used to separate the values in “selective” representation. Using the “value/intensity,” the “ordered” aspect would be clearer. In the figure 4d, a redundancy was used when the scale was applied both in “Z” and in “X/Y” reinforcing the intention of showing quantitative values.
Conclusions

MCDA is intended for political strategic choices in favour of variables that are axes of importance during possible futures simulations, and the InViTo Pampulha is an instrument for this visualization. For example, a user can understand that for a specific area, the increase of a market distribution variable importance can lead to more interesting results than the increase of transportation conditions. Starting from the use of InViTo, our work was focused on increasing the visualization power and trying the most adequate representations according to different goals.

In the InViTo application, the knowledge driven evaluation was applied, which means: through its expert knowledge or through its specific investigation intention proposes, the user assesses the relevancy of the weights on integrated variables. For future works, the studies will be enlarged towards programming with GH to apply the data driven evaluation so the system can simulate different weights for the variables until specific spatial distributions and conditions as objective functions are reached.

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References


Studies of Volumetric Potential in Pampulha, Brazil

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Key-words: Visualization, CityEngine, Urban Analysis, Volumetric Studies.

Introduction

The visualisation is a key support in an urban environment analysis. Whether representing real physical aspects of the city or abstract information, the visualization has a great potential of both improving the general understanding of urban related aspects and supporting the decision making process in urban planning activities. This work intends to contribute with a methodology process for the simulation and visualisation of volumetric potential studies in urban analysis using Lidar (light detection and ranging) data for Pampulha Region in Belo Horizonte, Brazil for the years of 2007 and 2015.

Maps are primarily informative. Therefore, when one goes from 2D to 3D representation is necessary to analyse if there is a gain in information. One great contribution of 3D representation is the possibility of visualizing abstract information such as the urban regulations that shape the city. Amoroso (2010, xi) defends the abstraction of urban data from the textual format to a visualization. Among others forces, she mentions criminal activities, population densities and air-quality as examples of these abstract forces that also shape the city and she argues that the visualization can provide deeper insights as it enables to take those aspects into account.

Between the benefits from the visualization, there are the faster and easier understanding of urban aspects, and the possibility of supporting the decision making process. A relevant problem in the decision process in urban planning is the complexity of the urban regulations. In general, the most frequent format to present the rules for urban occupation in Brazil is through texts and tables which are of difficult decoding. This can become an obstacle for the community participation on the planning process in general, and can also increase the informal city areas where the urban regulations are not applied because people tend to consider it a difficult process (Zyngier, 2012).

The main goal of this work is to present a methodology approach for the simulation and visualisation while developing a study of envelops and volume stocks in Pampulha, Brazil. The selection of the study area was a result from the Geodesign Pampulha Workshop – Third Iteration developed by the Geoprocessing Lab/EA/UFMG, Belo Horizonte, in March 2016. As a result from the Workshop, five priority areas were chosen for residential densification. However, only one of those areas was used for this analysis in order to simplify the processing time.

The process of analysis was based on three main steps: first, it was necessary to update the cadastral polygons from 2007 which were provided by PBH-Prodabel, in order to have the Lidar dataset matching the polygons of buildings’ projections; then, the heights were extracted from the Lidar dataset; and last, the occupation was simulated in CityEngine software using only the existing buildings at first, and then, calculating the possible volume stocks.

As a final product, the work presents both a visual and a textual analysis of the relation...
between the existing volumes and the volume stock available for area analysed. The intention is to reach a gain in visualization in relation to 2D maps that could also show the same information even if only in a binary format (yes or no for volume stock).
Methodology

The first step during the simulation process was to update the cadastral information of lots and buildings projections. The initial cadastral data provided by PBH-Prodabel was for 2007 so that an update work was necessary to have the 2015 Lidar dataset matching the actual polygons. This process was executed by visual control using a high resolution image of the area also from 2015 provided by PBH-Prodabel. The new and altered polygons (lots and buildings' projections) were vectorised and properly identified as non-official data in the ArcMap software.

Secondly, the Lidar dataset was transformed in height information for each one of the existing buildings. Lidar is a remote-sensing technique that collects surface elevation information from points in the surface through the use of laser light (ESRI 2016). The Lidar dataset needed to be converted first from LAS to Multipoint, and then, from Multipoint to Singlepoint in order to extract the "Z" value of the points and interpolate a raster surface from them. As the point cloud dataset from Lidar covers a continuous surface without distinguishing the elements, the additional information such as elevation from cars, vegetation and so one were excluded using the buildings' projections as a delimitation layer. Also, to avoid variations in the heights of the same element, the majority elevation value for each element was extracted generating only one elevation value for each buildings in the study area. Last, to reach the height information for buildings, the terrain elevation from the central point of the building projection was subtracted from the elevation information generated from Lidar dataset.

After reaching a height information for each one of the buildings' projections, the some steps were developed in CityEngine. For the simulation in CityEngine, it was important to have both the buildings and the lots cadastral polygons in shapefile (shp) formats associated with parameters that define the volumetric potential, or maximum occupation for each lot. Although there are great variations in the land use regulations among the cities in Brazil, in general, the maximum occupation is defined by a coefficient of utilization called CA (Coeficiente de Aproveitamento) that is applied to the total area of the lot, and the resulting area is assigned to the possible area of occupation (TO – Taxa de Ocupação), which is the lot's area reduced by the applicable setbacks, and find out the maximum height. Thus, the first CityEngine's procedure was to simulate the existing conditions applying a simple extrusion of the heights on the buildings' projections shape. Then, volumetric stocks for the existing buildings were simulated for each building according to its applicable CA. Last, volumetric stocks for vacant lots were simulated creating a TO area, according to the setbacks, and extruding a volume up to the maximum allowed by the CA. This was the only case where the simulation actually represents a maximum envelope.
CityEngine also offers the possibility of reporting information from the model. The access to this reported information enables the analysis of the alterations occurred. For instance, it is possible to analyse the relations between the occupation in the two periods, and the volumetric relations between existing buildings and stocks.

**Results**

The simulation of the existing conditions through the extrusion of the buildings’ projections (figure 2) enables a temporal analysis of the occupation between 2007 and 2015. Most of the transformed areas in the region analysed are in a preferred densification zoning (ZAP). Around 70% of the total altered buildings are in the ZAP zoning area, while second most transformed areas are in ZAR2, a restricted densification zoning. The increase rate in the number of units for the ZAP area was 4.5%, while for ZAR2 it was 3%. This shows the transformation potential of densification zonings for the analysed areas. From the volumetric aspect, the new buildings correspond to about 9% of the total existing volume in the area as shown in Table 1.
For the volumetric stocks of vacant lots, the simulation showed that there is still some availability for occupation. (Figure 3). The volume stocks of vacant lot represent about 2% of the total volume allowed by the zoning regulations for the total area.

Finally, comparing the existing buildings with the volume stocks for the study area, the simulation shows that most of the buildings still have great amount of stocks. It is important to highlight that although the existing conditions represent real physical information, the volume stocks simulations are abstract information. Therefore, the stocks does not necessarily represent...
envelopes, but instead they can represent a potential for construction. Figure 4 shows both abstract and physical information.

**Conclusions**

From the results presented, it is possible to observe a gain in the reached visualisation. The interpretation of the relation between the existing volumes and the volumetric stock available goes beyond the binary information (yes or no for volume stock), and offer a visual representation that enables the perception of the proportions and relations between the volumetric elements. Also, through the report possibility offered by CityEngine was possible to quantitatively analyse the transformations occurred in the area not only in a visual but also in a textual way.

Further studies which are already in process intend to explore the reached outputs such as the areas with great amount of volume stock, with a prognostic approach. The goal is to simulate and analyse scenarios for future occupations according to the present-day applicable urban regulations.

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When the parametric modeling reveals a collapse in the future urban landscape: The case of Divinópolis – Minas Gerais/Brazil

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Key-words: parametric modeling, urban landscape, technology of geoinformation, decision making, urban values.

Introduction

This article discusses issues related to the urban environment and landscape planning in the county of Divinópolis, Minas Gerais, Brazil, focusing on the central area of the city. The main proposed approach to the theme is the study of the mechanisms of the master Plans as generators and catalysts of landscape transformations, in order to carry out simulations that allow an insight into the future trends and analyze the feasible developed landscapes in a critical manner according to the current legislation (Villaça, 1999).

The City Hall of Divinópolis, in partnership with FUNEDI - Foundation of Education in Divinópolis (2013), made the diagnosis for the elaboration of the local Master Plan, which demonstrates the relevance of geoprocessing tools to urban planning processes, and also foments civic discussions regarding the common decisions.

The justification of this article relates to a law in Brazil (City Statute, 2001), where the Federal Government pressured the states and municipalities to take a leading role towards control and management of urban and regional planning processes. Based on this, the City Council of Divinópolis approved the new Participative Master Plan and established new tools for urban planning in 2014.

The main purpose of this article is to analyze the effects of zoning and urban parameters in the composition of the urban landscape in the central area of Divinópolis through three-dimensional scenarios designed with geoinformation technology. The main issue is that the parameters andзонings are approved without a visualization support before the final decision, as absolute and morphometric values, without simulating the future of the landscape, which would be an important step in the process of decision making.
Methodology

A methodological guide is proposed that includes the following steps: 1) survey and spatial data; 2) analysis of past and current legislation; 3) modeling and analysis.

According to Moura (2007), the spatial analysis methodology, based on crossing plans information, begins with the assembly of the database and specialization in georeferenced maps. The composition of systematized themes in the form of information systems is the base of modeling and it intends to simplify representation of reality to reach specific purposes of the analysis. Thus, the indication of main variables is an important step in the research, and will require specific technical procedures regarding processing and visualization.

Survey and spatial data

Divinópolis is a county of Minas Gerais, Midwestern region polo of the State, located in the metallurgical area, micro-region of Itapecerica Valley, crossed by Itapecerica and Pará rivers, and 121 km away from the capital. According to the census in 2010, conducted by the Brazilian Institute of Geography and Statistics (IBGE), the county has an area of 708.909 km², and 226.345 inhabitants, with a density of 319.29 inhabitants/km². (Wikipedia website, accessed in 07/04/2015).

Various processes were needed to collect and process data of the study area, such as collecting, georeferencing and vectorization of historical maps, and the survey of historical iconography to identify outstanding values. The data were selected at the central archive collection of the county, and in consultation with the county’s domain sites (Ferreira, 2015). The final vector map representing the history of the territory occupation, despite the low cartographic precision, creates a database for understanding the evolution of the settlement, and this product is the basis for the visualization of the occupation dynamics.

The field study occurs in two different approaches for data collection, through virtual visit with Google Earth software and field visit, in respect to the volumetric of the buildings, the type of use, the locals of establishments and great equipments, as well as the characterization of the general conditions of the city and especially the central area. There are six types of buildings: private residence, commercial, mixed-use, education unit, health unit and public use.

The data were georeferenced on the municipal cadastral map of the city, using polygons of buildings and blocks as univocal references. The result of the registration is the creation of a base with typologies of activities, which enabled the development of spatial distribution of density maps by category of land use, and a map of the general density of commerce activities, services and collective use services to the identification of the county’s centralities, based on kernel density (Saboya, 2008; Rocha et al, 2011; Guadalupe and Moura, 2014). The Purpose of the map is to demonstrate the extreme dependence that the city still has towards its central urban area, but at the same time to identify centralities that starts to configure themselves as local references.
at the periphery areas, and that could be empowered by the Master Plan concerning the
decentralization and diversity of activities. (Figure 2).

In order to analyze the risk of losing urban values, since the central urban area is the main
centrality but also the main place for historical and heritage values, a representation of the local
landscape based on a map from 1922 was elaborated. To this 2d first map it was added the
information about 3D values using the height of the buildings obtained in the study of historical
iconography as a reference. The architectural elements that tell the history of the place are those
who keep the essential values to the citizens. It justifies the study of the landscape
transformations throughout time, and its impact towards the most symbolic elements on the
landscape (Figure 3).

Analysis of past and current legislation
The Master Plans of 2000 and 2014 were studied, the last one being approved by citizens’
participation. They were prepared spreadsheets with urban parameters of master plans and
performing mathematical formulas to understand the requirements for the use of law and land
use in order to understand how the parameters affect the approved projects and result in the
built landscape in the city. In addition to this study, several people were interviewed for us to see
if they were able to understand the meaning of the parameters and their values, which were
approved in public sessions of the Master Plan process. The results favored the comprehension of
the project’s approval dynamics and the difficulties that citizens (even technicians) have to
visualize the urban parameters.

Modeling and analysis
Once the database was structured, the mathematical and geometrical rules that define volumetric
composition of the city under actual legislation, a digital modeling and three-dimensional
representation (ArcGis and ArcScene) were performed. The Digital Terrain Model (DTM) was
elaborated and, above it, the buildings volumetric representation. The goal was to recognize the
influence of urban parameters in the production of urban landscape, creating critical bases to
review those parameters or to propose new ones (Figure 4).
Results and discussion

There were two tridimensional representations produced: the already existing volumetric landscape and the possible volumetric landscape according to the maximum parameters authorizations contained in the actual legislation (Master Plan).

The comparison between the two scenarios shows how current laws are permissive, allowing in its normative: 1) the verticalization (increase of high-rise buildings), 2) the largest volumetric occupation, and 3) the significant increase in population density on an infrastructure already saturated. It is a space that already suffers from urban problems such as population growth and chaotic traffic, and should be subjected to a better management, mainly because the city presents significant elements for the image of the region, including the intangible ones such as the feelings of belonging of the territory.

![Fig. 4. Urban landscape in 2015](image1) - ![Fig. 5. Urban landscape of Divinópolis if all the parametric are on its maximum](image2) – ![Fig. 6: Comparison between the Fig. 4 and Fig. 5.](image3)

The digital modelling of urban landscape image, considering the authorized parameters proposed by current laws (Figure 5) is a base to begin a critic analysis about how catastrophic the application of current legislation could become, regarding the construction and modification of urban landscape. The comparison between the two scenarios, already constructed and authorized to be constructed, shows that the actual rules favors expansion throughout the area, as that the maximum authorized parameters stands out in relation to actual built ones, what means a tendency of volumetric expansion. The comparison also allows identifying the points where the growth has been so significant that buildings rise above an acceptable maximum. (Figure 6). The result of this analysis based on digital tridimensional simulation is that urban center, which already presents problems related to limitations in infrastructure and loss of cultural and historical values, runs the risk of having these problems magnified.

The current legislation is permissive, allowing in its rules the verticalization and the expansion processes tensions the existing infrastructure. The area, which already suffers from urban problems linked to population growth and overload in traffic, can also lose the essence of the city’s image. The average height of the buildings, which is currently 4.7 meters, could become 25.42 meters (8 to 9 floors). This verticalization tendency is accompanied by total waterproofing the surfaces of lots, since the law allows a 100% occupation of the garage and first floor’s level. The situation is even worst in buildings intended for use exclusively commercial, because in these cases it is allowed to build in 100% of the lot, without setbacks.

Conclusions

Jane Jacobs proposes the comprehension of the city from the following angles: 1) reflect on the processes; 2) use of induction, reasoning from the particular to the generic, rather than the reverse; 3) look for evidence in which little things lead to bigger things. According to her
e-agorâ|e-ayopû for the transition toward resilient communities

Based on bibliographical review, data collection and the models analysis, it is evident that urban rules which are regulating the constructions in Divinópolis are outdated, permissive and harmful to the city. The analysis of the historical evolution reveals that, except in some mandates of urban management, the municipal government never bothered about urban landscape changing, which could happen with at least a more appropriate application of urban parameters. This phenomenon, unfortunately, doesn’t happen only in Divinópolis, but almost in all medium and large cities in Brazil. Almost nothing is proposed to preserve the identities of cities that are not on the list of recognized heritage or/and considered national or international cultural heritage. The Master Plans goes towards the interests of the real estate market.

The purpose of elaborating a parametric model is to help citizens visualize the constructed and the authorized urban landscape, as well as giving support to decision making, since the urban planner acts as a mediator to decode citizens’ values to be respected by government technicians. Therefore, it is fundamental to produce methodologies to encourage the interest concerning to the city's landscape planning, in order, for example, to decrease informal occupation, that in Brazil represents the majority of urban construction.

The parametric model and its analysis reveal that urban laws in Divinópolis don’t take in consideration historical and cultural values and also don’t consider the limits of infrastructure capacity and don’t care about environmental values. Parameters related to visual axis, index of insolation, floor area ratio to allow soil impermeabilities, and urban volumetric limits to allow overuse of the central area according are not proposed in the Master Plan. According to the studies of urban growth and the identification of actual centralities, we can observe that Divinópolis is the transition from mononuclear city to polynuclear city, and the Master Plan could support this tendency to avoid the concentration in the main center.

The next step in the investigations will be to propose and simulate the results of new urban parameters. The citizens’ participation to discuss and chose alternative futures to the landscape can be based on the framework for Geodesign (Steinitz, 2012), which aims to design "for” and “with” the landscape, on an integrated and balanced way, as well as promoting visualization to social actors and performing revisions and adjustments whenever necessary. As a contribution to the state of art, this study presents a first step to give support to the review and the adjustment of the Master Plan, step that is already planned to be held in the Participative Master Plan of Divinópolis.

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A Spatial Decision Support System for Industrial Re-Use

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Introduction

The global economic crisis has drew even more attention to the phenomenon of abandonment and transformation of industrial sites - spaces which are now in a precarious balance between decadence and reuse, representing two sides of the same coin: a problem or a resource, according to the way they will be dealt with. Industrial territories are characterised by manufacturing sites, which have developed over time and now have lost contact with the surrounding environment, being deprived of their original function without acquiring a new one. So, nowadays, former industrial buildings need to find new uses, in accordance with policies acting on the whole territory. The presence of these disused industrial building, often a small-medium sized and scattered heritage, might be a considerable challenge for planners and policy makers but also an appropriate resource for the local development: the prospective of reuse of sites allows to minimize the consumption of new territory, while the "recycle" of buildings is one of the best "smart grow" option.

To favour this process, first and foremost an assessment of the extent of industrial abandonment, yet unknown in many Italian cities, is needed. In addition, even though research has often addressed the issues of industrial abandonment (Berens, 2010; Ronchetta 2008), only few recent studies have proposed "characterization-methods" for reusing industrial building (Sassi, 2007). In addition, through the interpretation of industrial features, it is possible to identify the most appropriate strategies for areas in crisis, in which intervention is a priority, in order to promote sustainable urban development, sustainable placemaking and revitalization. Indeed the selection of a proper site for every industrial reuse is a critical decision that could affect the profit and influences the life style of the surrounding communities (Eldrandaly et al., 2003).

In this context, the increasing availability of spatial information and the need of choosing the best choice for solving environmental problems have resulted in increased interest in applications named Spatial Decision Support Systems(SDSS). The SDSS are systems where the spatial properties of the data play a relevant role in decision making procedure (Bonfim et al., 2005).

There were a variety of specific applications in the urban field: they range from crime analysis (Kun, 2006) to urban growth modelling (Compas and Seguraman, 2004); from urban green space planning (Pelizaro, 2005) and site selection for local parks (Zucca et al., 2008) to industrial site selection (Eldrandaly et al., 2003) but no one takes into account the choice of the best abandoned industrial site for the reuse of it. Focusing on the problem of reusing industrial buildings, the paper proposes a new solution and analyses how that can favour the decision making process involving abandoned spaces. The purpose of using SDSS to help decision makers to promote reuse policies led us to develop a procedure to assess the potential of the different sites: criteria selected must satisfy economic, social, and environmental requirements, which are enforced by
legislations and government regulations (Eldrandaly et al., 2003).
Methodology

The study was developed in two distinct phases in order to assess the "level" of industrial abandonment in the case-study territory and then to analyse the phenomenon according to the "potential reuse" of the different spaces.

The first phase of the SDSS is the investigative one, has started with previous research, and has consisted in the acquisition and interpretation of information about industrial building and activities in the area.

In detail, the collection of data has entailed the acquisition of the cartography of the municipality considered (CTR) and the use of open-source tools like Open Street Map, to import the data into the GIS software (Quantum GIS 2.10). The overlapping of maps has implied a first confirmation of the position and dimension of industrial building in the area, while the direct investigation has allowed to categorise the status of activities or disposal of each production facility. In order to depict properly the evolution in the industrial use of the area, the process have taken into account both the 'disused' building, meant as completely abandoned (100%), that the 'underused' ones, interpreted as a percentage of abandonment (50%) (Sassi, 2007)

During this phase, the suitability criteria (environmental, geographical, economics, and social criteria) for site screening were selected and also the constraints were chosen: results of this step is a set of recommended values for these attributes.

Using that values recommended by the experts, the GIS screens all candidate sites located in the defined region of interest. The output of this phase is a list of candidate sites for further assessment.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental</td>
<td>Proximity of public transportation</td>
</tr>
<tr>
<td></td>
<td>Proximity to rivers</td>
</tr>
<tr>
<td>Economic</td>
<td>Status of the building</td>
</tr>
<tr>
<td></td>
<td>Energetic performance of buildings</td>
</tr>
<tr>
<td>Social</td>
<td>Wi-fi presence</td>
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<tr>
<td></td>
<td>Proximity to residential area</td>
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<tr>
<td>Geographical</td>
<td>Proximity to highway</td>
</tr>
<tr>
<td></td>
<td>Proximity to railway station</td>
</tr>
<tr>
<td></td>
<td>Proximity to main streets</td>
</tr>
</tbody>
</table>

The second main phase of the SDSS is called Evaluation one where the multicriteria evaluation method is used to identify the most appropriate sites for industrial re-use by comparing the alternative.

To implement the proposed decision-making system, the Integrated Land and Water Information System - ILWIS™ - was used; it is a geographic information system (GIS) and remote sensing free software for both vector and raster processing that include Spatial Multiple Criteria Evaluation (SMCE).

Results and discussion

The municipality of Tavagnacco in the Friuli Venezia Giulia region (Italy), has been selected to evaluate the SDSS developed because in this area a largely industrial area have been recognised. GIS results of a previous stage of this study (Movia and Santi, 2015) provide a quantification and a localization of the industrial abandonment in this municipality, and an homogeneous presence
of abandoned or underutilised buildings in the territory was documented. Data on infrastructure and maps show that abandoned industrial sites are located near the main roads. The analysis highlights how the built environment to recycle, in a future perspective, is remarkable both in terms of size and quantity.

![Map of Industrial buildings in the municipality of Tavagnacco, Italy.](image)

Fig. 1. Map of Industrial buildings in the municipality of Tavagnacco, Italy.

In detail, the first results of the survey are organised in a map (fig. 1) showing industrial building in the municipal area, classified as disused building (39%), 'underused' (30%) and used (31%), as well as the main infrastructures and the urbanised zones of the area. Despite the different urban settings and the differences between the identified planning issues, the results of the SDSS illustrate that proximity to the main streets was considered to be one of the key objectives (in particular, proximity to highway), followed by the need for good energy efficiency of buildings (mostly related to exposure and poor energy performance of aging buildings).

Conclusions

Selecting the location for an industrial site is a complex process that involves economical, social, environmental and political requirements that may have conflicting objectives. The spatial decision support system developed within this project represents a starting point that would be implemented. Future research developments will investigate the application of the SDSS model considering a greater area and possibly a larger set of criteria.
References


How knowledge subjectivity affects decision-making: a Geodesign case study for the Cagliari Metro Area

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Key-words: Geodesign, Strategic Environmental Assessment, participation, Planning Support System.

Introduction

Strategic Environmental Assessment (SEA), introduced by the European Directive 42/2001/EC, promotes a significant methodological innovation in the planning elaboration process with the aim to integrate environmental considerations and public participation. Two important condition for SEA to be effective is represented by its inclusive and incremental attitude (Fisher, 2003), in defining the objectives of the policies which need to be assessed, and the effective participation of all the key-actors in the process (Zoppi, 2012), as regards both the preliminary and ongoing evaluations (Brown and Thérivel, 2000). However, many difficulties can be found by experts on the proper implementation of these principles (De Montis et al., 2014), especially in setting a democratic process, in finding as many compromises during the participation phase and in consensus building (Zoppi, ibidem).

Geodesign (GD), intended as a methodological approach to decision making informed by digital spatial information, allows promoting multidisciplinary collaboration and participation (Steinitz, 2012). The GD logic can be applied in regional landscape studies in order to understand how the context should be transformed in the future, through the Geodesign Framework (GDF), consisting of six models. The first three models describe the study area before the implementation of the plan: based on a detailed description of the study area (Representation Model - RM), the process models representing how it is evolving in the present situation are identified (Process Model - PM) and then assessed in order to evaluate possible strengths or vocation for a particular purposes (Evaluation Model - EM). The last three models consist of a practical design stage in which, starting from the identification of alternative scenarios for development (Change Model - CM), and their impact assessment (Impact Model - IM), it is possible to choose a shared development alternative (Decision Model - DM). Therefore, while the last three models are related to the intervention stage and the initial three concern the assessment stage.

With these respect, the GDF shows a consistent logic with SEA, which should run since the early stages of the planning process in order to inform decisions at any stage, and it may contribute to address many current SEA pitfalls encountered in the regional planning practices (Campagna and Di Cesare, 2016). In line with the description above, the practical design phase, as generally intended, starts in the GDF with the CM. Nevertheless the alternative scenarios' definition, and as a consequence the decision-making process, is strongly influenced from the results of previous three models, in fact the output of the EM constitutes the input of the CM.

In the next sections, two examples of EM thematic maps are presented. These maps are realized during the preparation of the “Geodesign Workshop on Future Scenarios for the Cagliari Metropolitan Area”, to be
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held from 9 to 11 May 2016 at the University of Cagliari. The workshop consists of a 3 intensive planning studio days within a multidisciplinary team of students, scholars and local public and private stakeholders, in order to build up collaborative future scenarios based on sustainable development for the new Cagliari Metro Area. During the workshop’s organization 10 systems are analysed, starting from the description of the existing situation (i.e. RM) to the evaluation of territorial inherent vocations (i.e. EM), in order to give participants 10 evaluation maps of selected phenomena from which to start designing (i.e. CM). Three of these systems represent vulnerability elements (i.e. Cultural Heritage, Ecology, Hydrogeological hazard), the last seven systems represent attractiveness elements (i.e. Tourism, Agrifood, Transports, Low density housing, High density housing, Commerce and Industry, Smart services). This maps’ elaboration provides a useful basis for reflection on the difference between the objective phenomena’ representation and the subjective one, and how a different type of representation may profoundly influence the latter stage of the plan alternatives’ design.
Methodology

In this session we explore how the maps representing the EM of two of the ten systems, are created in a GIS environment. The first system is the “Cultural Heritage” (CULTH), which locates the mainly vulnerable areas in relation to the concentration of the most significant historical assets. The second system is the “Tourism” (TOUR), which identifies of the most attractive areas to develop appropriate tourism strategies. The EM maps are elaborated through a land suitability analysis, aiming at identifying, for each system of the study area, its inherent vocation. The information utilized in the maps creation includes data collection from social networks, namely social media geographic information or SMGI (Campagna, 2014) and their integration with Authoritative geographic information (A-GI), retrieved from the regional Spatial data infrastructure (SDI). As a matter of fact SDIs faced prosperous development worldwide in the last decade and allow the spatial data accessibility to the wider public in order to support informed decision-making (Campagna and Craglia, 2012).

CULTH, as a vulnerability system, identifies the areas affected by the major spatial distribution, density and proximity to the cultural heritage to be protected for its historical value, according to the Sardinian Regional Landscape Plan (RLP). The information used to define the RM of the CULTH system (Fig. 1a) is retrieved from the regional SDI as digital geographic datasets representing the cultural and historical characterisation of the area. Specifically, these areas include: historic city centres, cultural goods (i.e. the combination of historic architectures and the archaeological sites) and archaeological industrial areas related to the production processes of historical relevance (e.g. the Geological Mining Park and the historic saltworks).

TOUR represents an attractiveness system, which depicts the spatial distribution of tourists’ preferences regarding existing tourism lodging services (TLSs) and natural and non-natural resources. The innovative aspect of this map is the fact that it includes and represents consequently, tourists’ and local communities’ perceptions and opinions, spontaneously generated by users (Goodchild, 2007) and available on social media platforms. This information, or SMGI, provides relevant knowledge for better investigating tourism phenomenon (Briassoulis, 2002); in fact, understanding the tourists’ perceptions and opinions, and integrating this information with traditional authoritative data sources, or A-GI, may represent an opportunity of great potential to enrich, eventually, sustainable tourism goals with a broader, deeper and more multifaceted understanding of tourist destinations. With an improved awareness of the users’ characteristics, decision making can be simplified (Leslie et al., 2007) by emphasizing the strengths of tourist destinations for past and potential visitors. In the light of these considerations, the RM of the TOUR system (Fig. 1b) includes the concentration of the following three key elements:

- the existing TLSs and their relative perceived quality, retrieved from TripAdvisor.com and Booking.com. This dataset includes quantitative information concerning the TLSs scores based on rankings, divided into several categories, such as value/price, rooms, location, cleanliness and sleep quality.
- The already planned tourist areas, or F areas, defined by the 2266-U/83 Decree, namely Floris’ Decree, and spatially localised according to each Municipal Master Plan (MMP) of the 17 municipalities comprising the Metro area and to the Sardinian RLP.
- The users’ contributions on Panoramio, considered as points of interest, from which it is possible to elicit their landscape, natural and non-natural resources perception.
In order to obtain an EM map of the CULTH and the TOUR systems, each dataset is considered as a criterion in the following analysis.

As a vulnerability system, the CULTH map is implemented in order to describe spatial distribution of historical areas to be protected for future preservation strategies within the Metro area. Firstly, the historic city centres are given the highest vulnerability score, while a decreasing score are assigned to two buffer zones of influence around them: the first buffer zone extending up to 300 m away and the second one up to 1500 m. Secondly, a kernel density is implemented for points representing the cultural goods’ distribution, in order to identify the areas affected by their highest concentration. Lastly, the historical industrial sites are identified and given a vulnerability value. Two final maps are generated by assigning different weights to each of the three criteria, considering their importance and combining them together. In the first solution historic city centres and cultural goods have the same high weight while industrial areas have the smallest value for their presumed less vulnerability (Fig. 2a). In the second solution historic city centres have the biggest weight, cultural goods a medium value and the historical industrial sites the smallest weight (Fig. 2b).

As an attractiveness system, the TOUR map is implemented in order to describe spatial patterns of tourists’ preferences and to identify locations of interest for future tourism development strategies within the Metro area. In order to obtain an EM map of the areas suitable for tourism development, three different criteria are defined, relying on the three elements described above. Firstly, a kernel density is implemented for points representing the spatial distribution of
tourists’ preferences, in order to identify the areas affected by their highest concentration. Secondly, the existing F areas are identified for the 17 municipalities comprising the Metro area and treated as a boolean variable. Finally, a kernel density is implemented for points concerning the users’ contributions on landscape, natural and non-natural resources perception. Then, two maps are generated by assigning different weights to each of the three criteria, considering their importance and combining them together. In the first map, we consider the presence of TLSs and spatial distribution of tourists’ preferences on them, and users’ interest on landscape and natural and no natural resources the key factors for emphasizing the development of new tourism facilities for potential visitors. Thus, the spatial distribution of tourists’ preferences and the users’ contributions based on their landscape’ perceptions have the same high weight, while existing F areas have the smallest value (Fig. 3a). In the second solution, we hypothesize the presence of tourism facilities, accommodation and high tourists satisfaction’ level as the most important factors for determining the attractive areas to implement appropriate tourism strategies. In this case, the biggest weight is assigned to the spatial distribution of tourists’ preferences, while the users’ perceptions on landscape and resources and existing F areas take a medium and the smallest weight, respectively (Fig. 3b).

Results and discussion

The result of the analyses of the CULTH system EM are two thematic maps classifying the territory in 5 vulnerability levels, where red areas indicate those characterised by a very high vulnerability, in which only actions aimed at preserving and promoting these sites can be permitted. To the contrary, the dark green areas are the less vulnerable ones, in which do not persists any restriction in use. Also in the TOUR system, the final two maps are classified into 5 levels of colour ramp, where green colour identify very high attractiveness areas for developing appropriate tourism strategies, thanks to the presence of tourism facilities, accommodations, scenic values and high users interest level. Conversely, areas affected by very low attractiveness, due to the lack of tourism facilities, users’ interest and very low accessibility, are depicted with the red colour.

According to McHarg (1969) each place is a sum of natural processes to which correspond social values. In order to respect these values it is important to identify the intrinsic vocation of a territory. EM pursues this objective, but it is strongly influenced by the cultural and scientific knowledge of the individual participants elaborating it and by their role in decision making. As a matter of fact the case studies in the previous session show how maps can vary considerably in
function of: the data collected to describe a specific phenomenon, the criteria analysed and their respective weights, the spatial analysis performed and the modelling tools implemented. Analysing the two different systems is obvious that the information utilized during the maps creation’ phase results into different RM. In fact, RM is sometimes more objective, as the case of CULTH system, where the information includes data retrieved from the regional SDI and represents A-GI, and sometimes more subjective, as the case of TOUR system, defined using data retrieved by social networks, or SMGI, representing users’ preferences and opinions. By contrast EM is always characterised by subjectivity. As a matter of fact, the EM definition relies on the planners’ expertize, encoded in the processing model. For the output of the EM provides the knowledge support for plan alternative scenarios’ design (CM), decision-making process is strongly influenced by its results. Considering planning practices, a subjective perception of phenomena may represent the key factor in decision making stage, being really powerful in determinate future development scenarios.

Conclusions

In a Geodesign planning studio, EM maps may strongly influence the design and decision-making stages, thus an inclusive, participatory and multidisciplinary approach is fundamental in order to ensure a more democratic and transparent process during their definition. In this regard, the ultimate goal of the SEA is to find the best way to represent all the interests and needs that meet up in a specific territorial context, and especially to find as many compromises as possible so that all the key-actors’ wants are represented in the decision-making processes. This approach strengthens the evaluation process, which is basically orientated at creating inclusive consensus building among local population in respect to democratic choices, sustained over time. Future research streams will concern the investigation of how the participation of different stakeholders may influence the Geodesign assessment phase (i.e. the three initial GDF models). A test-bed for these assumptions will be the Geodesign Workshop, wherein different private and public stakeholders will participate.

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References


Knowledge Organization for Community Revitalization: An Ontological Approach in Taranto Industrial City

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Key-words: organization, design, places, ontological analysis

Introduction

Physical places are complex entities. To define a physical place one has to combine different things like physical location, mental images, spaces of representation, and even the architecture of cognitive processes in vision theory. Indeed, when we talk about place we’re enriching the physical space with new dimensions: an interpreted space, a reasoned space, a space with feelings, a result of an aesthetic fruition and much more.

Organizing and designing territories and cities (lived places) are complex paths from problem setting to problem solving. There are several crossings along this path: (i) knowledge construction; (ii) solution search and evaluation; (iii) decision making; (iv) practical application; (v) communication; (vi) argumentation; (vii) empowerment. In territorial organizational science and organizational studies, reflection insists on cognitive processes and dynamics that have to deal also with (a) spaces of uncertainty and ignorance; (b) spaces of willingness and action.

By spatial domain we mean a (portion of) space plus a set of entities, perhaps of different ontological nature, which show some form of spatial dependency and/or interaction and can be recognised in that space for their generative and ‘transformational’ dynamics. Many authors (e.g., De Roo 2012, Secchi 2005) have highlighted the complexity of society and territory, the difficulty in connecting the different elements to each other, as well as the ethical instinct to “select” relations. These criticisms and their interpretations have pushed urban designers to rethink urban planning as an act of collective intentionality, rather than as bureaucratic practices and conventions.

Communities live places at different levels (micro, meso, macro). They exercise and develop the same time different activities and different conceptualizations about them. Communities build environment of knowledge-in-action (Friedmann, 1987), these environments are characterised by a high complexity and dynamics. Modelling these environments is a challenging issue for theoretical settings and operational choices.

The paper intends to contribute to the agent-based knowledge of places, in particular when the action is about spatial transformations, and on how the space of knowledge is grounded in places of life.

It also addresses the individuation of an internal coherence (operative efficiency) and of an external coherence (environmental efficiency) for any place transformation. When is a spatial, or better, a place transformation performed or acted upon by a collective agent? This question addresses the multi-agent architecture of society and the hierarchization and finalization of its knowledge-in-action.
Methodology

We believe it is fundamental to cope and organize all this huge and unstructured knowledge. This knowledge needs to be linked to all the other information coming from analysis and studies about different levels that contribute in the making of a territory (dynamics, social and cultural relationships).

We need a conscious form of interpretation: -of places; -of stratified meanings that insist on every geographical object (natural and/or artificial) that is a place; -of relationships that exist between all the different objects. This leads to the individuation of the different levels ‘nested’ in the places’ representation since humans live, move and observe complex spatial environments using different paradigms often without being aware of this. The application of an ontological approach helps to clarify the essential elements (objects, properties, processes) and to organise them.

The search for a general framework where to discover and organise this kind of information, starts with a list of levels that seem quite relevant: spatial, artifactual, cognitive, social, cultural and processual. These levels, in turn, can be subdivided in finer levels as we show for some cases.

The spatial level
Mereological level (where one understands space in terms of spatial parts)  
e.g. recognising the subdivisions of an area like a neighbourhood
Topological level (where one understands space in terms of contact and unity)  
e.g. recognising the contiguity between neighbourhoods and the unity of a neighbourhood
Geometrical level (where one understands space in terms of shapes)  
e.g. seeing the geometrical shape of a neighbourhood
Geographical/morphological level (where one understands space in terms of locations and their descriptions)  
e.g. distinguishing being in a valley or having a radial/grid/linear pattern

The substance level
Material level (where one understands space in terms of materiality)  
e.g. seeing the presence of wood, concrete, water
Structural level (where one understands space in terms of qualified components)  
e.g. distinguishing natural vs manmade, residential vs production vs recreational area
Artifactual level (where one understands space in terms of intentionality)  
e.g. looking at entities as planned/intentionally modified things like buildings
Functional level (where one understands space in terms of functionality)  
e.g. understanding a building as a place for gathering or as a shelter
Production level (where one understands space in terms of manipulation)  
e.g. seeing an object/material as needed to produce something else

The cognitive level
Cognitive level (where one understands space in terms of experience)  
e.g. perceiving how to move across the objects
Representation level (where one understands space in abstract terms)  
e.g. perceiving the relationships among entities
Observation level (where one understands space in terms of how it does or may change)  
e.g. perceiving the change of the relationships among entities
Phenomenological level (where one understands space as a moving entity)  
e.g. perceiving space as an evolving situation
Perspectival level (where one understands space as something where one is located in)
  e.g. perceiving space from a specific point in it
Conceptual level (where one understands space as a collection of realised concepts)
  e.g. perceiving space as the manifestation of natural and artificial objects
Action level (where one understands space as an entity in which to act)
  e.g. perceiving the changes that one can bring to it

*The social level*
Social level is the level of norms and social roles and includes the organisational level, the service level, the economic level and the political level.

*The cultural level*
The cultural level is the level of knowledge and meaning and includes the behavioural level, the living level, the knowledge level, the historical level and the community level

*The process level*
The process level is the level of temporal change and transformation, it includes the dynamic level, the development level, the temporal level and the interaction level.

We can measure them by elicitation of different systems that compose the complex ambient of a city (for example: hydraulic infrastructures, nets, communication infrastructure). Ontological agent-based models can help us in the analysis of these systems and of their relationships. At the same time these models can model the linguistics acts that produce a place complex concept. The challenge is to model the natural and living aspect of a city (as the cognitive one and social one), not only the artificial aspects.

**Results and discussion**

An interesting example of ontological organization of knowledge is being developed in the making of the strategic plan of Taranto, an Italian industrial city, extended to 2065. It was started as a community-based, interactive process of knowledge exchanging and raising, aimed at building future scenarios for the new plan.

The process was carried out as a structured form of participation using a hybrid approach in which cognitive mapping was coupled with a more traditional face-to-face approach among participants. The general results of such exercises are first characterized by the presence of the environment as the most recurring issue, not just as an endangered issue (pollution, contamination etc.), but interestingly as a character of the city. It is present in community problems and/or expectations, but also in the perceptions of the physical reality of the city.

A second character present in the analyzed context concerns a more structural relationship with the sea, intended as a unifying and linking element rather an aspect of juxtaposition and/or separation. A further character is connected with this interpretation of the sea, concerning the potentials of tourist attraction of the city and its territory.

A fair number of issues are related to the inadequacy of urban and metropolitan connections to the city center, as well as related to the recovery of many illegal, often coastal settlements. That is an old problem in the whole area, which has always proved difficult to be dealt with effectively. A further recurrent suggestion refers to the archaeological and historical valorization of Taranto as a center of general cultural revival, as a symbol of the Magna Graecia period.
Rather interestingly, the industrial problem often seems absent from protocols, just like a common denominator on which it is not worth to spend words anymore, or a Big Brother under which everything still has to be examined at the end of each path that aims to be realistic. However, it will be rather difficult that final planning strategies can ignore industrial relations, so envisaging further knowledge-raising sessions in perspective.

At the end of the scenario-building process, it seems fundamental to cope with, and organize all the huge and not structured knowledge raised. Knowledge needs to be linked to all other information coming from analyses and research about all other different levels that are making a territory (as dynamics, relationships,...). In this concern, there is the need of a conscious form of interpretation of (i) places, (ii) stratified meanings that insist on every geographical (natural and/or artificial) object that is a place, and (iii) the relationships that exist between all the different objects involved.

This organizational need is inherently connected with knowledge representation needs, which are on turn necessary to scan scenarios according to a general metropolitan strategy for future the development of the area. This leads to the importance of an ontological approach and to the singling out of the different ontological levels ‘nested’ in the representation of places.

**Conclusions**

Through an ontological analysis we intend to ‘build’ a neutral representation of places and of (extreme) events. This allows us to read the different levels that contribute to form places and relationships in them, and to provide a deeper knowledge of the scenario.

We can then reach a disambiguated knowledge, a clearer frame to refer to for design risk averse scenario avoiding a complexity’s reduction approach, a formalization of the knowledge/model, the opportunity of sharing knowledge between different actors and stakeholders.

A place comes always in a context and we need to be aware of the contribution of each ontological level when evaluating the place and its context, including the understanding of how it may evolve and how changes may impact it.

Two crucial steps can be identified in this research:

1) to isolate and objectivise the most relevant levels (in ontology and in contexts);
2) to develop a formal framework for modelling levels and their interactions.

We need a conscious form of interpretation:

- of places;
- of stratified meanings that insist on every geographical object (natural and/or artificial) that is a place;
- of relationships that exist between all the different objects.

Applying the ontological analysis to a complex system like Taranto offers a more complete and systematized knowledge of its present (and the potential future) increasing confidence on the value of the model – (that is not a model based on an omni comprehensive rationality). A shared and disambiguated knowledge model is a useful tool for effective, transparent and participated planning activities and gives a more conscious approach to cope with the complexity of conceiving a strategy.
References


Integrating VGI system in a Participatory Design Framework

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Key-words: Volunteered Geographic Information (VGI), ICT, Spatial Planning, Spatial values, Geospatial modeling.

Introduction

Over time, urban planning has been based on analyzing and evaluating expert knowledge of interested area of change. However, citizens participation is still a crucial issue for designers who have used different strategies which are more and more related to the use of new technologies in order to involve the public (Healey 1997, Gordon, Schirra and Hollander 2011, Jones et al. 2015, Kleinhans Van Ham and Evans-Cowley 2015). These efforts have been focused mainly on the planning activity without considering the potential of the local knowledge as input for a new plan. In this contribution, we propose a methodology integrating new technologies to allow bottom up knowledge of places emerge. Notably, besides planners expertise we introduce the so-called “wisdom of the crowd”(Surowiecki, 2005) within the design process as the local expertise related to the uses and the values people add to spaces. Spatial values, indeed, might vary significantly, which is easy to understand if one can imagine that each place could have a different environmental context related to different cultural, temporal and locational characteristics (Borges, Jankowski and Davis Junior 2015a).

The opportunity of using local knowledge is given by the emergence of Volunteered Geographic Information (VGI) systems. VGI systems have been used with many different purposes so far; however, a clear classification of VGI types is not already consistently defined. Considering the way of contributing we can distinguish “active” and “passive” volunteers (Fast and Rinner, 2014). In our proposal we would use both of them in order to characterize the socio-spatial behaviour and the collective spatial values in the first place. With this input the design process can be based on the specific socio-cultural context of the area to be changed as well as the measurement of the impact. Our contribution results in an integrated design methodology for both the planning activity and the VGI system conceptual modeling.

The article is structured as follow: the state of the art related to VGIs and to the notions of space as social construction as well as the spatial value will be presented; also, two already completed case studies will be briefly presented to give an idea of possible improvements in applying the new framework; then, the framework will be explained through the description of the workflow we created as proposed methodology:. Finally, future works and possible application of the framework will be discussed.
State of the art

Landscape and urban planning can take advantage of new technologies to facilitate its process using crowdsourcing of data strategies such as Volunteered geographic Information. In a large sense, VGI systems allow collection of data produced by the engagement of large numbers of private citizens without any pre-required Geographic Information System (GIS) skills (Goodchild, 2007). According to Elwood (2008), it is digital spatial data that are produced not by individuals and institutions formally classified as data producers, but by citizens that gather and disseminate their observations and geographic knowledge. Similarly Public Participation Geographic Information Systems and Participatory GIS regards to the use of geographic information systems (GIS) to broaden public involvement in policy making” (Sieber, 2006).

The methodology proposed here makes use of a VGI system to collect volunteered information to supply the design process and it is based on the Geodesign workflow proposed by Steinitz (2012) which favors the participation during the design decision. Notably, it is not only related to understand problems or collect proposals from citizens as it is done in many projects (i.e. Fix My Street, Improve My City). Participation should allow a deeper understanding of the designer about the collective use of spaces and their associated spatial values.

Our preliminary assumption is that space can be considered as a social production. This is not a new idea since it has been introduced in the late eighteens by geographers such as Bourdieu (1989), Lefevbre (1991), Soja (1989). Their main contribution has been to reverse the way of conceptualizing space from a mere “container” to an entity that is constructed on the basis of socio-cultural structures. Also, literature on the concept of place underlines the difference between space and place which are considered as the opposite extremes of a continuum going from the ideal geometrical abstraction of space to the experiential world of place (Couclelis, 1992). In Tuan (1979) space becomes place as we get to know it better and endow it with social and cultural values.

However, notions of social space and place are surrounded by vagueness and are difficult to be represented as reference in IT systems. Nowadays, VGI data is opening up the opportunity to identify that notions since user-generated content is often experiential and largely personal in nature (i.e. geotagged photos), giving information concerning the space of personal activity (i.e. cellular phone tracking) (Feick and Roche, 2013). There are studies trying to use VGI data to extract pattern of collective behavior (Sagl et al., 2012) and to make it usable for planning (McLain et. al., 2013). However, in this work we underline the need of a VGI system properly designed to allow the collection of this type of data rather than proposing the use of existing data sources.

Another crucial concept in our perspective is related to the values people give to spaces depending on their way of experiencing them. For instance, either Cullen (1971) and Tuan (1974) stated different types value attribution or perceptions that people give to a place both “cognitive” and “sense” related. Amongst others serial vision, altimetry contrasts, color, texture, as characteristics that give singularity to places: Genius Loci.

The framework proposed here starts from the assumption that social spaces and spatial values can be considered as a necessary knowledge to produce a design grounded in the city of people. Furthermore, to have this knowledge citizens must be involved in the process in such a way to increase participation in the planning process through the use of VGI system.
Case studies

So far, countless experiments of VGI systems’ use have been done. Here, it is mentioned few examples intending to clear the understanding of the proposal. During the Collaborative Mapping and Citizen Participation course in Architecture and Urban Planning Program at the Federal University of Minas Gerais students used Ushahidi’s Crowdmap tool to develop a Genius Loci-related subject, which they named “Sensory Drift” (Borges, Jankowski and Davis Junior, 2015a). This case study exemplify the application of a VGI collection of value attribution. The categories of collection were sound, smell, texture, illumination, colour, temperature and feelings. The case study shows clearly that it is possible to collect the cognition using a VGI project but not group the people into their activities and motivations which makes hard for a designer to identify which are the affected groups of a potential change proposal. During a project at the University of Torino called HackUnito a mapping activity with students has been organized. In this case, the focus was on understanding how students use the city in their daily life. Therefore, the map’s legend was defined collectively and then POI have been collected in the area surrounding the University Campus (Calafiore et al. 2014, Calafiore and Dansero 2016). In this case, information mapped is related to the way a specific group use the city but without having knowledge of how they evaluate their experiences. As for passive VGI analysis we present two case studies performed by Borges, Jankowski and Davis Junior (2015b) on the first case Tweets’ collected during the world cup in Brazil clearly shows grouping classification by game, by nationality and by geotag of Tweet. The same pattern could be seen on the second case study where Instagram posts were selected and spatially analyzed using density of posts. From these cases studies it is possible to learn that the combined use of spatial value attribution and grouping classification is not present in a regular VGI approach.

New Methodology Proposal

The Participatory Design Framework proposed here is based on a methodology aimed at increasing participation in the planning process. In section 2 it has been shown that VGI systems can be considered as tools to enhance participation in collecting geographic information of various nature ranging from activity's spaces to value attribution to spaces. However, to make use of this data the design of the VGI system itself is a crucial aspect. Notably, the proposed framework which integrates the two perspectives of the planning process and of the VGI system modeling. It concerns the collection, organization and analysis of data to inform and support spatial change design. Also, it takes the Geodesign Framework by Steinitz (2012) as reference in defining the steps to be followed answering specific questions.
The Framework, as it is shown in Figure 1, can be described as a workflow. Each dashed square represents models that answer questions presented in the geo design framework (Steinitz 2012). After data is collected, a designer, who is not necessary an expert designer since the framework we are proposing entails essentially the participatory construction of a change design in the planning activity frame but it does not include all the planning process.

The first part of the workflow presents the description of the area (process model) and the assessment of the area (evaluation model) are the starting state of an area which is represented as socio-spatial behaviour and spatial values. The socio-spatial behaviour is related to actions that a person performs in space at a certain time. Also, to understand the sociality of the spatial behaviour we need to know the ‘why’ of an action to relate it with particular groups of persons. The ‘why’ consists in the intentionality of an action or, in other words, in the “aboutness” of it (i.e. “going to the university is about to be a student”). Particularly here the focus is on the intention of a group in performing some spatial actions because we assume that the spatial behavior changes depending on different group’s interests. Actions that are related to specific groups are defined as social practice to underline the “we-attitude” in performing the action (Tuomela 2002). An example of application that enable users to create groups and adding places in relation to groups is First Life (firstlife.org). As a result, a process model represents different spatial configurations of social practices depending on different groups. While the process model answers the question how the study area operates, it is also needed to answer if the area is working well or not. In order to do this, we introduced a preliminary glossary of spatial values that are selected on the basis of cognitive and senses perception (Cullen 1971, Tuan 1974). In this way we would collect the quality of the spatial experiences. In particular, spatial values are a way to attribute common sense assessment (cognitive and sense related) to an area.

The designing activity is described in the second part of the workflow and it is based on the evaluation model as input. It ends up with an impact model which takes into consideration the dynamics of change not only in reference with space but also with social practices performed by specific social groups. Here, the designer, who is aware of the socio-spatial behaviours of different groups and of the related spatial values, makes a proposal of change explaining where to make a change and how. Even in this case, the designer proposal is related to the “aboutness” of the change i.e. “making new infrastructures is about being a developer”. Our assumption is that every change embeds some particular intention and it will affect different social practices related.
to different groups. This does not allow us to talk about “groups” but “stakeholders”, which are groups of people interested by the social practice change and also related to the space change that should be taken into consideration. The output then is a change design related to different stakeholders which gives us knowledge of the change model (how might the study area be altered?) depending on stakeholders intentions. Also, stakeholders evaluate the change on the basis of their perspectives. Therefore, the impact is measured on many layers representing how a changed state in spatial configurations and spatial values will affect different groups of people. This framework allows to represent and reason in a planning process not only on physic characteristics of spaces but also on human experiences and their way of living the city through collecting that information using a VGI system.

Conclusions

The proposed framework is a preliminary work based on different experiences in using VGI systems i.e. in the presented case studies. Nowadays, it can be said that there is a general trend of using VGI systems (i.e. Ushaidi) or VGI data (i.e. geotagged photos) for urban planning. However, there is no convergence in a common use of these technologies to effectively support spatial decision making while increasing public participation in the definition of a plan as well as in scenary simulation. The framework described here goes in the direction of understanding an efficient way to collect, organize and analyse crowdsourced data. Also, it is the basis for identifying the VGI system requirements to be fit for use in the participatory design of a urban plan. The framework will be tested in a case study using the proper technology. Finally, in the structuring of the case study engagement strategy will be assessed.

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Evaluation of social benefits generated by urban regeneration: a stated preference approach

Marta Bottero and Giulio Mondini

Key-words: social benefits, Contingent Valuation Method, urban planning, stakeholders analysis, community participation.

Introduction

Urban regeneration operations refer not only to buildings restoration operations, but also to programmes aiming at eliminating social decline, increasing the quality of life of the inhabitants, supporting the valorisation of cultural resources, protecting the environmental system, bringing economic development and so on. In fact, as mentioned by Roberts (2000), urban areas are complex and dynamic systems, reflecting the processes that drive physical, social, environmental and economic transition and generating themselves important changes. Taking into consideration this complexity, it is of particular importance to provide the Decision Makers with integrated evaluation tools, able to consider the multiplicity of objectives and values when dealing with urban regeneration processes, to include the opinions and the needs of the different stakeholders involved and to assess the impacts and the consequences of each decisions. (Bottero, Mondini and Ferretti, 2015; Tyler et al., 2013).

The paper focuses on the use of stated references approaches for evaluating the benefits that urban regeneration programmes generate on local community. These methods are used for valuing non-market public goods that contain social, cultural and environmental benefits that are impossible to quantify using monetary values (Boxall et al, 1996; Louviere et al, 2000). In particular, state preferences methods are based on the creation of a simulated market data collection by asking individuals for their opinions or views. The methods lie on the elicitation of the individuals Willingness To Pay (WTP), that is the willingness to pay of the society for using a certain good or service, or Willingness to accept (WTA), corresponding to the willingness to accept for abandoning a certain good. Stated preferences approaches also offer an opportunity for community engagement and participation in the decision making processes.

Among stated preferences methods, a very important role is played by the Contingent Valuation Method (Mitchell and Carson, 1989; Carson, 2000). The CVM is widely applied in environmental cost benefit analysis and is based on the development of a survey for collecting data about the good or service under examination. In a CVM survey the respondents are asked what they are willing to pay towards the preservation or an improvement of a certain asset. The research can then estimate the monetary value of the asset by calculating the average WTP of respondents and multiplying this by the total number of potential consumers.

The present study aims at evaluating people’s perception of the social value of urban regeneration programmes and their WTP to fund specific transformation operations. Starting from a real case related to the urban regeneration programme for the city of Collegno (Italy), the research considers the application of the Contingent Valuation Method (CVM) for the estimation
of the social benefits that the operation is able to deliver.
**Methodology**

*Selection of the sample and development of the survey*

The first step in the application of the CVM consisted in the selection of the sample for the development of the survey. In particular, the questionnaire was conducted in the city of Collegno in March 2016 and addressed both to residents and to visitors. Around 100 interviews were conducted using face-to-face approach.

*Design of the CVM questionnaire*

The questionnaire consisted of three components, that can be described as follows.

**Attitude of the respondents towards the good under investigation.**

In this part questions aiming at understanding the familiarity of the respondents with the site in Collegno were included.

**Simulation experiment and WTP elicitation.**

This second part presented the hypothetical scenario for the evaluation.

The respondents were asked if the regeneration of the city of Collegno were to transform a specific site with the creation of an urban park, how much they would be willing to pay for the construction of the new facilities. Figure 1 shows the representation of the transformation operation that was included in the questionnaire.

The CV question was offered according to the “open format” and the payment vehicle was represented by a one-off payment in the form of an income tax.

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![Scenario without intervention](image1.png) ![Scenario with intervention](image2.png)

**Fig. 1. Representation of the hypothetical scenario for the evaluation.**

**Background information.**

The final part of the questionnaire requested standard demographic information from the respondents, including sex, age, education, income level, location of residence and location of work or study.
Data analysis

The data collected through the questionnaire were analyzed in order to estimate the mean WTP and to provide statistics about the respondents’ socio-economic characteristics and other variables included in the questionnaire.

Results and discussion

According to the data collected in the questionnaire, different WTP were defined by the respondents (Table 1).

<table>
<thead>
<tr>
<th>WTP</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>55</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>20</td>
<td>7</td>
</tr>
<tr>
<td>30</td>
<td>1</td>
</tr>
<tr>
<td>50</td>
<td>7</td>
</tr>
<tr>
<td>100</td>
<td>17</td>
</tr>
<tr>
<td>200</td>
<td>1</td>
</tr>
<tr>
<td>300</td>
<td>2</td>
</tr>
</tbody>
</table>

The respondents mean WTP was 31 €. This mean WTP value can be used for estimating the aggregated WTP amounts for the urban regeneration operation under investigation. In order to provide an aggregate measure of the social benefits delivered by the transformation, the catchment area of the new park has been defined. In particular, an isochronous map showing the places from which the park will be accessible in 20 minutes by car has been created in order to understand the potential beneficiaries of the new facilities (Figure 2).
Fig. 2. Isochronous map for the definition of the catchment area.

The mean WTP was multiplied by the number of family unites in the catchment area. According to the calculations done, the overall social benefit accrued from the regeneration project was estimated to be around 7 millions of Euro. This value shows that the respondents pay attention to the conservation and valorization of the built environment and urban landscape. Apart from the estimation of the WTP, the results of the questionnaire highlighted other relevant issues about respondents’ preferences towards the future transformation of the site, suggesting functions and services that could be included in the project. The study shows the importance of adopting public participatory approaches in proposing and deciding new uses in urban regeneration processes. In fact, active involvement can ensure good decisions, able to match the public’s preferences (Hing and Chan, 2015).

Conclusions

This paper focused on the evaluation of the social benefits that urban regeneration processes deliver on local community. In the research, the requalification programmes of the city of Collegno (Italy) has been considered and the benefits provided by the creation of a new urban park were estimated using the CVM approach. The results of the evaluation showed an overall benefit of around 7 millions of Euro, thus confirming the relevance of non-economic value of urban regeneration processes. With reference to the perspective of the work, it would be useful to use the results of the present study in a cost benefit analysis (Hanley and Spash, 1993; Stellin and Rosato, 1998) that would allow to compare the social benefits delivered by the operation with the cost for undertaking the project, providing a benefit/cost ratio able to inform public Decision Makers about the social return of urban regeneration investments.
References


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**URTL - Urban-Rural Transitional Landscapes**
Urban-rural-natural gradient analysis using CORINE data: an application to the Italian regions of Friuli Venezia Giulia, Umbria, and Calabria

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Key-words: landscape gradients; landscape classification; density analysis; adjacency analysis.

Introduction

The environmental gradient paradigm, originally introduced by Whittaker (1967), states that environmental variation is ordered in space and drives the distribution of the structural and functional components of ecosystems. Both simple and complex gradients can be found in landscapes, the former refer to an environmental series due to a single, measured, environmental factor, whereas the latter are based on several factors (man-made or natural), some of which may interact (McDonnell & Pickett, 1990). Anthropogenic gradients, generated by the increase of human influences on the structure and functions of landscapes, were identified by Forman and Godron (1986) in the specific succession of natural–managed–cultivated–suburban–urban landscapes. Along such a sequence, typical modifications in the structures and functions of ecological systems can be observed (see, e.g., Luck and Wu, 2002; McDonnell and Pickett, 1990). Urbanization and agriculture can be considered as main drivers of landscape disturbances at the broad scale producing particular environmental gradients that modify the structures and functions of ecological systems (Luck & Wu, 2002) with a magnitude directly related to the steepness of the gradient itself (McDonnell & Hahs, 2008). The gradient view implies the identification and characterization of various typologies of so-called transitional landscapes as part of a more general urban-rural-natural (URN) continuous gradient. These “mixed” transitional landscapes, where different uses compete and human pressures arise causing more or less marked unstable conditions, coexist with other so-called “pillar” ones, dominated by a single LULC (Land Use - Land Cover) (Vizzari & Sigura, 2015). These transitional areas are characterized by different drivers and landscape functions. In particular, the urban fringe areas represent intricate spaces from the economic, environmental and social viewpoint, (Ives & Kendal, 2013; Vejre, Jensen, & Thorsen, 2010). Land-use conflicts, species and habitat conservation, preservation of cultural heritage, changes in lifestyles, and products and services from multifunctional agriculture are some of the main topics of the discussion on these linkages (Cavailhès et al., 2009; Marcheggiani, Gulinck, & Galli, 2013; Von der Dunk, Grêt-Regamey, Dalang, & Hersperger, 2011; Zasada, 2011). The complex relationship between agricultural, forestry and pastoral activities in agri-natural interfaces is also a key topic in the academic debate. The dynamics of post-crop cultivation, arising from cultivations being abandoned, determine an uncontrolled evolution in land cover due to their particular environmental conditions (Gellrich & Zimmermann, 2007).

In this framework discovering and understanding the gamut of landscape types
Nested along the landscape gradient, even starting from widely available LULC data, is crucial to allowing effective land-use analysis and planning. Our research questions can be summarized as follows: can the CORINE Land Cover (CLC) dataset be used to detect the landscape typologies (including the transitional ones) and their reciprocal adjacencies along the URN gradient? Can the same dataset be useful to produce spatially comparable classifications of the gradient at the regional scale (European NUTS 2 level)? In this direction, starting from the CLC data, a broadly and easily applicable methodology was developed and applied on three Italian regions located along the North-South geographical gradient and characterized by very different landscape configurations: Friuli Venezia Giulia, Umbria, and Calabria.
Methodology

The model for landscape gradient detection and analysis was based on the calculation of continuous density indicators of the main URN gradient components (urban, agricultural, and natural elements). These indicators were computed using Kernel Density Estimation (KDE) on six LULC macro-classes derived from a reclassification and conversion to points of the CLC dataset, level 3, year 2006, retrieved in 100m resolution grid format (Table 1).

<table>
<thead>
<tr>
<th>MACRO-CLASS CODE</th>
<th>MACRO-CLASS NAME</th>
<th>CLC codes (level 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>U</td>
<td>Artificial surfaces</td>
<td>111, 112, 121, 122, 123, 124, 131, 132, 133, 141, 142</td>
</tr>
<tr>
<td>A</td>
<td>Arable lands and pastures</td>
<td>211, 212, 213, 231</td>
</tr>
<tr>
<td>P</td>
<td>Permanent crops</td>
<td>221, 222, 223</td>
</tr>
<tr>
<td>H</td>
<td>Heterogeneous agricultural areas</td>
<td>241, 242, 243, 244</td>
</tr>
<tr>
<td>N</td>
<td>Forests and semi-natural areas</td>
<td>311, 312, 313, 321, 322, 323, 324, 331, 332, 333, 334, 335</td>
</tr>
<tr>
<td>W</td>
<td>Wetlands and water bodies</td>
<td>411, 412, 421, 422, 423, 511, 512, 522, 523</td>
</tr>
</tbody>
</table>

KDE produces smoothed surfaces by applying a moving circular window (with a defined radius called bandwidth) superimposed over a grid where the density of studied variables is estimated at each location according to a kernel function classes (Bailey and Gatrell 1995). Four different bandwidth (250, 500, 750, 1000 m) were tested using a quartic function (a simplification of the Gaussian function). The 500 m bandwidth was finally chosen as the best compromise between data generalization and level of detail across the three study areas. A subsequent supervised classification was applied on KDE outputs to detect and identify specific landscape types along the gradient. The classes used in this step were defined assuming the dominance of a single LULC macro-class (to identify the “pillar” landscapes - PLs), or the co-dominance by 2, 3, 4, 5 or 6 macro-LULC classes (to identify the transitional landscapes - TLs). As a result of these combinations, we considered 63 theoretical landscape typologies (LTs). In the final classification maps, the resulting landscape areas smaller than 100 ha were integrated with the surrounding ones by a nibble process. The results of the classification were also interpreted by an adjacency graph analysis, performed in R environment by means of the qgraph extension (Epskamp et al. 2015). This analysis allowed the representation of the LTs on a network, including nodes and connections. The nodes represent the landscapes with a dimension proportional to their extension within the region. The connections symbolize, by their thickness, the length of shared boundaries between the different landscape types. To improve graph interpretability, only the landscapes wider than 5000 ha and the shared boundaries longer than 20 km in total were represented in the force-embedded layout.

Results and discussion

Extension and configuration of both PLs and TLs, as well as their reciprocal spatial relationships, can be interpreted by maps (Fig. 1), table of LTs areas (Tab. 1), and adjacency graphs (Fig. 2).
Fig. 1. Maps of landscape classes of Friuli Venezia Giulia (a), Umbria (b), and Calabria (c).

Tab. 2. Total areas (ha) and percentages of LTs in Friuli Venezia Giulia (a), Umbria (b), and Calabria (c). “W” includes only inland landscapes.

<table>
<thead>
<tr>
<th>Landscape type</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>a (%)</th>
<th>b (%)</th>
<th>c (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>381151</td>
<td>253667</td>
<td>572189</td>
<td>49.6%</td>
<td>30.0%</td>
<td>37.9%</td>
</tr>
<tr>
<td>A</td>
<td>157307</td>
<td>174466</td>
<td>128452</td>
<td>20.5%</td>
<td>20.6%</td>
<td>8.5%</td>
</tr>
<tr>
<td>H</td>
<td>49916</td>
<td>37428</td>
<td>132412</td>
<td>6.5%</td>
<td>4.4%</td>
<td>8.8%</td>
</tr>
<tr>
<td>P</td>
<td>4309</td>
<td>10550</td>
<td>135008</td>
<td>0.6%</td>
<td>1.2%</td>
<td>9.0%</td>
</tr>
<tr>
<td>U</td>
<td>18473</td>
<td>8587</td>
<td>12311</td>
<td>2.4%</td>
<td>1.0%</td>
<td>0.8%</td>
</tr>
<tr>
<td>W</td>
<td>461</td>
<td>13946</td>
<td>2110</td>
<td>0.1%</td>
<td>1.7%</td>
<td>0.1%</td>
</tr>
<tr>
<td>HN</td>
<td>34175</td>
<td>116439</td>
<td>163166</td>
<td>4.4%</td>
<td>13.8%</td>
<td>10.8%</td>
</tr>
<tr>
<td>AN</td>
<td>12948</td>
<td>115465</td>
<td>82764</td>
<td>1.7%</td>
<td>13.7%</td>
<td>5.5%</td>
</tr>
<tr>
<td>AH</td>
<td>40441</td>
<td>46646</td>
<td>56449</td>
<td>5.3%</td>
<td>5.5%</td>
<td>3.7%</td>
</tr>
<tr>
<td>PN</td>
<td>1281</td>
<td>21089</td>
<td>68409</td>
<td>0.2%</td>
<td>2.5%</td>
<td>4.5%</td>
</tr>
<tr>
<td>UA</td>
<td>28347</td>
<td>19073</td>
<td>6174</td>
<td>3.7%</td>
<td>2.3%</td>
<td>0.4%</td>
</tr>
<tr>
<td>PH</td>
<td>2749</td>
<td>6653</td>
<td>69776</td>
<td>0.4%</td>
<td>0.8%</td>
<td>4.6%</td>
</tr>
<tr>
<td>UH</td>
<td>20638</td>
<td>5915</td>
<td>15037</td>
<td>2.7%</td>
<td>0.7%</td>
<td>1.0%</td>
</tr>
<tr>
<td>PN</td>
<td>1281</td>
<td>21089</td>
<td>68409</td>
<td>0.2%</td>
<td>2.5%</td>
<td>4.5%</td>
</tr>
<tr>
<td>Others</td>
<td>12842</td>
<td>9954</td>
<td>26855</td>
<td>1.7%</td>
<td>1.2%</td>
<td>1.8%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>768932</td>
<td>844962</td>
<td>1507807</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>
As expected, morphology is the major factor influencing LULC and the related LTs identified in this study. In all the regions, mountainous areas are dominated by natural landscapes (N) which also have the highest incidence on the total regional areas. In a and c these landscapes appear quite compact, even though result more articulated in c. Heterogeneous agricultural PLs (H) are generally identified in low-hilly areas of all the three regions, with wider surfaces in c and a. In all the study areas, plain areas are mainly occupied by PLs dominated by arable land (A) or permanent crop (P). The former are wider and more compact in a and b, while the latter are wider in c. U landscapes, containing the main urban settlements, are relatively wider in a than b and c. Specific TLs, with different relative importance and configurations, are interposed between the PLs of the three regions. The widest TLs, in all the study areas, are the agri-natural landscapes (AN and NH). In c, because the higher relative importance of P, also TLs between P and the above-mentioned major PLs become important (PN as agri-natural interface, in particular). In a, mainly due to the higher compactness of N and A, AN and HN landscapes result relatively smaller than b and c. In b, because the wider low-hilly areas of the region, the same TLs assume the widest relative surfaces confirming the relevance of the agri-natural landscapes in this territory. In a, the higher incidence of UA and UH TLs (which can be considered as urban fringe landscapes) is related to the wider U PLs of this region. The former surround the many U landscapes scattered in the plain areas, while the latter are identified in the main urban fringes located in the foothills.

Conclusions

The proposed method seems very promising in performing spatially comparable classifications of the URN gradient of different study areas even starting from the widely available CLC dataset. The classifications result also very effective for understanding and communicating the geography of an even complex study area. The KDE technique, supervised classification, graph analysis allow for modeling and classifying landscape gradients and discovering the key landscape adjacencies featuring the areas under investigation. The combination of such techniques supports the identification of the different landscape typologies along the URN gradient (including the urban-rural and the agri-natural interfaces). In a future application of this approach it will be interesting to develop a diachronic analysis in order to discover the spatial and structural transformations of the URN gradient and to test the applicability and reliability of the proposed method to such purposes.
Acknowledgements

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References


Liveability services in transitional landscapes: a spatial-MCDA model for assessment and mapping

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Key-words: landscape liveability; population density; stakeholders preferences.

Introduction

Liveability is becoming a leading concept in landscape planning and management (de Haan et al. 2014). It is mainly an anthropocentric concept since it represents the suitability of a landscape to be inhabited by people (van Kamp, Leidelmeijer, and Marsman 2003). Ecosystems are able to fulfil important societal needs by providing ecosystem services (ES) similarly to Urban systems which provide the more traditional Urban Services (US). In this view, ES and US influence landscape liveability in a clearly comparable manner. In addition, liveability is strongly dependent not only on objective landscape features, but also on subjective stakeholders’ perception. Hence, the assessment of landscape liveability integrating ES and US with stakeholders perceptions, may result very effective for landscape planning and policy—making purposes.

The focus on relationship between liveability level, landscape typologies and resident population analysis can highlight interesting spatio-functional dynamics, giving new information supporting landscape planning. In particular, liveability analysis within urban-rural transitional landscapes appears relevant since these contexts are characterized by very complex spatio-functional dynamics which strongly affect their local liveability. In this vein, the present study aims at developing a methodology for liveability spatial assessment based on ES and US mapping and stakeholders involvement to quantify their relative relevance. The results are interpreted in the light of landscape typologies and population data focusing on urban-rural transitional landscapes.
Methodology

A Liveability Spatial Assessment Model (called LISAM) was developed starting from a previous work by (Antognelli and Vizzari 2016) in which a hierarchical classification of liveability services, based on the Common International Classification of Ecosystem Services (CICES) and including both ES and US, was used for calculation of the service weights through stakeholders involvement. This study was conducted in the Perugia area in Umbria (Italy) (Figure 1), approximately 1,007 km² wide, including the city of Perugia (Italy) and seven surrounding municipalities: Perugia, Magione, Passignano sul Trasimeno, Corciano, Umbertide, Torgiano and Deruta. The area encompasses an urban and productive system of high territorial complexity that, in the last decades, has been characterised by high rates of urbanisation. Seven local landscape planners (one for each municipality) and different local experts were invited to express preferences about the services included in the classification through completing various pairwise comparison matrices according to an Analytic Hierarchy Process approach (Saaty 1977). The respondents were asked to express the perception of the population who lives in the area they usually manage or study. The results of the pairwise comparison matrices were used to calculate the percentage influence on liveability of each service included in the classification, as perceived by representatives of the local population.

In LISAM the hierarchical classification was used to perform a Spatial Multicriteria Decision Analysis (S-MCDA) (Malczewski 2006) based on AHP. To this purposes, the majority of ES and US, included in the hierarchical classification, were spatialised and progressively aggregated in order to obtain a liveability spatial index.

The majority of the data used for service spatial indices calculation were collected from local authorities and open databases. Data elaboration was performed using open source Geographic Information Systems (QGIS) and Relational Database Management System (PostgreSQL). Continuous raster layers, representing local accessibility or availability of 43 on 67 services included in LIAM, were mapped using different approaches, depending on the service type (Table 1).

<table>
<thead>
<tr>
<th>Approach</th>
<th>Main GIS steps</th>
<th>Service type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euclidean distance</td>
<td>- Proximity analysis of delivery points</td>
<td>services whose proximity of delivery point is intended as easiness of connection to a network (e.g. water networks, sewage networks).</td>
</tr>
<tr>
<td>Density analysis</td>
<td>- Kernel Density Estimation (KDE) on delivery points location (bandwidth = 500 m)</td>
<td>services whose local availability level is dependent on the density of delivery points within a certain distance (e.g. historical sites).</td>
</tr>
<tr>
<td>Minimum driving time (MDT)</td>
<td>- Road network graph building of study area in PostgreSQL using Open Street Map data - Calculation of MDT to the nearest delivery point with pgrouting pgr_drivingDistance function - spline interpolation of MDT linked to road nodes</td>
<td>services for which a single delivery point can fulfil the local people's need (e.g. pharmacies, food shops).</td>
</tr>
<tr>
<td>Viewshed</td>
<td>- Areas of interest (AOIs) conversion</td>
<td>aesthetical services by high</td>
</tr>
</tbody>
</table>
For each pixel, calculation of number of visible sampling points falling into AOIs

Subsequently, raster layers, representing local service availability or accessibility, and their relative weights on liveability, interpolated in QGIS through the Inverse Distance Weighting, were progressively aggregated using concatenated Weighted Linear Combination (WLC) to obtain a final liveability index. In addition, the sum of the weights associated to the assessed services was used to express the percentage of liveability the indicator is able to explain (Figure 1).

To analyse liveability level within transitional landscapes, this result was integrated with a classification of the urban-rural-natural gradient of landscape of the same study area produced in a previous study (Vizzari, Sigura, and Antognelli 2015). In this study 11 different landscape classes (6 pillar and 5 urban-rural transitional landscapes) were identified through a PCA on seven main landscape features followed by unsupervised classification (Table 2). A statistical analysis was performed in QGIS to quantify liveability levels and resident population in each landscape type, along the gradient. Descriptive zonal statistics for non-parametric data (i.e. quartiles) were calculated on liveability results while other statistics (i.e. total population and population density) were calculated on census data.

<table>
<thead>
<tr>
<th>LANDSCAPE CODE</th>
<th>LANDSCAPE NAME</th>
<th>LANDSCAPE DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>UHI</td>
<td>Urban high intensity</td>
<td>Landscape highly dominated by the urban component</td>
</tr>
<tr>
<td>UMI</td>
<td>Urban medium intensity</td>
<td>Landscape dominated by the urban component, with sparse natural, agricultural and commercial elements</td>
</tr>
<tr>
<td>CMI</td>
<td>Commercial medium intensity</td>
<td>Landscape dominated by the commercial buildings, with high presence of roads, mixed with sparse natural, agricultural and urban elements</td>
</tr>
<tr>
<td>OMI</td>
<td>Olive yards medium intensity</td>
<td>Landscape dominated by oliveyards, with relatively widespread residential settlements, sparse arable lands and linear natural elements</td>
</tr>
<tr>
<td>OHI</td>
<td>Olive yards high intensity</td>
<td>Landscape highly dominated by oliveyards</td>
</tr>
<tr>
<td>AMI</td>
<td>Agricultural medium intensity</td>
<td>Landscape dominated by arable lands, with relatively widespread urban features and sparse natural elements, vineyards and rare olive yards</td>
</tr>
<tr>
<td>AHI</td>
<td>Agricultural high intensity</td>
<td>Landscape highly dominates by arable lands</td>
</tr>
<tr>
<td>VMI</td>
<td>Vineyards medium intensity</td>
<td>Landscape dominated by vineyards, with sparse arable lands, and natural elements, and small urban settlements</td>
</tr>
<tr>
<td>VH1</td>
<td>Vineyards high intensity</td>
<td>Landscape highly dominated by vineyards</td>
</tr>
<tr>
<td>NMI</td>
<td>Natural medium intensity</td>
<td>Landscape dominated by woods and linear wooded features framing frequently agricultural lands, olive yards and isolated buildings</td>
</tr>
<tr>
<td>NHI</td>
<td>Natural high intensity</td>
<td>Landscapes highly dominated by woods and wooded features</td>
</tr>
</tbody>
</table>
Results and discussion

The liveability indices, at the various hierarchical levels, resulted capable to include both the local availability or accessibility of US and ES and their relevance expressed by the interviewed stakeholders. The final liveability map is able to explain from 73 to 87% of the total liveability, depending on the area considered (Figure 1). As expected, the highest liveability level was observed in Perugia town centre and its surroundings, and in Umbertide town centre. The periurban areas of these two cities and some small town centres show slightly lower liveability values. The outer plain, and low hilly agricultural areas, located in the central-western part of the study area and along the Tiber valley, show average values of liveability. The lowest values of liveability can be highlighted in the more mountainous areas located in the northern part of the study area. So, liveability is higher in the more urbanized landscapes and show similar trends to population density and total resident population (Figure 2). In fact, the median value of liveability show a high correlation with both the variables (Pearson's $R^2$ is 0.89 and 0.90 respectively for population density and percentage). This evidence is clearly related both to the higher accessibility of US within more urbanized landscapes and to the higher importance given to these services by stakeholders. Statistics per landscape typologies show that significant percentages of population live within transitional landscapes in generally small or disperse settlements (Figure 2). In these landscapes liveability values show high variability and become higher only where anthropogenic features related to US occurs.

In general, if landscape liveability, as perceived by our interviewed stakeholders, become a purpose of landscape management, it could evidently increase the typical tendency of urban-rural transitional landscapes towards urbanization. So, this tendency, even though could turn out to produce an increase in liveability levels, inevitably would generates a relevant ES reduction typically related to urbanization processes.
Fig. 1. Overall liveability map. Key: CO: Corciano, DE: Deruta, MA: Magione, PA: Passignano S.T., PE: Perugia, TO: Torgiano, UM: Umbertide; number of services mapped is reported in the first line of the legend; explained local share of liveability is reported using isolines; classes are defined using mean (M) and standard deviation (SD) as follows: min – (M – 2SD), (M – 2 SD) – (M – 1SD), (M – 1 SD) – M, M – (M + 1SD), (M + 1 SD) – (M + 2 SD), (M + 2 SD) – max.

Fig. 2. Liveability and population in the different landscape typologies. Liveability is described by side-by-side box plots (left); percentage of population and population density in landscape typologies are reported (right). On X axis, transitional landscapes are highlighted in blue.

This well-known trend is clearly related to the higher perceived importance of US, compared to that of ES, by the majority of population and, very often, by the same landscape planners. The effects of the undervaluation of ES in this liveability assessment is widened by the effects of some difficulties in ES assessment. In fact, all the services not mapped in LISAM implementation, determining the quota of unexplained liveability described in Figure 1, are ecosystem ones.
Conclusions

LISAM can serve as an innovative and versatile tool for locally determining the relative value of landscape liveability, also considering the expressed stakeholders’ preferences. The model explicitly addresses the need for place-based perception assessment methods (Potschin and Haines-Young 2012), helping to overcome the difficulties related to the introduction of the ES approach in local landscape planning and policy development as asked by different authors (see e.g. (Geneletti 2011; Müller, de Groot, and Willemen 2010). This particular LISAM application, together with the focus on the relationships between liveability, landscape types and population, has confirmed the undervaluation of ecosystem services previously highlighted by many authors (see e.g. (Troy and Wilson 2006) and the important role of urban components in liveability, according with (Leby and Hashim 2010; van Kamp, Leidelmeijer, and Marsman 2003; Tallon and Bromley 2004). Together with ES and US, a more comprehensive assessment of perceived landscape liveability will require the integration of ecosystem and urban disservices within the same approach to consider those factors generated by landscape components that reduce the overall level of place liveability as indicated in the definition by (Veenhoven 1996).

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References


e-agorâ|e-αγορâ for the transition toward resilient communities

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Big data and environmental management: the perspectives of the Regional Environmental Information System of Sardinia, Italy

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\textsuperscript{b}Department of Civil and Environmental Engineering and Architecture - University of Cagliari, Cagliari, Italy. (sabrinalai@unica.it)
\textsuperscript{c}Division for Environmental Sustainability and Information Systems - Autonomous Region of Sardinia, Cagliari, Italy (giacocco@regione.sardegna.it, nsannio@regione.sardegna.it)

Key-words: big data, environmental management, environmental indicators.

Introduction

In the 2000s and in the 2010s, the expression ‘big data’ has come to the fore embracing discourses on technical tools, organizations, and uses of datasets that are too large to be handled through current available technologies (Fosso Wamba et al., 2015). However, this simple definition is problematic. While Batty (2015) argues that some 40 definitions of big data exist, a very popular scheme is provided by the so-called ‘multiple V model’, which implies the description of the volume, velocity, variety, value, and veracity of the dataset at hand (Assunção et al., 2015; Hashem et al., 2015; Russom, 2011). The multiple V model is straightforward and covers, although implicitly, other key aspects such as political stakes, organizational commitment, openness, security, and spatial features of the data involved.

The adoption of big data and their analytics in many organizations is challenging, since it is hindered by typical barriers involving technological skills, mentality, data sharing, and privacy issues (Villars, Olofson and Eastwood, 2011; Edosio, 2014). In urban and regional science, a relevant paradigm is that of ‘smart cities’, invoking a process toward more efficient forms of management through continuous use of big and open data analytics disentangling the rationale of complex networks interlaced in urban areas (Batty et al., 2012; Townsend, 2013). Environmental management and planning imply the development of information-intensive processes, not least because the increasing complexity of environmental issues and institutional apparatuses have spurred the need for designing and maintaining large datasets (Vitolo et al., 2015).

This contribution develops on the multiple V model defining big data and uses the resulting analytical framework to pinpoint strengths and weaknesses of a possible big data driven evolution of the Regional Environmental Information System (REIS) of Sardinia, Italy.
Methodology: the multiple V model

Big data and their implications can be defined and identified in a number of ways; some are simple and refer to particular features of the data, while others are complex and involve the description of issues pertaining to the underlying organizational activities (production, analytics, sharing, access, etc.). The multiple V model (Table 1) provides a simple, yet powerful, framework for defining whether a dataset can be regarded as big data (Assunção et al., 2015; Hashem et al., 2015; Russom, 2011) by referring to intrinsic characteristics of the data themselves. In its first formulation, the model included three Vs for volume, variety, and velocity. Volume stands for the size of the dataset and it is perhaps the most frequent concern emerging in definitions which primarily focus on the quantity of information, too large to be efficiently managed with the available technologies. Talia et al. (2015) estimate the total quantity of data produced worldwide by 2020 in 45 ZB. If some years ago ‘large’ meant some MBs, big data currently involve datasets including at least some TBs. Large volumes of data become even less handy when they are arranged into a variety of formats (i.e. texts, vector files, images, space, time, etc.): datasets are not structured anymore and need proper envelopes to be stored and analysed. The third V stands for velocity and refers to the pace of the flow of data into a given storing unit. Big data here means living entities that expand at huge rates, and they often imply a pace of data delivery higher than 10 Gbps.

Tab. 1. The multiple V model for analysing big data.

<table>
<thead>
<tr>
<th>Properties</th>
<th>Data</th>
<th>Benchmarking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>Quantity of information</td>
<td>More than 1 TB</td>
</tr>
<tr>
<td>Variety</td>
<td>Quality of information</td>
<td>More than 3 format types</td>
</tr>
<tr>
<td>Velocity</td>
<td>Speed of data flow</td>
<td>More than 10 Gbps</td>
</tr>
<tr>
<td>Veracity</td>
<td>Reliability of big data</td>
<td>Trustfulness of sources</td>
</tr>
<tr>
<td>Value</td>
<td>Worth of adopting big data</td>
<td>Positive balance</td>
</tr>
<tr>
<td>Visualization</td>
<td>Representation of data</td>
<td>Intelligence of trends</td>
</tr>
</tbody>
</table>

Beyond the above three most cited aspects, three other Vs can be found in the literature: veracity, value, and visualization. Veracity refers to the correspondence of big data to up-to-date, actual and real phenomena, conditions, and locations. This V implies that big data analytics lead to reliable results and that the sources are verified and trustful. Value stands for the economic advantage connected to the adoption of big data by a private or public organization. Recent reports by McKinsey and Company estimate in three trillion USD the value of open governmental data worldwide (Gurin, 2015). In this respect, a pragmatic analysis of critical processes and possible savings for a given organization is at the heart of the decision to develop on big data (Copeland, 2015). The last V stands for visualization, embracing a set of techniques able to represent big data synthetically and effectively: big data analytics often include statistical and geoprocessing tools for reducing the complexity of large datasets to metrics defining trends and hot spots.
Can the Regional Environmental Information System of Sardinia be put in the context of big data? Results and discussion

The REIS, originally set up in the framework of measure 1.7 of the European Regional Development Fund (ERDF) Sardinian Regional Operational Programme 2000-2006, includes large datasets arranged into a series of “thematic modules” (for instance on air, water, waste, soil, electromagnetic sources) interlinked by means of an overarching cross-thematic analysis and reporting tool, and it is currently being enriched by adding further thematic modules (on biodiversity and energy) and by implementing more sophisticated reporting tools. The REIS was conceived to support spatial planning and decision processes in the environmental domain by integrating environmental information produced and/or collected at various levels by various institutions, so as to provide decision makers, local authorities and practitioners with a common and certified environmental data base, compliant with Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE). Moreover, the REIS is integrated with the Regional Spatial Data Infrastructure (RSDI). In Table 2, the main goals of the REIS are reported.

<table>
<thead>
<tr>
<th>Main goal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissemination</td>
<td>From 8 to 50 TB</td>
</tr>
<tr>
<td>Integration</td>
<td>Many formats (csv, pdf, xml etc.) processed</td>
</tr>
<tr>
<td>Modulation</td>
<td>Incoming flows: 100 bps only for the internal links</td>
</tr>
<tr>
<td>Openness</td>
<td>CDB with high reliability</td>
</tr>
</tbody>
</table>

The REIS is maintained by the Division for Environmental Sustainability and Information Systems of the regional administration: it was tested and launched in 2012 and it is currently being updated. The REIS is reachable via the world wide web (Figure 1), although right to use is currently being restricted to public institutions; however, in the next future it is envisaged that access will be granted also to the wider public, with appropriate profiling and access levels. As for the first V, the REIS is currently organized in a distributed architecture, where datasets are separated from management modules. Data are stored in two domains: the current and the
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Historic archives, containing a total amount of information ranging from 8 to 50 TB. With respect to variety, the very same data can be delivered in different formats depending on the user’s account level and related permissions. Not all of the formats, however, are fully compliant with open data requirements (ePSI Platform, 2010), as information and datasets can be exported in a variety of formats scoring between 2 and 4 stars (csv, xls, xml, html, rtf, doc, pdf, jpg, tif, txt, shp, dxf). Finally, data delivered do not currently come with a content license. As for the velocity, a distinction needs to be drawn between incoming and outgoing information flows. With respect to incoming flows, optical fibre connections allow the internal part of the REIS to exchange data at a high pace (more than 100 bps), while external incoming flows (e.g. data acquisition from automatic sensors) suffer from structural limitations of the available bandwidth. Outgoing information flows at a high speed, because a distributed architecture assigns any time each request to the least busy server. With respect to the veracity, according to their reliability level, data are stored in three databases as follows: i) Consolidated Data Base (CDB), which only includes data certified by an authoritative source, e.g. by administrative agencies or other verified organizations; ii) Staging Data Base (SDB), including information not yet verified by a certified source, such as data from environmental impact statements prior to the conclusion of their related environmental impact assessment procedures; and iii) Data Warehouse (DW) containing both internal data (from the CDB) and external data, such as users’ generated contents (e.g. comments on environmental facts and emergencies, tourists’ comments on routes, etc.).

### Tab. 3. The analysis of the Sardinian REIS according to the multiple V model

<table>
<thead>
<tr>
<th>V’s</th>
<th>Synthetic description</th>
<th>Qualitative assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>From 8 to 50 TB</td>
<td>☑</td>
</tr>
<tr>
<td>Variety</td>
<td>Many formats (csv, pdf, xml etc.) processed</td>
<td>☑</td>
</tr>
<tr>
<td>Velocity</td>
<td>Incoming flows: 100 bps only for the internal links</td>
<td>☑</td>
</tr>
<tr>
<td>Veracity</td>
<td>CDB with high reliability</td>
<td>☑</td>
</tr>
<tr>
<td>Value</td>
<td>No official estimates available</td>
<td>☑</td>
</tr>
<tr>
<td>Visualization</td>
<td>Powerful reporting routines</td>
<td>☑</td>
</tr>
</tbody>
</table>

As for the value, a complete assessment concerning quantitative proxies of the benefits of the REIS is still lacking. The implementation of the REIS cost approximately 12 million Euros; in return, the REIS is expected to benefit current administrative procedures through simplification of the processes, i.e. reference to a unique digital technical dossier for the many authorities involved. In addition, the REIS is bound to facilitate professionals and consultants (as soon as they are granted access to the system), by providing a unique, certified, and geo-referred environmental dataset, leading to clear time and cost savings. Furthermore, the regional administration has recently signed two memoranda of understanding with the local Association of Manufacturing and Service Companies (therefore allowing for simpler and faster service delivery processes to its members) and with another Italian regional autonomous administration (Friuli Venezia Giulia), by allowing it to reuse the REIS, its design and architecture (which implies significant cost saving for the Friuli Venezia Giulia region); both memoranda therefore lead to broad social advantages. Turning finally to visualization, the REIS is equipped with reporting tools that enable users to extract intelligible information from the stored data bases. The system allows users to produce tables, graphs, and maps, and delivers aggregate analytics, such as a dashboard with the main environmental facts, variables, and indicators.
Conclusions

This paper contributes to surveying current trends in the area of ‘Big Data’ for urban and regional planning by looking at an innovative case study, the Sardinian REIS, a planned and managed institutional regional information system designed to support environmental planning processes and decision making in the environmental domain. In addition, it presents a benchmarking operative application of the multiple V model, a framework usually referred to in theoretical terms, and it also develops on the nature and possible evolution of an environmental information system, a data structure not frequently analysed in the big data literature. To look at the REIS in the big data field might be regarded as uncommon, first because a significant share of the data stored in the REIS datasets is not produced real-time, second because the largest part of data are not being acquired through social media or other crowdsourcing tools, and, third and most important, because a structure is being superimposed on data and therefore (apart from the Data Warehouse, which can accommodate also unstructured data) the core of the datasets (both CDB and SDB) only contain structured data. We tried to assess to what extent such a system can be put into the big data context by briefly analysing its characteristics against the multiple V model framework and found out that the REIS conforms to the framework in terms of volume, variety, veracity and visualization. Conversely, REIS’s performances in terms of velocity are not high as a result of structural constraints on the maximum bandwidth due to internet communication network’s being far from cutting edge in the island. Moreover, further data and research would be needed to assess the REIS’s value, since current information on, and evaluation of, benefits stemming from routine use of the system are not available yet, not least because the system is currently being updated and it is not accessible to the wider public for the moment being.

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Quantifying transport infrastructures and settlement fragmentation: strategic measures for rural landscape planning

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Key-words: rural and peri-urban landscapes; landscape fragmentation; fragmentation indices.

Introduction

In recent spatial planning policies, ecosystems contiguity and integrity are of paramount importance. Thus an increasing interest attains policies aiming at reducing landscape fragmentation (hence, LF), where once large habitat patches break into smaller areas, or fragments, that often tend to be more isolated and disconnected than in the original condition.

Transport and mobility infrastructures (TMIs), such as road networks and urban settlements, induce LF in rural and peri-urban areas, have negative effects on flora and fauna, and lead to the loss of certain habitats. In recent years, some indices have been introduced in literature to quantify LF due to TMIs and settlements: the Infrastructural Fragmentation Index (IFI) and the Urban Fragmentation Index (UFI).

We develop our study in Sardinia (Italy) and monitor the values of IFI and UFI in the time period 2003-2008 for three landscape units (LUs) established by the regional landscape plan (RLP) (RAS, 2006). In the next section we present the methodology used. In the third section we show and discuss the results achieved, while in the fourth section we present the concluding remarks of this work.
Methodology

Maintaining ecosystem continuity is becoming a central element in spatial planning policies (Romano and Tamburini 2001). Several authors (Battisti 2004; Henle et al. 2004; Dobson et al. 1999; Wilson 1993; Wilcove et al. 1986) argue that natural environment fragmentation is one of the main causes that has adverse effects on biodiversity. According to the European Environment Agency (EEA 2011), natural environment fragmentation, i.e. LF, is the transformation of larger patches into smaller ones, or fragments, where the fragments tend to be more isolated than in the original condition. In this work, for patches we mean rural and peri-urban landscape areas occupied by habitats. LF is extremely evident in urban areas, or in areas intensively used, where it is due, for example, to TMIs (EEA 2011; Saunders, Hobbs, and Margules 1991) and urban development (Battisti and Romano 2007; Serrano et al. 2002).

The main ecological effects produced by TMIs include loss of habitat and biota, increased mortality of plants, death of animals killed by vehicular traffic and habitat fragmentation, which in turn triggers habitat loss (Spellerberg 1998). Also the rural road network leads to LF, which depends on characteristics of the roads (Jaarsma and Willems 2002). LF caused by roads and railways can be assessed using indices, such as the IFI (Bruschi et al. 2015; Fabietti et al. 2011; Guccione, Gori, and Bajo 2008; Melis and Puddu 2008; Battisti and Romano 2007; Zanon, Geneletti, and Franceschini 2007; La Rovere, Battisti, and Romano 2006; Biondi et al. 2003; Romano 2002; Romano and Tamburini 2001). There are many ways to calculate the IFI (Bruschi et al. 2015; Fabietti et al. 2011; Melis and Puddu 2008). In this study, we use the approach suggested by Bruschi et al. (2015), Biondi et al. (2003), Romano (2002), and Romano and Tamburini (2001), who proposed the following equation 1

\[
IFI = \frac{\sum_{i=1}^{n} L_i \cdot O_i \cdot N \cdot P}{A} \quad (1)
\]

where \(L_i\) stands for the length in meters of the road or railway trait with the exclusion of discontinuities (viaducts, bridges, tunnels, etc.), \(O_i\) for the (adimensional) occlusion coefficient, \(A\) for the extension in squared meters of the LU area; \(P\) for the perimeter in meters of the LU, and \(N\) for the number of patches. \(O_i\) varies in the range 0.3-1.0 depending on the difficulty that the fauna has in crossing the transportation infrastructure (Table 1).

<table>
<thead>
<tr>
<th>Types of transportation infrastructure</th>
<th>(O_i)</th>
</tr>
</thead>
<tbody>
<tr>
<td>National road n. 131 and n. 131bis (Four-lane roads) and railway</td>
<td>1</td>
</tr>
<tr>
<td>National, regional, and provincial roads</td>
<td>0.5</td>
</tr>
<tr>
<td>Municipal and local roads</td>
<td>0.3</td>
</tr>
</tbody>
</table>

According to Bruschi et al. (2015) and Romano and Tamburini (2001), IFI increases with \(A\): thus it is useful for measuring LF in LUs with similar extension. Urbanization induces effects on ecological networks (De Montis et al. 2016) and causes fragmentation processes and soil consumption, which produce qualitative and quantitative effects on habitat, flora, and fauna (Astiaso Garcia et al. 2013). LF due to urban areas can be assessed through the UFI (Astiaso Garcia et al. 2013; Battisti and Romano 2007; Biondi et al. 2003). According to Romano and Zullo (2013) and Battisti and Romano (2007), the UFI can be modeled by the following equation 2
\[ UFI = \frac{\sum_{i=1}^{n} S_i}{A} \cdot \frac{\sum_{i=1}^{n} p_i}{2 \sqrt{\pi \sum_{i=1}^{n} S_i}} \]  

where \( S_i \) stands for the extension in squared meters of the \( i \)-th urban area, and \( p_i \) for the perimeter in meters of the \( i \)-th urban area. The first term of equation 2 quantifies the incidence of urbanized areas on the LU surface; the second term is the ratio between the perimeter of the urban area and the circumference of the equivalent circle (Romano and Zullo 2013). According to Battisti et al. (2013), UFI ranges between zero for purely rural areas and the value of the second term of equation 2 for completely urban areas. In the next section, we illustrate the application of the two indices to the measurement of LF change from 2003 to 2008 for three LUs in Sardinia, Italy.

**A case study in Sardinia**

We have applied the two indices, IFI and UFI, to the study of three LUs, which are defined as ‘Gulf of Asinara’, ‘Meilogu’, and ‘Gennargentu-Mandrolisai’ by the RLP (RAS 2006) and illustrated in Figure 1. In particular, we have obtained the IFI by considering transport infrastructures crossing rural and peri-urban areas, and calculated the UFI taking into account urban settlements, industrial and commercial areas, and outbuildings settlements.

---

Fig. 1. The LUs Gulf of Asinara (A), Meilogu (B), and Gennargentu-Mandrolisai (C).
Data on TMIs and urban areas consisted in the regional land cover maps corresponding to 2003 and 2008. We mainly use data available on-line in the official website of the Autonomous Region of Sardinia (RAS 2016) as shapefiles based on Corine Land Cover classification and include: LUs, road and railway network (including bridges, viaducts, and tunnels), urban settlements or other populated areas, and industrial areas. Orthophotos are available on-line through the Web Map Service of the Region. Data in shapefile format are not accurate, as they present i) lacking or missing correspondence between satellite data and vector data, and ii) poor level of detail in the land cover map. Data were corrected in time consuming manual sessions.

<table>
<thead>
<tr>
<th>LUs</th>
<th>IFI 2003</th>
<th>IFI 2008</th>
<th>Variation</th>
<th>UFI 2003</th>
<th>UFI 2008</th>
<th>Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gulf of Asinara</td>
<td>44,220</td>
<td>55,929</td>
<td>26.48%</td>
<td>1.42</td>
<td>1.79</td>
<td>26.06%</td>
</tr>
<tr>
<td>Meilogu</td>
<td>8051</td>
<td>9022</td>
<td>12.06%</td>
<td>0.13</td>
<td>0.15</td>
<td>15.38%</td>
</tr>
<tr>
<td>Gennargentu-Mandrolisai</td>
<td>8067</td>
<td>8133</td>
<td>0.82%</td>
<td>0.12</td>
<td>0.12</td>
<td>-</td>
</tr>
</tbody>
</table>

According to Table 2, results describe a similar scenario for both the indices. Gulf of Asinara is the most fragmented LU and Gennargentu-Mandrolisai the least one. In addition, Gulf of Asinara shows the highest LF increase in the period and Gennargentu-Mandrolisai the lowest one. Variation values show roughly the same size for the three LUs: LF increase of Gulf of Asinara is almost twice as much as the one of Meilogu.

Conclusions

In this preliminary study, we have estimated the level of LF in rural and peri-urban areas through two indices, namely the IFI and the UFI. Both the indices have been calculated for the years 2003 and 2008 and three LUs designed in the RLP of Sardinia. Results indicate that the indices offer a similar information, as both indicate that Gulf of Asinara is the most fragmented LU and shows the highest LF variation. This is due to a comparatively denser pattern of TMIs and settlements. In addition, results demonstrate how the two indices are powerful in anticipating possible critical situations due to the increase of LF and, thus, indicating key issues to policy makers and planners. Similarly, IFI and UFI provide analysts with synthetic tools for assessing the environmental and landscape impacts of plans responsible for the development of infrastructures and settlements. Further studies need to be developed in order to i) increase the accuracy of the data provided by the Region and re-calculate the IFI and UFI value, ii) calculate the IFI and UFI values also for vulnerable domains (natural areas, protected areas, etc.), iii) take into account the daily average traffic and the impact of transport infrastructure on terrestrial wildlife and calculate more accurate values for the coefficient of occlusion, and iv) suggest ad hoc measures for preventing and mitigating the effects caused by LF in rural and peri-urban areas.

Acknowledgements

Antonio Ledda gratefully acknowledges the University of Cagliari for the financial support of his PhD scholarship.
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Multi-temporal satellite imagery for soil sealing detection and urban growth mapping in the city of Ranchi (India)

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Key-words: soil sealing, urban sprawl, remote sensing, change detection, LULC.

Introduction

Remote sensing has already proved to be a powerful tool for land planning, monitoring and management. In particular, remote sensing techniques can be useful to evaluate the impact of natural processes and human activities on environment in the context of conservation policy and sustainability. In this work we used multi-temporal satellite imagery from the Landsat space program to map urban growth dynamics occurred in the Ranchi city context (NW India). Our attention was focused on the period 1975-2011, when a strong and unregulated urban expansion affected the area (about 1900 km²). At the moment the definition of soil sealing is not univocal (Pilieri, 2009). Land cover changes affecting urban, agricultural and natural areas are the one generally considered while speaking about soil sealing. In this work we focused on urban class that traditionally and irreversibly subtracts land to other classes. Urban areas were mapped from satellite images for 4 years (1975, 1988, 2004, 2011). Further analysis based on spatial data processing and change detection approaches permitted us to describe different urban development dynamics that affected different parts of the city and to quantify them.
Methodology

The characterization of surfaces was carried out using Landsat MSS and TM datasets available for free from USGS archives (http://glovis.usgs.gov/) by QGis and SAGA Gis free/open source software. A total of four images acquired in different time (1975, 1988, 2004, 2011) were used to map urban sprawl and human activity impacts onto natural areas through a change detection analysis in the reference period. All data were referred to the WGS84 – UTM 45N reference system. The images were initially pre-processed (calibrated and atmospherically corrected) using a simplified radiative transfer model (RTM) described by Moran et al. (1992):

$$\rho_\lambda = \frac{\pi \cdot d^2 \cdot \left( L_\lambda - L_\lambda^{atm} \right)}{\tau_\lambda \cdot \left( \tau_\lambda \cdot \sin \beta \cdot I_\lambda + E_{down} \right)}$$

where $\rho_\lambda$ is the at-the-ground reflectance value, $L_\lambda$ is the at-sensor-radiance [W·sr\(^{-1}\)·m\(^{-2}\)·μm\(^{-1}\)] obtained by applying gain and offset values supplied with Landsat images, $L_\lambda^{atm}$ is the upwelling atmospheric scattered radiance [W·sr\(^{-1}\)·m\(^{-2}\)·μm\(^{-1}\)], $d$ the Sun-Earth distance coefficient (astronomical units), $E_{down}$ the scattered downwelling contribution (that we assumed equal to $\pi \cdot L_\lambda^{atm}$), $\tau_\lambda$ the atmospheric transmittance, $\beta$ the sun incidence angle (rad) calculated at each position (pixel) using a DEM and $I_\lambda$ the sun irradiance [W·m\(^{-2}\)·μm\(^{-1}\)]. Atmospheric correction was performed applying the Dark Object Subtraction approach (DOS – Chavez, 1996), to reduce atmospheric scattering. In order to minimize residual spectral differences among scenes of the time series, a further inter-calibration step was achieved. This very important step assumed that invariant surfaces, like buildings or other manmade structures, should maintain the same spectral behavior along time. We therefore identified some areas (well visible on all the images) having this peculiarity. Correspondent reflectance values were then extracted and compared by scatterplots. We assumed the 1988 scene as reference; other images were relatively corrected according to a linear regression model calibrated on the basis of the invariant pixels. Correlation coefficient values (Pearson) for all tested regressions was over 0.79. Efficiency of inter-calibration was tested by comparing residual reflectance differences of invariant pixels of different images with uncertainty reference values obtained by applying Variance Propagation Law (VPL – Borgogno-Mondino et al., 2016) to RTM. After the inter-calibration step we found that about the 99% of residual differences were lower than uncertainty thresholds (min. 0.022, max 0.041). Referring to corrected images, we focused on five classes (1 - urban areas, 2 - open canopy forest, 3 - close canopy forest, 4 - crop areas, 5 - water bodies), useful to describing soil sealing dynamics. To improve discriminability among classes some spectral indexes were derived from the original bands previously calibrated. The Normalized Differencing Vegetation Index (NDVI – Rouse et al., 1974), the Normalized Differencing Water Index (NDWI – Gao, 1996) and the Normalized Differencing Built-up Index (NDBI – Zha et al., 2003) were calculated and jointly considered with the original bands to calculate correspondent Principal Components (PC) by Principal Component Analysis (PCA). On screen image interpretation was achieved to select those components that better permitted to separate urban from other classes. Selected PCs were different for each image: PC1 and PC2 for 1975; PC1, PC2, PC3 and PC4 for 1988; PC2, PC3 and PC4 for 2004; PC2, PC3 and PC4 for 2011. A cluster analysis was achieved considering the selected PCs by K-means with 10 classes. Clusters were interpreted on screen to label the urban ones. Urban clusters were finally merged to generate a single urban class that we used to mask PCs stacks. This permitted us to operate a second cluster analysis (K-means, 4 classes) focusing on pixels other from urban. Mapped clusters were labelled referring to the average spectral signature of the assigned pixels. We finally obtained 4 LULC maps by merging urban with other classes. LULC maps accuracy was tested by confusion matrix comparing them with LULC maps.
e-agorā|e-ἀγορά for the transition toward resilient communities

from the Indian Space Research Organization (ISRO) available for the years 2006 and 2012. We randomly selected 300 ground control points for comparison. No reference data were available for 1975 and 1988 maps. We, therefore, assumed classification accuracy comparable to the one of 2004 and 2011. A change detection analysis was finally achieved comparing couple of successive images (1975-1988, 1988-2004, 2004-2011). For each period changes were mapped and labelled (“from-to”). Corresponding transition matrices were also generated to quantify the size of changes. Those areas where soil sealing occurred were interpreted to characterize urban sprawl dynamics. For this task we generated, from the obtained LULC maps, a Urban Density Map (UDM). Urban density was calculated using a sliding window of 150 x 150 m (5 x 5 pixels) running over the processed LULC map; at each position urban density was calculated as 100*(urban pixels/total pixels). We performed a new cluster analysis (K-means, 5 classes) using the 4 UDMs previously generated. Result was interpreted according to the average temporal profile of each cluster, permitting to remove from urban maps, those pixels probably representing bare soil erroneously classified as “urban”. A second cluster analysis (K-means, 4 classes) was finally achieved using cleaned UDMs, focusing on the remaining pixels. Four clusters of differently developed urban areas were finally mapped, permitting to interpret when, where and how urban development (therefore soil sealing) occurred in the area.

Results and discussion

LULC maps generated during the classification step showed an overall accuracy (tested for 2004 and 2011 images) of about 83%. Conversely vegetation classes (2, 3 and 4) show a not negligible class commission (averagely 18%). Commission concerns especially transitional areas (ecotones) and probably also depends on the different seasonality of compared data. Change detection achieved comparing classification results, brought to generate 3 tables reporting the size of changes and 3 maps locating the changes occurred in the considered periods. Since we investigated soil sealing determined by urban sprawl the main focus of this work was on the urban class. Table 1 demonstrates that built-up areas progressively expanded from 15.86 km² in 1975 up to 87.06 km² in 2011. The majority of soil sealing affected classes 2 and 4 (open canopy forest and crop areas) and was concentrated along the main road network, in the suburban areas and in the remaining empty spaces closed within the old city. A further reading of urban sprawl dynamics was based on UDM analysis. By classifying UDMs we recognized 4 different types of evolution suffered from different parts of the Ranchi city (figure 2). The one falling in the class called “city center” (C1) showed a progressive closure of remaining void spaces in the original city core and moved to saturation. The one labeled as “rather saturated” (C2) showed a rapid improvement (measured by the slope of the UD graph) in the period 1988-2004, pushing those areas to a rapid, saturation that in 2011, was almost reached. In areas belonging to classes ”Fringe type 1” (C3) and ”Fringe type 2” (C4) urban sprawl started moderately in 1988, and rapidly accelerated in the following period (more for Fringe type 2 class). These areas are the ones future planning politics should concentrate their attention on. By comparing the average class value of urban density with its standard deviation (assumed as proxy of uniformity of density within the class), it can be noticed that, for C1, standard deviation decreased continuously from 1975 up to 2011, suggesting that all empty spaces still remaining in the old city texture were filled by new artifacts increasing area homogeneity in terms of urban density. Conversely other classes showed a moderate
augmentation of standard deviation along years, suggesting that the urban expansion model adopted by the Ranchi municipality in new areas tended to a diffuse sprawl where buildings and spaces almost equally alternates.


<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – Urban Areas</td>
<td>13.49</td>
<td>0.06</td>
<td>0.23</td>
<td>2.05</td>
</tr>
<tr>
<td>2 – Open Canopy Forest</td>
<td>0.12</td>
<td>11.06</td>
<td>16.13</td>
<td>30.86</td>
</tr>
<tr>
<td>3 – Close Canopy Forest</td>
<td>0.17</td>
<td>33.13</td>
<td>99.11</td>
<td>61.74</td>
</tr>
<tr>
<td>4 – Crop Areas</td>
<td>16.20</td>
<td>35.51</td>
<td>28.61</td>
<td>1552.07</td>
</tr>
<tr>
<td>5 – Water Body</td>
<td>0.02</td>
<td>0.06</td>
<td>0.29</td>
<td>7.08</td>
</tr>
<tr>
<td>Total “before”</td>
<td>30.00</td>
<td>79.82</td>
<td>144.37</td>
<td>1653.80</td>
</tr>
<tr>
<td>1 – Urban Areas</td>
<td>28.32</td>
<td>0.09</td>
<td>0.23</td>
<td>1.35</td>
</tr>
<tr>
<td>2 – Open Canopy Forest</td>
<td>0.18</td>
<td>13.21</td>
<td>33.84</td>
<td>32.53</td>
</tr>
<tr>
<td>3 – Close Canopy Forest</td>
<td>0.40</td>
<td>7.50</td>
<td>113.44</td>
<td>22.84</td>
</tr>
<tr>
<td>4 – Crop Areas</td>
<td>31.31</td>
<td>42.81</td>
<td>63.94</td>
<td>1509.43</td>
</tr>
<tr>
<td>5 – Water Body</td>
<td>0.00</td>
<td>0.01</td>
<td>0.00</td>
<td>0.37</td>
</tr>
<tr>
<td>Total “after”</td>
<td>60.21</td>
<td>63.62</td>
<td>211.45</td>
<td>1566.52</td>
</tr>
<tr>
<td>1 – Urban Areas</td>
<td>59.12</td>
<td>0.01</td>
<td>0.01</td>
<td>1.06</td>
</tr>
<tr>
<td>2 – Open Canopy Forest</td>
<td>0.22</td>
<td>20.54</td>
<td>19.05</td>
<td>23.80</td>
</tr>
<tr>
<td>3 – Close Canopy Forest</td>
<td>1.24</td>
<td>6.73</td>
<td>147.01</td>
<td>56.47</td>
</tr>
<tr>
<td>4 – Crop Areas</td>
<td>26.33</td>
<td>44.23</td>
<td>50.30</td>
<td>1445.01</td>
</tr>
<tr>
<td>5 – Water Body</td>
<td>0.15</td>
<td>0.00</td>
<td>0.00</td>
<td>3.67</td>
</tr>
<tr>
<td>Total “after”</td>
<td>87.06</td>
<td>71.51</td>
<td>216.37</td>
<td>1530.01</td>
</tr>
</tbody>
</table>

Fig. 2. (left) Example of map (subset from the original) showing urban development occurred in the period 2004-2011. Black = unchanged urban areas; grey = new urban areas. Reference frame: WGS84 – UTM 45N. (right) Graph relating to the increment of build-up areas for the reference period.
Conclusions

This study demonstrates that soil sealing by urban growth heavily affected Ranchi in the reference period (1975-2011). Free satellite data from the Landsat space program proved, once more, to be effective in mapping land cover macro-classes. It also demonstrated that, if time series are used, some further discriminants can be added to improve results, and in particular mapping of urban areas. Classification results from multispectral satellite images, once processed with some specific zonal statistics (e.g. urban density map generation), can help to map city zones that suffered from different urbanization models. UDMs classes showed average temporal profiles similar to those expected from general population growth models, suggesting a direct relationship between urban landscape modification and population increment in urban areas. Change detection analysis proved that a drastic growth of the city started after 1988, first saturating the city center (class C1) and then moving towards peripheral areas that reacted differently (classes C2, C3 and C4). This general boost was probably related to the administrative independence of Jharkhand reached in 2000. From a quantitative point of view we found that in the Ranchi area, built-up class increased of about six times from 1975 to 2011. Fastest growth occurred after 1988. From that moment on the city center (class C1) continued with the same regular development started in the previous years and, in 2004, saturation was reached. New urban sectors started differently, moving from the center out. Urban growth proceeded not symmetrically, but followed some privileged directions. The first growing phase concerned C2 in the period 1988-2004, while a second phase slowly started in 1988 accelerating from 2004 on (classes C3 and C4). Looking at urban density standard deviation we could guess that the new phases of urban growth have a different built-up strategy (if compared with the older ones), where buildings are maintained more spaced, suggesting a “diffuse” city model.
References


Temporal variation of ecological network's structure: some insights on the role of Natura 2000 sites

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Key-words: Ecological network’s structure; Landscape fragmentation analysis; Natura 2000 sites; Calabria.

Introduction

Modelling an ecological network is key for analysing landscape connectivity and biodiversity preservation. Moreover, the diachronic analysis of ecological connectivity allows to highlight the changes in the landscape structure. Since landscape connectivity reflects a basic form of interaction between species and their environment, the modelling of ecological networks is currently an important issue for researchers and practitioners on the field of landscape management. In this work, we present the results concerning the implementation of two ecological networks, obtained by the same method on the whole territory of the Calabria region (Italy), and referring to years 1990 and 2012. We focus on the evolution of landscape connectivity developing a multi-temporal assessment that accounts for landscape evolution trends. Our main objectives are the analysis of ecological network’s robustness and the investigation of the role of landscape fragmentation interpreted through changes in spatial articulation of physical constituents (i.e., the different land uses) and qualitative constituents (distribution of habitats and bio-permeability quality classes).
Methodology

For the two reference years under investigation (i.e., 1990 and 2012) the respective ecological networks (ENs) have been built according to Fichera et al. (2010), who adopted the Functional Connectivity (FunConn) model (Theobald et al., 2006; 2011). FunConn is a toolbox working on ArcGIS® environment that allows to identify movement patterns and the landscape connectivity for each single faunal species under investigation.

As synthesized in fig. 1, the following base data were used: land cover (LC), i.e. the CORINE land cover at third level of detail; human disturbance (HD), modelled starting from built-up, road and railroad networks data (information about population density and road-railroad typology was taken into account); autecological information about the 87 target species selected. To obtain each EN, were implemented the steps reported in the following table (Table 1):

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Defining the habitat-quality (HQ) map for each of the 87 faunal species</td>
</tr>
<tr>
<td>2</td>
<td>Defining the overall HQ map</td>
</tr>
<tr>
<td>3</td>
<td>Defining functional patches (FPs)</td>
</tr>
<tr>
<td>4</td>
<td>Connecting all FPs taking into account landscape bio-permeability (BP) to the animal movement and the human disturbance (HD) sources</td>
</tr>
</tbody>
</table>

HQ ranges between 0 and 100, i.e. from unsuitable to optimal habitats. For each target species, HQ calculation requires the definition of the following parameters (Table 2):

<table>
<thead>
<tr>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource quality obtained indexing each land cover (LC) class ranging from unsuitable to optimal habitat, and based on habitat preferences of each target species</td>
</tr>
<tr>
<td>Functional patch structure that accounts for the so-called ‘edge effect’ by evaluating proximity to patch edge to define suitable areas</td>
</tr>
<tr>
<td>Distance from the human disturbance (HD) sources</td>
</tr>
</tbody>
</table>

The overall HQ maps (i.e., a multi-species habitat quality surface) is obtained by means of a weighted sum taking into account the different ecological importance of the target species. In more details, the inclusion of target species in a Site of Community Interest (SCI) of the so-called Natura 2000 European network, as well as in the IUCN Red list of threatened species, determines a different weight for those species in obtaining the overall HQ map. The delineation of functional patches was based for each organism on the minimum foraging requirements and on the ability to move among different patches (Girvetz & Greco 2007). The overall HQ map and two main organism-specific parameters guide this process: maximum foraging radius and minimum patch size. The maximum foraging radius is a measure of how far target species move seeking out forage while the minimum patch size represents the smallest biologically relevant patch size for each of the target species selected. In defining the two ENs that are not species-specific but multispecies (Fichera et al., 2015), the maximum foraging radius has been imposed at 100 m (corresponding to the minimum foraging radius of the target species) while the minimum patch size...
size at 10 ha. Moreover, in the 2012 EN, the obtained FPs were integrated with the SCIs boundaries that are designed in Italy since 1997. As a result, we obtained a network of integrated patches (IPs). The last step is the generation of the landscape network that represents the habitat patch connectivity. The resulting EN consists of nodes, patches (i.e., functional patches), edges, linkages, and corridors (designed taking into account the landscape BP to the animal movement). In order to investigate the occurred changes in the spatial configuration of the two defined ENs, the landscape fragmentation was analysed by means of the free software Guidos v2.5 (Vogt, 2016). Moreover, to highlight the EN’s robustness, the spatial comparison of the two ENs was performed by means of the free software Conefor v2.6 (Saura and Tomé, 2009). To this end, the number of nodes and core areas as well as the overall index values (OIVs) and the Betweenness Centrality (BC) were analysed.
Fig. 1. Logical schema of the proposed methodology aimed at the spatial analysis and comparison of the two ecological networks (ENs).
Results and discussion

For both ENs, gradient of landscape fragmentation was calculated on the following landscape indexes calculated as a function of spatial entropy (Shannon, 1948; Vogt, 2016) and mapped as binary data (Table 3):

<table>
<thead>
<tr>
<th>Landscape index</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bio-Permeability (BP)</td>
<td>Areas with BP&gt;66 that represent the priority areas for the construction of</td>
</tr>
<tr>
<td></td>
<td>the ecological network’s (EN) corridors</td>
</tr>
<tr>
<td>Habitat Quality (HQ)</td>
<td>Areas with HQ&gt;66 that represent territories most suitable to wild fauna and</td>
</tr>
<tr>
<td></td>
<td>under the lower effect of the human disturbance</td>
</tr>
<tr>
<td>Functional and Integrated Patches (FP &amp; IP)</td>
<td>Core areas of the two ENs that represent the structural elements of the</td>
</tr>
<tr>
<td></td>
<td>reticular systems (i.e., FPs on 1990 and 2012 ENs and IPs on 2012 EN)</td>
</tr>
</tbody>
</table>

Subsequently, landscape fragmentation was analysed by means of the morphological spatial pattern analysis (MSPA) (Vogt et al. 2006; Soille et al. 2009) that allows to qualitatively describe the fragmentation through the morphology of its different constituents: core, islet, perforated, edge, loop, bridge and branch. The results of the analysis of the landscape fragmentation process are synthesized in Fig. 2. The data comparison shows a slight increase in HQ 2012 that denote a greater aggregation of the constituent elements, while a slight decrease in BP 2012 can be linked to the raise of small disjointed portions of landscape patches. On the other hand, particularly interesting appears the analysis of the different patches (FPs and IPs) that represent the core areas from which the two ENs are built. In addition to the progressive decrease of the fragmentation values linked to the increase of forestry areas from 1990 to 2012, it is evident that the integration of the SCIs in building the 2012 EN is able to improve significantly the compactness and the spatial distribution of the core areas on the study area. Referring to the analysis of ecological network’s robustness, the main characteristics of the two ENs as well as the most significant graph indices were reported in Fig. 2. Evidence shows a general decrease in the connectivity levels in 2012 and a general consistent rearrangement of the components towards a more disjointed structure. An insularisation process can be inferred analysing the high increase (from 1 to 8) of the NC index. Moreover, the increase of BC describes the tendency to construct clusters including a higher number of patches that act as bridges and provide short-cuts.

Conclusions

Starting from the analysis of the recent land-use dynamics occurred in the study-area, we scrutinised the performance and changes of the landscape connectivity from 1990 to 2012 comparing the two different ENs. This is a step of a multi-temporal analysis that showed its significant role in the sustainable landscape planning. Moreover, several future research directions are outlined: the analysis of intermediate years, a deepening on the dynamics of fragmentation and their effects on landscape connectivity, and the impact of new built-areas.
Fig. 2. Synthesis of the landscape fragmentation analysis performed on functional and integrated patches (FPs and IPs), habitat quality (HQ) and bio-permeability (BP). Below, the ecological networks’ main characteristics (number of core areas and nodes) and Graph indices (Overall Index Values – OIV - and Betweenness Centrality - BC) and the network graphs were reported.
References


Reducing land take and preserving land quality. A methodology for the application of the Lombardy Regional Law

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Key-words: land take, land use planning, GIS, Composite Index.

Introduction

Land take is a process of change of natural and semi-natural land taken by residential, industrial, infrastructure, service and other development (Zoppi et Lai, 2014). This change causes the irreversible conversion of un-built land to urban use and leads to a progressive soil and landscape degradation. The land take in Italy continues to grow, with a slight slowdown in the last few years (ISPR, 2015), although its quantification at the regional level is problematic because of the non-homogeneity of geographic information (CRCS, 2012).

The growing awareness about the destruction of a non-renewable resource led to new laws and regulations addressing the problem, and to achieve the EU objective of zero land take by 2050 (European Union, 2013).

The need to measure on one hand the quantity of the land take and, on the other, the quality of the land taken is a hard challenge (Salata et Gardi, 2015; Song et al., 2015).

In this context, Lombardy Regional Law n. 31/2014 “Measures for the reduction of land take and for the rehabilitation of degraded land” has been approved. This law requires municipalities to develop the land take map in order to investigate land quality describing the degree of agricultural use, as well as pedological, naturalistic and landscape peculiarities. This should help achieving the goal of reducing land take and preserving land quality.

According to Lombardy Regional Law n. 31/2014, the Regional Territorial Plan (PTR, Piano Territoriale Regionale) defines the general contents of the “quality map of un-built land” to be prepared by each municipality.

The goal of the present work was to develop a common methodology that could be used by all the municipalities in Lombardy for the redaction of the “quality map of un-built land”. The methodology should identify a quality index for each territorial unit inside the municipal boundary that can be appropriately aggregated and weighed to calculate a composite index.
Methodology

The goal of the work was to calculate the Land Quality Index (LQI) by the sum of four indexes, one for each aspect defined by the law (pedology, nature, landscape, agriculture). The methodology was developed following four basic steps: 1) available information gathering, 2) data selection, 3) assessment and index calculation, 4) methodology application.

1. Available information gathering.

The phase of searching for available information was fundamental for the general applicability of the overall methodology. The data have to be:

- official,
- readily available,
- with an adequate detail and scale for the municipal level.

All the data potentially interesting for the aim of the present work come from official databases at Regional or Provincial level; most of them can be downloaded from the geo-database of Lombardy Region. All the data have been collected and organized in a Geographical Information System (GIS), using ESRI ArcGIS software (v. 10.1).

2. Data selection

The information collected has been reviewed several times in order to discard the less reliable and to avoid any duplication.

The data selection has been done following four criteria:

- availability of information,
- clear interpretation and classification,
- date of update,
- detail and scale.

3. Assessment and index calculation

This phase had the aim to define how to aggregate and weigh the different data in order to calculate single and aggregate scores. The criteria used for this assessment aimed to give great value to the land with a higher quality: higher scores always correspond to higher quality and higher land protection.

This phase led to the definition and calculation of four indexes, each with a value in the [0-1] interval. Each index represents one of the aspects defined by the law: pedologic (IPed), naturalistic (INat) and landscape (ILand) peculiarities, and the degree of agricultural use (IAgr).

Land Quality Index (LQI) was obtained by the sum of the 4 indexes.

4. Methodology application

The methodology has been applied to the municipality of Passirano (Province of Brescia), located in Franciacorta, which is one of the “experimental zone” of the Lombardy’s PTR.

Results and discussion

The following maps (Fig. 1 to 4) show the four indices: (IPed), (INat), (ILand) and (IAgr). The Land Quality Index (LQI) has been calculated for each territorial unit (Fig. 5), without giving a further weight to each aspect, following the formula:
e-agorà|e-ἀγορὰ for the transition toward resilient communities

\[ LQI_{[0-4]} = \frac{(IPed_{[0-1]})+(INat_{[0-1]})+(ILand_{[0-1]})+(IAgr_{[0-1]})}{4} \]

Fig. 1. Index of pedological peculiarities (IPed).

Fig. 2. Index of naturalistic peculiarities (INat).

Fig. 3. Index of landscape peculiarities (ILand).

Fig. 4. Index of agricultural use (IAgr).
LQI could be used to incorporate a “quality weight” in the quantitative threshold of land take, giving a reduction of the land take allowed proportional to the quality of the land. LQI could also provide a quantitative reference for an eventual “environmental compensation” of urbanization.

**Conclusions**

The methodology developed for the application of Lombardy's Regional Law n. 31/2014 allowed the calculation of the Land Quality Index (LQI) that gives a value to each piece of land according to its soil characteristics, natural and landscape peculiarities and the degree of agricultural use. LQI has been calculated in order to combine pedologic, naturalistic and landscape peculiarities, and the degree of agricultural use, as required by the law. The application to the Municipality of Passirano shows how the methodology can be used with the data available. Application to other different study areas is needed in order to check the possibility to use the methodology for all the municipalities of the Lombardy region.

**References**


Introduction

GIS tools and spatial analysis techniques have already proved to be effective in urban planning and landscape description. In the last few years potentialities offered by the continuously improving GIS technology and amount of available digital georeferenced data have encouraged the adoption of multi-criteria spatial analysis to support land planning (Malzewski, 2006). Highly populated peri-urban areas are critical for different aspects such as urban sprawl, soil sealing and degradation and, in general, loss of ecosystem services (Antrop, 2004). Landscape metrics represent a widely employed tool to characterize either planned (Weng, 2007; Aguilera et al., 2011; Frondoni et al., 2011) and unplanned urban areas expansion (Kuffer and Barros, 2011). In some works metrics have been integrated with remote sensing data (Herold et al., 2005) and with socio-economic proxies (Irwin and Geoghegan, 2001; Schwarz, 2010). In spite of this wide literature in most cases GIS tools are used to generate mere representations by integrating data deriving from different sources. Some others, conversely, present GIS-based applications where representation is integrated with quantitative concerns looking for a major objectivity in landscape reading and future planning (Borgogno-Mondino et al, 2014, 2015). In this context maps become measurement tools for planners and policy makers to support their decisions with numerical data. It is authors’ belief that, if we have to select among different planning solutions proposed by technicians, a numerical approach, standardly adopted to generate those solutions, can drive us to the best practices. Within such scientific context this work proposes and tests a landscape analysis approach based on GIS advanced tools specifically aimed at urban dynamics description and planning. The case study concerns the first urban belt of Turin (NW Italy) within an area characterized by the permanence of historical, valuable farmhouses surrounded by agricultural pertinences which are prevalently disused at present. The erosion of traditional rural landscape and the pressure on farmhouses due to urban expansion after the World War II are especially evident on the North-Western fringes of the settlement. Around the half of the XXI century radical changes deeply modify the urban frame starting from the second half of the last century when greatest engineering industries and automotive factories (Pininfarina, Bertone, Westinghouse, etc.) settling in this area. Building activity frenetically increases as well: residences, infrastructures, industrial and commercial firms assault or cancel canals and trails, rural buildings and productive fields. Some historical farmhouses progressively turn to dereliction and rural landscape gets more and more unreadable up to now.

Procedure relies on the idea that urban growth dynamics in respect of rural areas can be assimilated to a balance between opposite forces where urban growing pushes against rural. Strength and direction
of forces depend on a difference of “potential”. In order to represent the field of forces operating in a certain period, it's necessary proceeding to preventively define the potential associated with each compared time. We assume as positive the potential associated to the rural areas’ resilience towards urban growth, and as negative the one related to urban pressure against the rural ones. Based on digitized and georeferenced historical and present maps, the proposed procedure operates according to the following steps: a) identification and vectorization of territorial features that are retained to define the local (positive and negative) potentials; b) formalization and implementation of appropriate space dependent functions for potential representation at each considered time; c) change detection aimed at mapping the changes occurred between 1968 and 1992, according to the available cartographic sources; d) interpretation of changes and representation of the “field of variation” of urban textures in respect of rural surroundings; e) proposal to adopt the procedure for scenarios’ simulation of future planning ideas. This methodology can help planners to evaluate and quantify (both in strength and direction) the driving forces of urban growth, i.e. to represent a field of variation where urban-to-rural pressures are evident in order to be effectively oriented or corrected by future planning choices.
**Methodology**

Procedure was tested using a) the Regional Technical Map 1:10.000 (hereafter called CTRN_10K) available from the free online geodatabase of the Piemonte Region Map Service (http://www.geoportale.piemonte.it/cms/). It portrays the investigated area in 1992 and has been supplied in vector format in the UTM 32N WGS84 reference frame; b) the 1:25.000 scale map by Italian Military Survey Service (IGM, Istituto Geografico Militare) dated 1968 (hereafter called IGM_25K). The latter has been supplied as paper copy (2 sheets, respectively named 056 III-SE (Torino) and 056 III-SO (Rivoli)) referred to the Italian National reference frame GAMS-BOAGA. Data processing has been achieved availing of the free GIS tools available in QGIS 2.8.8 and SAGA GIS 2.2.X. Pre-processing operations have concerned: a) hard copies digitization by scanner (300 dpi); b) georeferencing of images by a 2nd order Polynomial transformation (16 GCPs, RMSE = 5.3 and 4.6 m respectively for the two scanned maps); c) georeferenced image mosaicking to recover a unique representation. The second step concerned the selection from maps of those information being considered to represent local potential. This is a crucial point of the workflow since landscape experts, surveyors, and policy makers has to meet in order to define criteria to base following actions. In the procedure here applied the selected information must be derived from the available maps in order to guarantee a spatial representation. From each of the two compared maps (1968 and 1992) we have extracted elementary and simplified information: two layers representing anthropic features (“roads” and “buildings”) and one layer representing the semi-natural (“open-land”) ones. The formers were labeled as “urban growth potential factors”, the latter as “rural resistance potential factor”. Features’ selection has been achieved by a simple query for the vector CTRN_10K map, while it has required a preventive vectorization for the IGM_25K raster map. Finally, the following vector layers were available for both the periods: buildings (BUI, polygon layer), Roads (ROAD, polyline layer), Open land (LAND, polygon layer). We filled attribute tables of layers with a numerical code representing a weight, supposed to come from the above mentioned experts, aimed at somehow quantifying the urban potential (ROAD and BUI layers) threatening rural areas and the resistance potential that rural areas can oppose to urban (LAND layer). For instance a higher weight was assigned to industrial areas since they reasonably represent a higher threatening potential respect to the rural context than residential ones. Weights, once assigned, can be used to compute and represent in shape of raster maps different space-dependent indexes aimed at measuring the distribution of the resultant local potential. Where threatening potential prevails over resilient one, i.e. built-up features dominates open spaces, local potential is negative, otherwise positive. Local potential can vary with continuity within a range of values. For each compared time (1992 and 1968) a “local potential function (LPF)” was generated by raster calculation according to (1).

\[
LPF(x,y,t) = \left[ a_1 \cdot LAND(x,y,t) \right] - \left[ a_2 \cdot ROAD(x,y,t) + a_3 \cdot BUI(x,y,t) \right]
\] (1)

where \( LAND(x,y,t) \), \( ROAD(x,y,t) \) and \( BUI(x,y,t) \) are the raster maps of indexes generated from the vector layers and \( a_i \) numerical coefficients that can be tuned to calibrate the relative importance given to each factor of eq.1. \( LAND(x,y,t) \) was obtained by direct rasterization of the correspondent polygon layer, in respect of the “weight” field of its attribute table. \( ROAD(x,y,t) \) and \( BUI(x,y,t) \), conversely, were generated taking care of both horizontal distance from the nearest feature and its weight. Allocation and distance spatial operators, available in SAGA GIS software, were used for this task. It is worth to remind that Allocation grid, \( A_i(x,y,t) \), contains for each pixel (whose size is defined by the operator) the value of the reference attribute (i.e. weight)
corresponding to the nearest feature (road or building). The Distance grid, \( D_{i}(x,y,t) \), contains for each pixel the value of the Euclidean horizontal distance that separates that location from the nearest feature. \( ROAD(x,y,t) \) and \( BUI(x,y,t) \) were generated from \( A_{i}(x,y,t) \) and \( D_{i}(x,y,t) \) according to (2). Under these hypotheses: a) the contribution of the considered factor decreases while increasing the distance from the nearest feature; b) its initial (and maximum) value is the one corresponding to the weight of the nearest feature. Constant values (1000 and 10) and the \( \text{INT() operator} \) were just introduced to exclude numerical problem during index computation. \( I(x,y,t) \) is the generic index map obtained for the two observed times from the related allocation and distance grids.

\[
I(x; y, t) = \text{int} \left[ \frac{1000 \cdot A_{i}(x, y, t)}{D_{i}(x, y, t) + 10} \right] \tag{2}
\]

Since weights can refer to different scales depending on the layer, before applying (1), we normalized all factors to a common scale by statistic standardization. All index maps are space/time dependent. In the computation of LPF we assumed the rural resistance potential as positive and the urban growth one as negative. Such definition can be easily interpreted since it clearly separates those factors that are “usually” protecting rural landscape (sign +) from those “usually” threaten it (sign -). Finally, landscape changes were mapped by comparing \( \text{LPF}(x,y,1968) \) and \( \text{LPF}(x,y,1992) \) by grid differencing (3):

\[
D(x, y) = \text{LPF}(x, y, 1992) - \text{LPF}(x, y, 1968) \tag{3}
\]

\( D(x,y) \) is a new raster map showing how changing forces (potential difference) acting onto the rural landscape from urban operated in strength and direction in the reference period. Positive value of \( D \) mean that rural areas have improved; conversely, negative values of \( D \) mean urban prevailed against the rural texture. Since we aimed at generating some valuable representations in which both technical and communicative aspects could be equally and effectively perceived by the planners, starting from \( D(x,y) \), we have mapped changes based on vector format where strength and direction of urban growth forces against rural areas can be easily observed. This is an effective and immediate representation of the change spatial distribution coupling it with the direction and strength of the urban growth forces which have been acting in the reference.

**Results and discussion**

During \( \text{LPF}(x,y,t) \) computation a fundamental role was played by the index maps \( ROAD(x,y,t) \), \( BUI(x,y,t) \) and \( LAND(x,y,t) \). The weights of table 1 have been assigned to layers to measure contribution of each feature to final potential (positive and negative). They were arbitrarily assigned by authors to exemplify the proposed procedure. Maps have been generated with a cell size of 30 meters and weighting parameters of (1) have been set to 1.
Tab. 1. Weights that have been assigned to features belonging to the “roads”, “buildings” and “open-land” vector layers extracted from the original maps used for simulation.

<table>
<thead>
<tr>
<th>Layer</th>
<th>Feature type</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>roads</td>
<td>Main roads</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Secondary roads</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Service roads</td>
<td>1</td>
</tr>
<tr>
<td>buildings</td>
<td>Industrial</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Residential</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Historical</td>
<td>-1</td>
</tr>
<tr>
<td>open-land</td>
<td>Crop field</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Meadows</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>other</td>
<td>1</td>
</tr>
</tbody>
</table>

By raster calculation (1) we have balanced positive and negative potentials for the two times (1968 and 1992) generating the corresponding LPF(x,y,t) maps (figure 1 - left). LPF(x,y,1968) and LPF(x,y,1992) have been then compared by grid differencing to generate D(x,y), showing the field of forces that urban operated against rural in the reference period. Finally we down-sampled $D(x,y)$ to a geometric resolution of 90 m, $D(x,y)_{90}$ to reduce the level of detail for the successive step aimed at representing the field of forces in the reference period.

![Fig. 1. (left) LPF(x,y,1992) defining the landscape rural resistance potential in the study area in 1992 ($a_1 = a_2 = a_3 = 1$). (right) Potential difference map, $D(x,y)$. D profiles should provide evidence of occurred changes along the defined transect.](image)

$D(x,y)_{90}$ has been converted back to a vector point layer. Direction and size of vectors exiting from each point of the newly generated vector layer, and representing the local force of urbanization, have been obtained from $D(x,y)_{90}$ interpreting it as a three dimensional surface. Therefore it has been processed by geomorphological operators available in Qgis, to generate correspondent slope and aspect grid maps (90 m cell size). Slope has been assumed as strength of the local force, while aspect as direction. Intersecting the point layer from $D(x,y)_{90}$ with slope and aspect grids, we have transferred local value of slope and aspects to each point in shape of attribute. Using
ordinary tools for vector map visualization management of Qgis, we’ve finally generated the map of forces shown in figure 2.

![Fig. 2. Landscape change map showing the direction and strength of acting forces.](image)

Conclusions

GIS advanced tools shows to be powerful tools to represent urban-to-rural landscape dynamics. The “potential and forces field” interpretation of changes based on space-dependent index maps has allowed representing the local importance urban growth and rural resistance potentials. LPF represents, at the generic time, the degree of threat that rural landscape suffers from urban growth. By differencing LPF of the two compared times (1968 and 1992), it has been possible mapping both local strength and direction of changes. If the compared situations are referred to the past, information concern past dynamics. On the contrary, if the same approach is adopted comparing the present situation with a planned future one, the information we get can be used to evaluate the limits and potentialities of proposed solutions, giving planners a further tool to check their interventions and eventually re-calibrate them. Nevertheless some limitations can be easily recognized: firstly, the proposed methodology is based on simplified hypotheses mainly related to index formulas. A second limitation dials with the persistence of subjectivity during both the selection of territorial factors to be considered and weights assignation. Only collaboration among technicians, policy makers and citizens can drive to make this point a strength in place of a weakness.

References


The bioremediation of polluted areas as an opportunity to improve ecosystem services

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Key-words: LUC, Ecosystem service, Spatial Multicriteria Analysis, Scenarios Comparison, Wildlife impacts.

Introduction

The intensive urban development characterizes the European context, demonstrating existing dynamics generally oriented toward the increasing of urban population in cities and in the coastal areas, and the reduction of rural landscape (abandonment, underutilization, deterioration, pollution, inappropriate utilization, etc., of agricultural areas and marginal lands). The main impact of such dynamics is the loss of territorial maintenance and the phenomenon of land abandonment (landslides, burning, wastes disposal, together with socio economic degradation). This land downgrade, despite it not, necessarily, correspond to a severe soil pollution, could impulse to a land requalification, basically based on a land use change, passing from intensive agricultural use toward no-food cropped areas or (if possible) areas for recreational use. European Community policies, jointly with industrial stakeholders in the field of the biomass production, could be an important support such conversion. Due to the use of decision support software, the gradual evolutions of land use change (LUC) scenarios are conceivable. Scenarios comparison will be based both on a productivity criterion and on the evaluation of Ecosystem Services (ESs). ESs indeed provide better condition for human well-being, qualitative livelihoods and efficiency for the human habitat (Costanza, 1997). Since the Millennium Ecosystem Assessment (MEA, 2003 and 2005) scholars consider ESs an essential topic for improve urban and peri-urban resilience and a key concept for updating the planning framework. Moreover ES are useful tools for the assessment of planning policies and of the outcome of the EU funds.

In Campania Region (Southern Italy), both PON Biopolis and the European LIFE/ENV/IT/275 Ecoremed projects work for providing scientific proofs in the using of no food crops to prevent marginalization or abandonment in large areas. In such framework the aim of the study is to find out a set of consistent scenario for testing the impacts of LUC for such widespread polluted areas that could become an opportunity for a positive change of the ESs values, improving the biodiversity of the territory. The here presented evaluation, made through the ESs approach are now under comparison with the first results of
e-αγορά for the transition toward resilient communities

the LUC on the ecological networks and local wildlife.
Methodology

The methodology entailed five steps:

**GIS Inventory**

GIS inventory has been prepared with basic layers of information (DEM, land use, Corine Land Cover, environmental constraints, national and regional protected natural areas, SCI and SPA, rainfall, administrative limits, hydrographic network, road and rail networks, etc.). All these layers were collected in the framework of the PON Projects Biopolis and LIFE Ecoremed, have been optimized and implemented for the purpose of the present work. For this study, more detailed map has been considered and mainly the maps of soil characterization for 25 chemical elements derived from more than 2000 samples on a 5 * 5km mesh (De Vivo et al., 2006). The knowledge of the territory, integrated by satellite images to improve land cover, is considered comparable to a conventional research scale of 1: 100,000 (Pindozzi at al., 2016).

**Scenarios building**

The most possible land use change (LUC) has been sorted out basing on the construction of suitability map, with the use of GIS tool and decision support software (ArcGIS/ILWIS) and a multicriteria approach (Malczewski, 1999 and 2006; Saaty, 1980 and 2005); environmental and socio-economic factors were considered as well. Three scenarios are built up through multi criteria analysis: 1. Scenario zero, current conditions or scenario in which it is not expected LUC; 2. Scenario Fringe of abandonment, in which a downgrade is supposed, depending on unfavorable environmental conditions or bad localization; 3. Scenario Fringe No-Food, in which it is realistic to assume a LUC, these areas are converted to no-food crops.

**Ecosystem Service assessments**

Ecosystem services can be understood as the contribution of eco system structure and function – in combination with other input – to human well-being. The importance ("value") of ecosystems and their services can be expressed in different ways. In this paper, we refer to the economic value of ESs, in order to quantitatively compare LUC scenarios processed. Many studies provide a monetary evaluation for ES related to specific land use/ land cover. The assessment approach is a tailored version of benefit transfer method (Costanza et al., 1997 and 2008), where the value of each land use polygon is referred to its area, the ES value (€/years) of land use class, a coefficient of context variables. Starting from the literature review (de Groot et al., 2002 and 2010; Fisher et al., 2008; Scolozzi et al., 2012), the monetary values used in this paper, have been standardized for euro per hectare per year, and updated in 2014 (Table 1).

<table>
<thead>
<tr>
<th>Assessment classes</th>
<th>Fresh-water</th>
<th>Cropland</th>
<th>Pastures</th>
<th>Forest</th>
<th>Rock</th>
<th>Urban</th>
<th>Urban green</th>
<th>Fresh-water wetland</th>
<th>Herbaceous ground cover in orchard (by authors)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monetary values (€/ha per years)</td>
<td>3290</td>
<td>1980</td>
<td>126</td>
<td>6060</td>
<td>-</td>
<td>-</td>
<td>5557</td>
<td>18,196</td>
<td>2106</td>
</tr>
</tbody>
</table>

A new classification item - herbaceous grand cover in orchard - was added due to the need of verify the specific bio-remediation solution developed within the LIFE-Ecoremed project. Starting from a general awareness of the territory driving forces, alternative ES values have been
assessed using literature data going from no-change to energy crops (Poplar, Eucalyptus, Giant reed, Thistle) or to abandonment scenario.

**Wildlife impact assessment**

Firstly possible wildlife impacts have been evaluated basing on "umbrella species" approach, starting from the species identified in the list of SCIs and SPAs (EU dir. Habitat), within the area of study. For each selected species the potential spatial distribution map has been developed (according to their etho-ecological characteristics and their degree of sensitivity to the expected LUC) to assess the impact by hypothesized intervention scenarios. Evaluation have been incorporated with a typical approach used for environmental impact assessment, extended to a broader sample of species (over 300) than usual, and based on faunistic indexes proposed by M. Sacchi (in preparation). Indexes considered are: Habitat Index (indicates the suitability of a territory for a considered species); Conservation Index (represents the species importance from conservation point of view) (Cramp and Simmons, 1977, 1980, 1983, 1985, 1988, 1992, 1993, 1994 a, 1994b). The system proposed employees the use of matrixes functional to the computation of numerical values indicating improvement or worsening of wildlife component.

**Driving forces**

In addition to the potential Driving Forces resulting from internal (increase in the productions value) or external factors (incentives/subsidies to increase ES or LUC), it is well known the interest of some operators (i.e. industrial stakeholders interested in the thistle chain or other non-food crops).

**Results and discussion**

**GIS Inventory**

The identification of Fringe areas (i.e. degraded areas that are the most likely to LUC) is in part derived from GIS inventory. Only considering the areas in the so called "Land of Fire", there are more than 10,000 hectares that, thanks to their unfavorable environmental conditions, could be abandoned, consequently to the negative media campaign. Furthermore deterministic analysis (focused on land use, slope and height) has highlighted other 80,000 hectares, aggregated in 8 districts, in the Apennine areas (figure 1).

**Scenarios analysis**

The suitability map has been sorted out basing on probabilistic analysis. Each grid of the map is the suitability value for the LUC, estimated to the whole territory of Campania region. In the case of the multi criteria analysis, 16 layers/criteria have been selected and then organized as: constraints, environmental factors, socio-economic factors, location factors (figure 2). About 120,000 hectares have been sorted out, spatially allocated on 12 districts (figure 3) and considering only the Land of Fires, the Fringe areas have increased their value to approximately 16,000ha. In the abandonment scenario, land use classes of permanent crops are down scaled into "Land principally occupied by agriculture"; the classes "non-irrigated arable land" and "land principally occupied by agriculture" become "pasture"; "natural areas" or "semi-natural areas" are converted into "Sparely vegetated areas", "Burnt areas" are now classified as abandoned land and "bare rocks". In the "No-food crops" scenario the non-irrigated arable land in the Apennine areas are converted into thistle, rapeseed and giant reed whereas in the "Land of Fire" the conversion supposed for the same LU class is into Eucalyptus; orchards do not change but it was supposed a coverage with grass. Lastly the remaining areas are supposed to be converted into giant reed, black poplar or eucalyptus, depending on soil water availability index value for agricultural purposes.
**Scenarios assessment using ES support tool**

Scenarios assessment is possible only considering the variations of ES provisions compared to that of current land use. In Scenario 0 for the whole Campania region, total ES monetary value is of 4000 M €, with an average value of about 2800 € / ha. With deterministic approach, it has been supposed a change of land use into non-food crops of around 6% of the entire region. Such a conversion would result in an increase of 55% in the value of ES supplied considering only the marginal areas, and an increase of 2% for the entire region. With the probabilistic approach, it was assumed a change of land use into non-food crops of around 9% of the entire region. This conversion would lead to an increase of ES that is of 86% for the marginal areas and of 6% if the entire region is considered. Lastly with “Fringe areas – abandonment scenario” a decrease in the provision of ES down to 70% for the marginal lands has been supposed. The decrease considered to the whole region would be of ~5% of previous value.

**Impacts on the Wildlife**

The impact on wildlife, obtained from the spatialization of 14 "umbrella" species habitats has highlighted the risk of the creations of new habitats suitable not only for the protected species but also for invasive species (i.e. wild boar and fox). Such an eventuality requires the development of appropriate wildlife-territorial strategies. Limiting to “Land of Fire” zone, results assess better conditions for most of the species involved. Especially in the case of “Fringe Areas - No Food crops scenario”, high values for reptiles and also excellent value for mammals and amphibians have been resulted. For the birds lower values have been assessed, but sufficiently moved to an advantageous situation.

**Driving forces**

Results show an increase of the ES value especially considering "fringe areas", both in case of a private and public action, also referring to the opportunities for farmers income in the short and medium-long period. Finally the study develops the case of a private investment for more of 15,000 ha converted into Thistle (Carduoideae) crop aimed to marginal lands reclaiming for biopolymers, nutraceuticals and feed productions in order to compare socio economic benefits with environmental ones.

**Conclusions**

The bioremediation of polluted areas can be considered also as an opportunity to improve ecosystem services and a chance for territory revitalization. The progressive land abandonment,
if properly driven, will led to an increase of the ES value during the time, quantified in more than 2% compared to the small percentage of regional territory involved.

With the small intervention of appropriate public incentives/subsidies (no-food crops conversion, recreational areas, etc. etc.) the provisions of ES could increase up to 6%; it is unrealistic to assume that all of the LUC for energy crops could be realized, but even if only a part of that potential LUC is realized (for example in a percentage of the “fringe areas” of SCENARIO 2) it could give an important contribution to renewable energy portfolio, to farmers’ income and to public benefits. Fringe Areas – No Food Crops scenario will correspond to a reduction of the value of the agricultural land and of the farmers’ income. This reduction correspond to an increase of the social benefits, quantified by the increase of the ecosystem services: the increase is in the order of the decrease for the farmer. In absence of public action, the scenario will be the abandonment, in which it would be observed a reduction of both farms and ES values. In this last case it would occur land degradation, soil loss and in some case, for natural or anthropogenic contaminated soils, the population will be more exposed to health risks because of pollutants mobilization (for runoff, with transport wind, leaching, etc.). Another aspect to be considered is related to the LUC impact on the wildlife network. The possible ecological LUC impacts have to be assessed, because of the complexity of the interactions and because of limitations in current understanding of the dynamic properties of ecosystems. For the wildlife possible evolution tends toward a more favorable habitat, if framed within proper planning strategies devoted to the individuation and management of ecological networks hedges, patches of deciduous groves and / or deciduous trees, thinning, etc.). Best strategies have to be aimed at maintaining a physical-territorial continuity and eco-functional between the natural environment, the creation of systems that could improve the species mobility, defend from isolation and guarantee a suitable gene flow between populations in order to safeguard biodiversity.

References


Landscape Bionomics: A Comparison Between Two Rural-Suburban Landscapes from Brussels and Milan

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Key-words: Landscape Bionomics, Landscape Ecology, Ecological Planning, GIS.

Introduction

The idea of the present study derived from a meeting at the University of Leuven discussing on “landscape interfaces” with Hubert Gulink, Ingegnoli and Marcheggiani. The reference discipline was the Landscape Ecology, applied to a twin set of cases showing indeed many similarities from Asbeek/Asse in Belgium and Bollate in Lombardy and from Brabant and Brianza. These correspondences outstand both geographically and historically speaking. The aim of this international research is twofold. One side, a more specific goal was to comprehend more than two centuries of transformation dynamics of the structure and functions occurred within the landscapes of both suburban areas. Secondly, we aimed to ground territorial evidences of the effectiveness of such innovative approach to land planning, widening its implementation over a pool of real cases across Europe. The key finding of our experiment is the possibility to overtake dominant ideology in planning which opposes “form” and “content”, enriching the analyses with a comparative method of landscape diagnosis, helping decision makers to choice alternative scenarios basing on indices and metrics deemed of a higher readability, not only for ecologists but also for practitioners, planners and policy makers.
Methodology

The study followed the Landscape Ecological discipline (Naveh & Lieberman, 1984; Forman & Godron, 1986; Finke, 1971) in the form proposed by Ingegnoli (2002, and Ingegnoli & Giglio, 2005) as “biological integrated”, recently named Landscape Bionomics (Ingegnoli 2011, 2015). This school of landscape ecology is based on the recognition that the complex adaptive system of the landscape is a proper level of biological organisation, so much more than a simple set of spatial characters. Therefore, this school tried to focus the landscape ecological elements and processes, proposing new concepts (e.g. ecocoenotope, ecotissue), new functions (e.g. biological and territorial aspects of vegetation -BTC-) and new studying methods (e.g. LABISV landscape survey and evaluation of vegetation), etc. Let us briefly present some of them:

(i) The biological territorial capacity of vegetation or BTC (Ingegnoli 1991, 2002; Ingegnoli & Giglio 2005; Ingegnoli & Pignatti 2007), is a synthetic function, referred to the vegetation of an ecocoenotope, i.e. the ecological system, composed of the community (biotic view), the ecosystem (functional view) and the microchore (sensu Zonneveld 1995). It expresses the flux of energy a vegetation system must dissipate during a year to maintain its degree of organization and metastability. It is based on: (1) the concept of resistance stability (Odum 1971); (2) the principal types of ecosystems of the ecosphere (Whittaker 1975); (3) their metabolic data (biomass, gross primary production, respiration, R/PG, R/B) (Duvigneaud 1975, Piussi 1994, Pignatti 1995). Two coefficients are present within this function:

\[ a_i = \frac{(R/GP)_i}{(R/GP)_{max}} \quad b_i = \frac{(dS/S)_{min}/(dS/S)_i} \]

where: R is the respiration, GP is the gross production, dS/S is equal to R/B and is the maintenance/structure ratio (or a thermodynamic order function; Odum 1971, 1983) and i are the principal ecosystems of the ecosphere.

The factor ai measures the degree of the relative metabolic capacity of the principal ecosystems; bi measures the degree of the relative antithermic (i.e. order) maintenance of the principal ecosystems. We know that the degree of homeostatic capacity of an ecocoenotope is proportional to its respiration (Odum 1971, 1983). So through the ai and bi coefficients, even related in the simplest way, we can have a measure which is a function of this capacity:

\[ BTC_i = (ai + bi) Ri \quad [Mcal/m^2/year] \]

(ii) The Human habitat (HH) and the ecotissue concept. The areas where human populations live and work permanently, limiting the self-regulation capability of natural systems form the human habitat. The HH is differentiated from the natural habitat (NH), but their sum is >1, because of the concept of ecotissue. The ecotissue is the complex multidimensional structure of a landscape where a main spatial mosaic of tesserae (generally formed by the vegetation coenosis), is hierarchically integrated with the set of correlated mosaics and information of different temporal and spatial scales.

(iii) The landscape bionomic survey of vegetation” or LaBiSV is the method proposed to study the vegetation in a landscape (Ingegnoli, 2002; Ingegnoli e Giglio, 2005; Ingegnoli & Pignatti 2007). It is able to integrate three different criteria (a biotic one, an environmental one and a configurational one) with different temporal and spatial scales. It helps in the definition of the so called “normal state” for each specific type of tessera (the term tessera can be used to individuate -in practice- an ecocoenotope).
It uses a parametric standard form (a proper one for each type of vegetation) for the analysis and evaluation of a vegetated tessera. The standard form (or schedule) has been designed to check the organisation level and to estimate the metastability of a tessera considering both general ecological and landscape ecological characters:

- **T** = landscape element characters (e.g. tessera, corridor);
- **F** = plant biomass (quantity and characters) above ground;
- **E** = ecocoenotope parameters (i.e. integration of community, ecosystem and microchore characters);
- **U** = relation among the elements and their landscape parameters.

The evaluation classes are four, the weights per class depending on an evaluation model, one for each of the main types of vegetation ecosystem (Ingegnoli, 2002). The method let us evaluate the quality of vegetation per parametric set of data: proper equations, calibrated per vegetation type, combine the quality of the surveyed tessera vegetation and its plant biomass to estimate the BTC of the tessera itself, thus the degree of metastability of vegetation can be estimated. Results may be represented through ecograms (see Fig. 3). For BTC function is related to the concept of metastability, its distribution enables to study vegetation and to evaluate landscape transformation. However, BTC of even an entire landscape unit, does not consider itself the functional diversity distribution and the amount of information linked to that composition. Therefore, Ingegnoli has integrated the theory by a bionomic index: general Landscape Metastability (g-ML) able to measure the metastability of a landscape unit recalling the concept of negentropy, which allowed Shannon and Weaver to use the Boltzmann entropy function as a measure of information. This synthetic landscape magnitude considers the functional diversity of distribution of the BTC in a given LU and the amount of information linked to that composition. Remember that g-ML represents an information quantity per the flux of energy able to maintain the landscape level of organisation. Through the g-ML function it is possible to add a further deeper control on the bionomic state of a given landscape unit.

The method proposed by Ingegnoli has been applied to compare two rural-suburban landscapes from Brussels and Milan, showing indeed both geographical and historical similarities from Belgium and Lombardy and from Brabant and Brianza. As shown in figure 1, Asse and Bollate show similarities, being nearly located N-W of their capital cities, both having about 30-35,000 inhabitants, even though their respective areas are quite different: the territory of Asse (50.08 km²) is about 3.8 times larger than the territory of Bollate (13.10 km²).

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Fig. 1. The two cities of Brussels (right) and Milan (left) and the location of the municipality of Asse and of Bollate. Please note as both municipality are placed N-E of the cities (from Google Maps®). The polygons in red represent the demarcation of the administrative boundaries.
Results and discussion

Both for Asse and Bollate a relatively complete sequence of high-quality historical maps is available, from as early as the XVIII century until today. The general structure of the Belgian case is characterized by a mixed presence of agriculture and industry, typically suburban, and by a residential network along the main roads. Remnant forest patches are still present in the landscape, but the fragments are relatively small and their connectivity is weak. Many query arise on the bionomic state of this landscape (Marchegiani 2010). On the other side, the general structure of Bollate is characterized by a strong presence of urban areas around an historical centre, and with many scattered industrial zones and only few patches of cropland. In the green part Bollate shows a vast and imposing baroque villa with a wide garden...
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(France style): Villa Arcimboldi (1640), even called “Castellazzo di Bollate”, now under restoration.

In parallel with the survey of land use changes over the time, and their grouping in seven main landscape apparatuses, we surveyed the most significant vegetation types of tessera, following the LaBiSV methodology (Ingegnoli, 2002; Ingegnoli and Giglio, 2005; Ingegnoli and Pignatti, 2007).

Figure 2 and 3 show the most significant transformations of the two territories during more than two centuries. These changes are more pronounced in Bollate as compared to Asse, where changes were not so strong. As we can see in Fig. 2, Asse shows a near constant HH, a small decrease of BTC and forest patches (only in the last 50 years), a longer decrease of cropland and a growing of population which induced a lower grow of urbanization since 1850.

Changes in Bollate during 230 years were more pronounced. As we can see in Figure 3, here a growth of HH (from 71.7 to 84.2 %) in only 110 years, as well as a relatively recent decrease to 79.8%, are consequences of the huge urbanization and the establishment of the Groane Regional Park. A drastic decrease of agriculture resulted from these processes, with a decreasing share of 83.1 % to 38.2 in less than 60 years. As shown by the maps, the landscape was reshaped drastically in this time period. The small decrease of BTC did not follow the strong decrease of wilderness areas and forest patches: only after 1954 the BTC passed from 1.47 to 1.03, notwithstanding the forest regrowth. The growth of urbanization has been following population increase since 1888, more than doubling in 66 years (from 4.25 to 9.95), then arriving to the present 39.8 %.

![Image](input2012-e-aporaeagora.png)

**Fig. 4.** Comparison between the movements of the landscapes of Asse (brown) and Bollate (blue) registered on the plain representing the state of the complex system (HH, g-LM). Note that today Bollate has a g-LM higher than Asse (7.5 Vs. 6.4).

Plotting on a phase space the derived g-ML against the HH, the experiment allows to check the divergences of the two landscapes. Figure 3 highlights, on the plain representing the state of the complex system (HH, g-LM), the sharp differences between the two landscape transformations of Asse (brown) and Bollate (blue) in the last 230 years. The changes in Bollate were 12 times wider than in Asse, but remaining not so far from the optimum (green line). Even today the g-LMBOLLATE = 64.5 % of the optimum, while g-LMASSE = 52.0 %. No doubt they are both altered, being outside a security coefficient (about ± 10-12 % of the optimum), but the distance of Asse from that threshold is – 40.9 %, Vs. only – 26.7 % of Bollate. The main reason of these situations
may be found comparing the diagnostic evaluations of Asse and Bollate. The Diagnostic index is a further parameter of Ingegnoli’s original work, which quantifies the “distance” of each ecological parameter detected by the standard, giving an appropriate score according to the offset values (in percentage) from the threshold of normality. The diagnostic index (DI) of Asse resulted today 68.33% of the optimum referred to the landscape type “agriculture-productive”, very similar to the value of Bollate (same landscape type) in 1954: But, after this period, Bollate overcame the threshold and passed into the other landscape type “suburban-rural”, referring to which DI arises now to 70.0, while Asse is now in a belt of instability, that is the threshold between the two types, being not completely structured as suburban-rural but under the influence of Brussels.

Conclusions

The key finding of our experiment is the possibility to overtake the dominant ideology in planning which tends to upset the criteria for choosing between “form” and “content” of a project. Removing the form from content, what you get is just an empty formalism. The analytical and diagnostic tool based on Ingegnoli’s work, allows to pours approaches own of human medicine into landscape analysis, strengthening the planning stages and supporting choices by indices and metrics deemed of a higher readability, not only for ecologists but also for practitioners, planners and policy makers. No doubt that the crucial point remains the definition of the landscape as a peculiar biological level. As pointed out by Ingegnoli (1999, 2002) in a frame like this, even the non-equilibrium thermodynamics underlined the importance of the essential characters of the landscape. These intrinsic biological characters of the level (structural and dynamic) may go over the exportable characters (spatially dependent processes). In facts, each system which presents proper characters is an entity, and we can find properties characterizing cell, organism, population, ecocoenotope, landscape. Being the landscape a complex bio-ecological (bionomic) system, we must pay attention to the emergent property principle, and being a living entity, we must pay attention to ethics.

i. That is why scaling up a bionomic system of ecological communities we cannot describe the behaviour of a landscape. Therefore, the use of computer clustering landscape indicators has to be very controlled and strictly limited.

ii. That is why also the concept of metastability becomes basilar. Consequently, different types of landscapes (or their parts) may be correlated with diverse levels of metastability. This statement has a very important dynamic significance, because it allows knowledge of the transformation modalities of a landscape and consequently (as we will see further) allows the diagnosis of its healthy state.

iii. That is why we have to consider landscape bionomics as a discipline like medicine, biologically based and transdisciplinary. We can properly compare a landscape scientist, which we call “ecoiatra”, with a doctor of a more wide and complex level of life. Remember that we have to study the landscape pathologies, but also their influence on human health, which may be dangerous even in absence of pollution.

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Mapping Cilento: Visual analysis of geotagged Twitter data to study touristic flows in southern Italy

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Key-words: Data Mining; Visual Analytics; Flow Analysis; Geotagged Social, Rural Tourism.

Introduction

This work extends a previous visual analytics approach to analyse the use of geotagged Twitter data in order to better understand the spatial, temporal and demographic properties of tourist flows in rural and wide coastal touristic venues. Based on a case study situated in Cilento it demonstrates how the proposed approach provides detailed spatial information of tourist movements for policy-making purposes. Travel activities account for an increasingly large part of human movement and the analysis of tourist flows has been key to discovering insights that influence income and expenditure in government or privately funded endeavours. While techniques to study routine travel habits are well established, relatively fewer methods have been developed to support the analysis of tourist flows. The lack of attention thus far has been attributed to difficulties with acquiring data suitable for such analysis. Regional and national travel databases are common sources of information for flow analysis. Yet, such data are unsuitable for studying touristic flows, as they are not structured into categories that adequately differentiate between trip making purposes (Schlich and Axhausen, 2003). A distinctive feature of tourism involves the movement of people between urban and rural spaces (Christaller, 1964; Mansfeld, 1990). From a sensing perspective, tracking human movement across an urban-rural transact poses some peculiar challenges with scale, precision and cost involved. Referenced to timestamps and geographic coordinates, this data can be used to monitor and regulate cities in real time (Kitchin, 2014).

As part of the “Smart Cities” agenda, the “Big” data generated by such sensing infrastructures are used to study various phenomena and their very dynamics (Nabian et al., 2013). In spatial planning, systems developed on this basis have been employed to extract information related to economic development, mobility and governance. Geotagged Twitter data is valuable a source of information, generated by such sensing infrastructures, suitable for touristic flow analysis.
Methodology

Cilento is a well-known touristic venue located in southern Italy where, for the last two years, policy makers have been engaged in a national interest project (TOOK-Marche Cilento) funded by European union and state funds (Min. Sviluppo Economico and DPS) to foster the exchange of best practises in sustainable tourism between developed and under developed regions in Italy. In this specific case, the objective is to develop a local strategy for tourism that encourages economic development and territorial cohesion. The Cilento region spans about 4900km² comprising of a range of environments including a picturesque coastline and mountainous inland dotted with multiple UNESCO heritage sites (e.g. Paestum, Punta Licosa, Capo Palinuro). While majority of the settlements are located close to the coastline, the inner boundaries of Cilento mainly consist of land parcels for agriculture and nature conservation. As of late, the region has suffered from low economic performance due to a change in tourist demographics and spending power.

Geotagged Twitter data was chosen to operationalize our analysis. Apart from the distinctive advantages mentioned above, Twitter provides freely accessible mechanisms to monitor activities that occur within a specified area and timeframe. However, several technical requirements must be fulfilled in order to perform flow analysis with geotagged tweets. Firstly, tweets are not directly downloadable from a web repository but must be gathered from Twitter’s application programming interfaces (API) based on a well-defined set of queries. Secondly, the collected tweets in raw point format are ill structured for flow analysis and require processing prior to visualization. Finally, common flow representations are prone to visual clutter that occludes important patterns (Schulz & Schumann, 2006) and thereby require optimization for accurate representation. In this section, we provide technical details that elaborate on how data is collected, processed and visualized for communicable insights.

Two distinct types of data are required, namely user profiles for demographic information and geotagged tweets for spatial and temporal information. We carried out data collection in three phases. The first phase involves gathering geotagged tweets posted within the boundaries of Cilento between 29 May 2014 and 31 December 2014 through Twitter’s stream API. In phase two, we compiled a list of unique user IDs extracted from the tweets collected in phase one. Finally, we iteratively queried Twitter’s REST API to gather geotagged tweets and user profiles that correspond to each user ID on the list compiled in phase two.

A trajectory is a time-ordered collection of geotagged tweets that traces the movement of an individual through space and time. Each sequential pair of tweets in a trajectory is referred to as a pathway and reflects the movement of an individual from a location to the next. Aggregation is typically required to extract collective patterns from the data. Thus trajectories are simplified by binning the origin and destination of each pathway to cells in an n x m grid. This step reduces the large number of spatial variations among trajectories to a representative subset where the frequencies of travel along common pathways become evident.

To characterize the demographic features of tourist flows in Cilento, we must determine their location of origin. We obtained a demographic breakdown of the population sample by grouping individuals according to the time-zone listed on their profiles. In this manner, locals were differentiated from tourists, while foreign tourists were distinguished from domestic tourists. Finally, foreign tourists were broken down into sub groups. Time-zone was chosen instead of content from the location field because the former is formatted in a consistent manner. Twitter users choose their time-zone from a list of predefined cities, but any text information can be submitted to the location field regardless of its validity (Hecht, et al., 2011). We obtained the timezone information by systematically querying user profiles with Twitter’s REST API. Missing
values were expected thus the classification was improved by clustering individuals based on the frequency of their activity in Italy. We define four metrics to accomplish this:

\[
\begin{align*}
T_d & \quad \text{Number of days an individual has been active in Italy;} \\
C_d & \quad \text{Number of days an individual has spent in Cilento;} \\
\bar{C}_d & \quad \text{The median number of days that all individuals have been collectively active;} \\
\bar{T}_d & \quad \text{The median number of days spent in Cilento by all individuals collectively.}
\end{align*}
\]

The value \(T_d\) indicates the total number of days an individual has created tweets, while \(C_d\) refers to the number of days that those tweets occurred within the geographic boundaries of Cilento.

We consider any individual who did not declare a ‘time-zone’ to be domestic tourist if \(\bar{T}_d \geq \bar{C}_d\). Then, we define a probability index \((p \geq 0.75)\) to distinguish domestic tourists from the locals on the basis that locals spend most of their time within the region. The probability index \(p\) is computed in the following manner:

\[
p = \begin{cases} 
\frac{C_d}{T_d} & \text{if } C_d \geq \bar{C}_d \\
0 & \text{otherwise}
\end{cases}
\]

We developed FlowSampler (Chua, Marcheggiani, Servillo, & Vande Moere, 2014), a purpose built visualization tool that enables interactive visual analysis of spatial temporal patterns in an integrated view. As shown in Figure 1, the primary interface is a flow map that depicts tourist flows among various locations in Cilento (see Figure 1a). The flow map can be dynamically filtered across four variables: Time (See Figure 1b), direction of travel, number of trips and demographic group (See Figure 1c). Selecting a cell reveals the incoming and outgoing flows from that location (see Figure 1d).

We implemented dynamic zooming in the flow map. This provides spatial planners with an overview of the data before further analytical task are carried out. The zoom level of the flow map can be modified with the mouse wheel and the filter range by manipulated by moving the interactive range sliders or selecting individual bars.

The flow map (Figure 1) provides a spatial view of the data. The principle behind flow map is based on a node-link type representation where trajectories are plotted as lines that link origin to destination. To reduce visual clutter, flow maps merge trajectories that share similar origins and destinations. A line of varying thickness is then use to express the number of trajectories that have been aggregated. Similarly, ellipses of varying diameter are used to represent selfdirected flows. We adopt a node-link representation that can be super imposed onto a variety of base maps depending on various planning needs.
Fig. 1. Components of the visualization interface. (a) Flow map geographically centered on Cilento. (b) Timeline indicating the number of unique individuals posting geotagged tweets per day. (c) Widgets for filtering the map based on direction of travel, number of trips and demographic group. (d) Cut out of the flow map depicting both incoming and outgoing flows from a selected cell.

The trajectory selection widget and the headcount selection widget are histograms (see Figure 2) that visualise the distribution of the aggregated trajectories and unique people who travelled along a certain flow pathway respectively.

Fig. 2. Demographic Breakdown of individuals in Cilento. Locations outside of Europe have been aggregated into wider geographic regions.
Results and discussion

Despite these limitations, we would like to point out that our approach provides equally valuable and alternative insights that are complimentary to the current understanding of tourist flows in Cilento, derived from existing data sources (e.g. regional or national tourism reports). A dataset consisting of 23,177,616 geotagged tweets posted by 475,727 individuals was collected between 29 May 2014 and 31 December 2014. Of this data, 3,135 (0.7%) individuals posted 72,031 (0.3%) tweets within the geographic boundaries of Cilento. We constructed trajectories for each of the 3,135 individuals based on a subset of 606,309 (2.6%) tweets – the total number of tweets posted by these individuals in the dataset. On average, there are 193 tweets per trajectory. Geotagged We have described in detail a set of techniques and findings from studying tourist flows within the geotagged Twitter data. Our approach to analysis - developing interactive visualisation software to investigate the spatial, temporal and demographic properties of tourist flows, enables relatively sophisticated descriptions of tourist movement, as well as profiles of tourist. Nonetheless, there are limitations to be aware of: flow information is mined as observed movements between origin and destinations without the actual travel trajectories. Nonetheless, this is the first large-scale observational study of tourist flows that to our knowledge attempt to provide a comprehensive description of tourist profiles and their associated movement. Circulation refers to the diffusion of flows in a system. Figure 3 presents a visual comparison of how individuals from various demographic groups move throughout the region. Figure 3a
depicts the movements of locals while Figure 3b illustrates the aggregated tourist flows. Comparison between both maps reveals a substantial difference in the way individuals from both demographic groups circulate the region. In contrast to locals who primarily move inland, tourist activity tends to be situated along the coastline. The route between Capaccio and Agropoli however, appears to be equally important for both groups. Further comparisons between domestic (See Figure 3c) and foreign (See Figure 3d) tourists reveal several spatial differences. Whereas foreign tourists tend to be situated around Agropoli and Palinuro, domestic tourists are seen in Ascea. The routes taken by domestic tourists also differ substantially from foreign tourists in that they are situated further inland.

**Conclusions**

We have described a set of findings from studying tourist flows through the lens of Geotagged Social Media (GSMD). Our approach - developing an analytical technique to collect and investigate the spatial, temporal and demographic features of tourist flows, enables relatively sophisticated descriptions of tourist movement, as well as the demographic profiles of tourist groups. However, biases in the data as well as methodological limitations should be considered when drawing conclusions from analysis of GSMD. Nonetheless, this is the first large-scale observational study of tourist flows on wide-open rural tourism venues, that to our knowledge attempt to provide a comprehensive description of tourist profiles and their associated movement, there are several avenues for future work. We plan to conduct a comparative study with existing rural, intermediate or urban flow analysis techniques in order to evaluate and better understand the added value and potential pitfalls that may occur when using geolocated social media data to inform spatial planning. To optimise our system, we will experiment with visualisation techniques such as interactive clustering to address challenges with visual clutter. Finally, feedback from spatial planners suggests that contextual data such keywords could be useful for characterising flow patterns. The occurrence of special events such as festivals or strikes can be better understood by combining what people say with what they do.

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Association between a spectral index and a landscape index for mapping and analysis of urban vegetation cover

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Key-words: Urban planning; management of green areas; remote sensing; NDVI; NRDI.

Introduction

Throughout history, the natural landscape has undergone several different processes of man-made transformations, being gradually replaced by artificialities through constructions and interventions in order to make life easier in the urban centres and signalling the mankind’s challenge of acting in the natural space while still preserving it (Antrop, 2004; Bessa and Soares, 2003; Houghton, 1994; Santos, 1994).

The exponential growth of urban populations, notably after the 19th century, has called for the necessity of rethinking the urban space to guarantee people’s environment and life quality, especially in what concerns the vegetation cover of which the urban landscape is composed. The fragments of arboreal vegetation in the urban landscape are responsible for different functions, which are related to the aesthetical quality of the environment, the possibilities of social interaction and leisure time, the protection of biodiversity and of groundwater recharge and against geotechnical problems. Apart from that, they also guarantee the maintenance of nature’s balance, regarding climate, environment’s humidity, air quality and noise control. (Loboda et al., 2005).

According to Falcón (2007), the concepts related to the planning of green areas have been officially incorporated to urban planning since UNESCO’s conference “Man and Biosphere” (MAB), which took place in Barcelona in 1988. At that occasion, the basic principles for the planning of “urban green areas” in a sustainable city were defined.

Geotechnology plays an important role in the identification, profiling and analysis of the vegetation cover in urban areas. Spatial analysis models are frequently used as a tool for planning and managing urban green areas. Remote sensing techniques, digital image processing and structuring of Geographic Information Systems serve a significant function in this case. (Moura, 2005; Magalhães, 2013; Magalhães and Moura, 2013).

The use of remote sensing for studies on vegetation covers through information sources in high spatial resolution (satellite imagery and aerophotogrammetry) is not new (Jensen, 2007). However, it lacked the application of automated classification processes (DIP – digital image processing) instead of the sole classification through visual inspection of high resolution images (which until very recently only comprised the visible spectrum, such as the most widespread ones in Brazil: Ikonos and QuickBird). Some Brazilian cities with enough resources for investing in data are able to use high resolution spatial data (such as 20 cm) and automated classification based on spectral bands (such as the infrared range). This new possibility results in the improvement of the information used to elaborate urban parameters, such as: permeability and
infiltration rates, heat zones, warming, environmental comfort, the use of soil, variability index etc. In addition, it also contributes for the automation of classifications, making these studies quicker and more accurate.

This paper seeks to evaluate the association between the NDVI (Normalised Difference Vegetation Index) spectral index and the NRVI (Normalised Remaining Vegetation Index) landscape index, so as to analyse the vegetation cover and its spatial relation with the pattern.

A case study

Aiming to demonstrate the potential and the limitations of applying the studies through high resolution images in Brazil, this paper will focus in the Pampulha Region (Figure 01), in Belo Horizonte. It was chosen as a case study, for it is the most significant landscape intervention in the city’s history, having attached great importance to the maintenance of open spaces and green areas in the planning of edifications.

Due to its environmental characteristics (low relief and low slope values) and to its cultural importance, Pampulha has become well known in northern Belo Horizonte (Brazil), attracting private investors and real estate professionals, resulting in a dynamic conformation and in the landscape’s transformation (Carsalade and Castro, 2011). Such dynamics have raised several environmental, urban, architectonic and cultural issues that have become crucial in the last years.

In addition to that, the region has chances of being protected by UNESCO as a cultural heritage site in the near future, as it comprises a great deal of Brazilian modernist architecture by Oscar Niemeyer and contributions of Portinari, Burle Marx, Ceschiatti and Paulo Werneck (Carsalade, 2015). In this way, the region’s importance and its existing problems justify the choice of Pampulha as an object for the current study, because it is an area of some conflicts of interest in what concerns the protection or expansion of urban densification and the expressive presence of vegetation cover in private lots.

Fig. 1. A case study - Pampulha, Belo Horizonte – Brazil. Source: Laboratório de Geoprocessamento/ EA – UFMG.
Methodology

This study's methodology was divided in three main steps, commencing with data acquisition, which was followed, in this order, by the pre-processing and processing of the acquired data (Figure 02). The images used for this research were provided by the Municipality of Belo Horizonte (PBH – Prefeitura de Belo Horizonte) and acquired through an aerophotogrammetric survey with a digital camera A3 Edge/Visionmap, comprising the visible spectrum (RGB) and the near infrared (NIR), with a spatial resolution of 20 cm.

\[
\text{NDVI} = \frac{\rho_{ivp} - \rho_v}{\rho_{ivp} + \rho_v} \quad (1)
\]

Where: \(\rho_{ivp}\) is the reflectance in the near infrared; \(\rho_v\) is the reflectance in the red.

The NDVI is based on the spectral signature of the target’s behaviour, in the case of vegetation covers, which presents specific responses that are related to photosynthesis, whose process absorbs solar radiation in the red rage of the spectrum. The plants’ cellules reflect more strongly in the near infrared range. The portions absorbed in the red and reflected in the infrared vary accordingly with the plants’ conditions. We can associate them to other normalised indexes in order to make correlations and verify the studied place’s ambience as well as improving its management (Rouse et. al., 1973; Myneni, 1995; Freire and Pacheco, 2005).

Subsequently, the result was classified in order to separate the NDVI rate that portrayed the most representative vegetation (arboreal), taking into consideration the values above 0.16. The product was converted from the raster format to vectors so as to apply the landscape index. The NRVI was applied to each block, giving the attribute table each referring piece of information.

The NRVI (Normalised Remaining Vegetation Index) is directly proportional to the remaining amount of vegetation cover of a given spatial unit of analysis. The index may vary between -1 and 1. In this way, a NRVI of 1 indicates a hundred per cent of remaining vegetation cover in the area, while a NRVI of -1 indicates the absence of vegetation cover, while a hundred per cent of the area serves other purposes (Bonet et al., 2006). For areas where the use and the remaining vegetation are equivalent, the index equals zero. The NRVI is expressed by the following formula:

\[
\text{NRVI} = \frac{(Ra - Ua)}{(Ra + Ua)} \quad (2)
\]
Where: Ra is the remaining area; Ua is the used area.

Finally, the data was systematised in cartograms and tables, enabling the visualisation and analysis of the phenomena.

**Results and discussion**

After the application of the methodology, the following result (Fig.03) was found, where the two maps, generated each by NDVI and NRVI, can be compared.

![Images of maps and legends](image)

**Fig. 3.** A) RGB false colour composite of aerophotogrammetric image; B) NDVI map; C) Classification of vegetation cover; D) Arboreal vegetation cover and blocks; E) Landscape index NRVI per blocks.

At the analysis of the results it is noticeable how the pieces of information referring to each index are similar and complementary. When analysing the generated maps, we were able to observe that, in the southern part of the studied area, the NRVI values (Fig.03-E) are lower for the vegetation cover, while there is a densification of arboreal vegetation cover in the northern part. This is proved at the analysis of the NDVI image (Fig.03-C), where the arboreal vegetation is predominant. In addition, it is possible to notice the direction of the loss of vegetation cover from south to north, indicating that an optimised management of such areas are necessary to guarantee the maintenance of the remaining green areas.

**Conclusions**

The association of high resolution aerophotogrammetric imagery to the spectral response in the near infrared range enabled the optimised identification of the arboreal vegetation cover, since the spectral response of the vegetation occurs in this rang of the electromagnetic spectrum. The landscape index NRVI presents great potential for environmental analysis of urban areas, especially when defining protected zones that are responsible for the urban environmental quality.
Therefore, the integration among products of digital aerophotogrammetry, spectral indexes for mapping of vegetation and landscape indexes provides the management of the urban expansion process, its influences on environmental processes and the need to preserve urban green areas, aiming to the maintenance of life quality.

**Acknowledgments**

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**References**


e-agorà|e-ayopú for the transition toward resilient communities
Introduction

Societal trends, environmental concerns, technological progress, and impinging economic crisis are causing new challenges in transport studies. They are shifting policy questions, conventionally related to solving capacity problems and congestion, to wider impacts of the transport, such as reduction in greenhouse gasses, more livable and healthy settlements, and the ICT impact on activity patterns (Litman 2006; Litman and Burwell 2006; European Parliament 2014; Lord, Negron-Poblete and Torres eds. 2015; Occelli and Sciullo 2015).

Notwithstanding, considerable efforts have been invested in addressing concepts of sustainability in the transport system: nowadays the future development of mobility is uncertain both in scientific and non-scientific literature (Gillis, Semanjski and Lauwers 2016; Shuldiner and Shuldiner 2013).

Whereas, in many situated contexts, research advancements seem unable to offer effective insights into mobility problems at hand, on the policy ground, the urgency to deal with its determinants and impacts is mounting. In order to respond to it, recently a number of studies have called for a strengthening in the ability of the practitioners who are engaged in the design and management of policy actions (De Bruijne, van de Riet, de Haan and Koppenjan 2010; Givoni 2014; Timms, Tight and Watling 2014).

This paper makes a claim that such a strengthening depends on the context’s ability to get hold of research advancements and leverage their application in policy practices. More specifically it aims at providing an operational analytical approach to monitor the evolution of mobility flows at sub-regional level. In the following section, first we outline the conceptual background that underlies the proposed approach. Then the methodological framework is described. This is based on the well known spatial interaction approach, which is formally re-interpreted by means of a statistical language. The implications of this reformulation are discussed and the information sources to implement the socioeconomic indicators for estimating the mobility flows are presented.
Background

The calculation of appropriate estimates of mobility flows for planning tasks has been at the core in land use and transport studies (Acheampong and Silva 2015; Arentze and Timmermans 2000). When looking at their achievements these can be interpreted according to three main axes: methods, data and appropriation, Fig.1. Over time, therefore, the trio Methods-Data-Appropriation, would represent a certain capability level a context is endowed with for applying scientific advancements.

![Fig. 1. Capability level in implementing mobility research.](image)

Whereas methods and data usually make the happy couple in scientific advancements, their appropriation by urban and transport policy practices often acts as a third wheel. Several complains about the ineffectiveness of research in policy practices may well be explained by the fact that the evolution trajectory of the MDA trio, has mainly taken place in the left part of the scheme of Fig.1.

Of course, progress along the appropriation axis depends on many factors, such as technical competences of practitioners, institutional mandates and, more broadly, the permeability of the cultural setting to changes and innovative thinking. Strictly speaking, appropriation of scientific results by a certain problem owner may well be considered as independent from scientific advancement itself. The point is, however, that because of the very pace of technological progress, in the long run, such independence may not be socially acceptable nor viable. Although the argument falls outside the scope of this paper, it raises questions about the possible ways to make the appropriation easier.

One suggestion in this respect is that efforts should be meant at designing a MDA trio in such a way to make it most adapt to a certain situated context, while taking into account the point of view of the problem owner. In the present study, the point of view is that of a regional governmental organization, who has basic computation competence, needs to rely on existing information and has a very tight budget to carry out the analytic work.

The main goal of the study is to develop an operational analytical approach to monitor the evolution of population mobility flows at sub-regional. More specifically it aims at updating the
census based mobility flows among the Piedmont municipalities, by taking into account the socioeconomic changes that have occurred after the census base years.

**Methodology**

The methodological approach consists of two main steps. The first step concerns the estimation of the effects of a set of socioeconomic and demographic determinants on the mobility flows to extrapolate marginals of a mobility table. The Italian Central Bureau of Statistics (ISTAT) has recently published Italian census mobility data at municipality level. In this study we use the Piedmont census mobility flows at 2001 and 2011. By collapsing rows and columns of the mobility matrices zone outflows and inflows are obtained. These serve as dependent variables in a regression estimation procedure, where a set of mobility determinants are considered. Their selection is based on the availability of the socioeconomic and demographic data used for defining the determinants. It builds upon a previous study by Occelli and Sciullo (2015) which investigated the effects of a set of determinants on census municipality outflows in the 1981-2011 period. While exhibiting a certain variation in time-period, the estimated values between 2001 and 2011 do not change significantly enough to reject an inter-temporal equivalence hypothesis. Therefore, we can reasonably use a linear combination of parameters estimates at census times, to extrapolate new levels of zone outflows and inflows at certain dates between the two censuses. The second step extrapolates the origin-to-destination flows, given the updated marginals of the mobility tables. We use the maximum entropy principle, as popularised by Wilson (1967, 1968), Coelho and Wilson (1977) and Roy (2004), to extrapolate fully-constrained mobility matrices at the chosen time intervals. As a result, a spatiotemporal atlas of mobility tables can be obtained and, given plausible hypotheses, it can be updated over time within forward looking exercises of policy scenarios.

**Results and discussion**

The proposed two-stage method of estimation-extrapolation can be considered as an efficient tool for applied research in the field of policy making and evaluation at the regional and sub-regional level. From an operational point of view, it allows practitioners to easily exploit available data at the municipality level to estimate mobility flows. It can be used retrospectively to better understand the relationships between socioeconomic changes and impacts on mobility flows at a local level. In this sense, it can enhance understanding of the observed changes in the spatial patterns of mobility. In addition, the application of this analytical approach makes it possible to obtain a multi-level description of the mobility phenomenon: from the very micro (at the municipality level) to some meso (specific local areas) and to macro (land-use or transport planning areas) levels. By crossing these different description levels additional insights into the impact of the economic and demographic cycles on mobility are likely to be obtained. Not only. When changing the direction in the causal relationships between determinants and mobility flows, the reverse investigation of the effect of mobility patterns on certain specific socioeconomic phenomena could also be carried out. From a more theoretical point of view, the possibility to have a multilevel application of the methodology, would be valuable for developing policy oriented scenario analysis. For instance, if some demographic or economic scenario based estimates are provided by external models at a
micro, meso or macro level, they can be rather straightforwardly incorporated into the estimation-extrapolation procedure to test their impact on the mobility scenario. A series of experiments could then be carried out, and their results provide more robust evidence in handling certain transport and land-use policy phenomena.

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A parametric method to analyze and enhance the cultural heritage and its context

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Key-words: Urban design for cultural heritage, Natural and cultural heritage, Heritage context, Decision Support System, Cultural tourism.

Introduction

Cultural heritage’s protection and improvement is the central topic in a lot of administrative, juridical, national/international rights bureaus: since Hague Convention (1954) and General conference of the United Nations Educational, Scientific and Cultural Organization (UNESCO) meeting in Paris (1972), cultural and natural assets assume the role of elements characterizing a nation, its culture and its memory.

Two different restrictions characterize the assets: direct restriction (acting on the asset itself) and indirect restriction (acting on the near and more distant context). They are rules that specify the measures to preserve, protect and control the assets; identify possible interventions and possible procedures; define preventive measures and precautions and the duties of assets’ owners. In particular, the indirect restrictions aim to ensure the necessary space to the cultural enrichment and the public enjoyment of assets. The concept of indirect restriction is present in different documents and laws of many countries, including those prepared by UNESCO. In particular, in the "Operational Guidelines for the Implementation of the World Heritage Convention" (UNESCO 2013), the protection of cultural and natural heritage is characterized by boundaries referring to the asset itself and it is completed by buffer zones, areas in the neighborhood of the asset which are subject to certain rules in order to protect the asset itself (Martin and Piatti 2009).

The issue of protection and conservation compares with the theme of enhancement and usability of assets. A recent speech by Giuliano Volpe (Archaeology professor and Chairman of 'Consiglio Superiore of Beni culturali e paesaggistici' of MIBACt), stressed the importance of active participation of citizens and the development of heritage area: it takes an inter-disciplinary approach and a holistic view of cultural heritage and it is crucial to reconcile environmental protection with the enhancement of assets, preservation issues with innovative uses, the ancient with the modern (Volpe 2015).

Even in a hyper-conservative context like Italy (relevant legislation is D.Lgs 42/2004 Legislative "Code of cultural heritage and landscape" made by Ministry of Heritage and cultural activities and tourism, MIBACt), the issue of enhancing the assets could not be an integral conservation but a dynamic relationship between the asset and its physical and social environment. In urban areas and local and regional scale, the enhancement of cultural and environmental heritage (that represents a benefit for the territory) plays a key role in the regeneration and development strategies and allows integrating economic, social, cultural and environmental objectives involving multiple stakeholders (public, private and social). In this direction, several studies highlight the importance of tourism’s initiatives that aim promoting development of historical-artistic heritage, archaeological, architectural and landscape...
of the territory to ensure the accessibility and the effective enjoyment of the asset (Ashworth and Page 2011, 7). An increasing number of cities and regions chooses tourism as strategic sector for urban regeneration and local and territorial development: it is necessary a long-term urban and territorial planning combined with the enhancement of historical and cultural heritage to improve the mobility network, the utilities and their quality. It is also interesting the so called "tourist products", the factors that determine the competitiveness and attractiveness of a specific location. The main are: the quality of primary (the assets itself) and secondary elements, the internal and external accessibility and ease of mobility (Van den Berg et al. 1995). These elements are the main objects of specific urban policies because they may permit the development and regeneration of assets and surrounding context.
Methodology

The presented research aims to analyze the assets in an indirect manner to understand how to improve the surroundings in relation to the restriction framework (De Lotto et al. 2015, 2078). For the analysis and evaluation of the context, authors defined four main site analysis parameters:

A. Physical and spatial usability and accessibility: analysis of main territorial features, presence or lack of infrastructures, accessibility to public transportation system and so on;
B. Relevant visual perception: identification of perceptual hierarchies directly link to the nearest surroundings (i.e. city block) and to the wider landscape;
C. Urban and functional overview: analysis of morphological (urban fabric) and functional features of the immediate surroundings, in order to highlight the relation between the asset and its context (in particular if the neighborhood is equipped with facilities and other urban functions in direct relation to the asset);
D. Cultural aspect: the asset is not only linked to the territory but also implies anthropological aspects; it creates identity and involves people and social features. For the objective cultural component of the asset (historical-anthropological characteristics) there is a considerable amount of information (above all, historical maps and real estate registry), for the subjective dimension, data collection is only possible through direct survey and questionnaires.

Furthermore, to identify the existing and developing physical, economic and social relations, it is crucial the location of the asset; authors identify three principle localizations: consolidated urban areas; non-consolidated urban areas (fragmented areas, suburban areas and urban edge/fringe); natural and/or less urbanized context.

In addition to the existing heritage database (i.e. in Italy, Lombardy Region, together with MIBACt, defined SIRBeC - Information System of Cultural Heritage, a cataloging system of cultural heritage spread on the territory or conserved in museums, libraries and other cultural institutions), it is fundamental to create a semantically indexed database (Best Practices Report, BPR) of case studies, projects under development and others already successfully concluded from all over the world aiming to redevelop and enhance in different ways the assets' surroundings.

All the analyzed case studies, as well as the assets, are evaluated through Multicriteria analysis to obtain a priority intervention's ranking to better develop the asset's context. To maintain thematic and semantic unity, the territorial analysis' criteria and the parameter to identify BPR are identical: the four parameters A, B, C, D (defined above) and possible sub parameters (explanations and more punctual features). The last step is the definition of different scenarios (with the use of Scenario Planning) (Schoemaker 1995) characterized by different enhancement and development strategies according to the analyses and Best Practices selected. To apply properly scenario planning with the multitude of elements and relations presented, it is necessary a multidisciplinary, dynamic, flexible and adaptive tool and it is crucial the role of integrated assessments as tools to support planning and decision-making process (Multicriteria Decision Support System, MCDSS) (Zeleny 1982).

The logical framework of operations follows a widely accepted approach:
The operations are carried out through a GIS-based instrument: it allows a rapid and efficient use of map-overlay technique to emphasize the interactions, relationships and conflicts that arise between the different involved elements, historical, cultural and economic themes and values (Al-kheder et al. 2009, 87; Murgante et al. 2009; Cano et al. 2013, 40).

**Results and Discussion**

The methodology is applied in Pavia, a medium sized city (72,000 inhabitants and 63 km² area) located in northwest of Italy, 35 km South of Milan. Authors analyzed three different case studies: the square in front of an important church (Santa Maria del Carmine) located in the consolidated city center; a historical cascina (farmhouse, Cascina Cravino) reconverted into an university settlement in the non-consolidated suburbs and the complex of Certosa di Pavia (composed by church, monastery and cloisters) located in a natural environment 8 km north far from Pavia. As example, authors show the analysis and evaluation sheet of Santa Maria del Carmine Church and its square.
Analysis sheet - Santa Maria del Carmine Church and its square

**Localization:** Pavia, historical centre  
**Intended use:** Temporary market, random events, parking  
**Surface:** 2000 sqm  
**Access for car:** Roma Street  
**Walkable access:** Carmine Street, Roma Street, S.G. Miani Street  
**Adjacent services:** Santa Maria del Carmine Church, Second Level College of Science Taramelli (ex Carmelite monastery), Private Institute of Art Michelangelo (inside Orlandi Palace), offices, private services  
**Commerce:** different public structures  
**Description:** public space nearby buildings under the direct restriction of D.Lgs 42/2004, art.10 “Code of cultural heritage and landscape” (1. Santa Maria del Carmine Church, 2. Orlandi Palace, 3. SS. Trinità Church, 4. Ex Carmelite monastery)

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**Fig. 2. Evaluation sheet of Santa Maria del Carmine Church and its square.**
The presented assessment shows that:

A. Physical and spatial usability and accessibility: GOOD. In a 5-minute walk distance (about 420 meters) there is an excellent public transport accessibility (urban and extra urban bus lines and railway station) and parking areas;
B. Relevant visual perception: GOOD. Excellent perception at urban block level; good landscaping perception (steeple is a fundamental element of city’s skyline);
C. Urban and functional overview: GOOD. The analysis shows the presence of a good functional mix due to the proximity to important citizens commercial streets (Cavour Street, XX Settembre Street);
D. Cultural aspect: GOOD. Community recognizes the important architectural, historical-cultural and symbolic value and role of asset.

From the performed evaluation, it emerge different possible trends of enhancement, improvement and development of urban areas influenced by the asset. For Santa Maria del Carmine’s square purely temporary operations and urban installations are assumed to reach an always lived and livable space avoiding that it becomes a mere junction to other attractors (i.e. the commercial streets) but that converts itself in an attraction (De Lotto et al. 2014, 56). The Best Practices semantically indexed database allows to have a huge amount of good experience from which to create development scenarios and then to move towards the best strategy for each asset-related context.

Conclusions

The proposed methodology aims to create a sequence of operations to guide decision-makers (stakeholders, planners, local government) through the complex system of actions relating to urban/territorial environment in which the assets take place. The logical framework wants to converge towards overall scenarios with different topics: the social dimension of cultural assets; the development of cultural tourism activities; urban and regional planning; the definition of spatial environments characterized by the presence of monumental elements; mutual interaction between relational space and the asset itself. The framework is structured through a process that analyzes the surroundings and the asset itself according to the same features that are used to analyze the Best Practices.

While the spatial analysis process can be considered concluded, the Best Practices database has to be built according to the chosen criteria. This step can be carried out through the analysis of existing databases related to redevelopment projects published in magazines and books, but also through inclusive procedures using the network and the cultural volunteering acquiring more comprehensive information regarding less known but effective interventions. Authors are studying the opportunity to define a specific APP that allows anyone to locate, photograph and catalog (according to the A, B, C and D criteria) the visited places related to assets. The resulting database, must subsequently be verified and validated, but the data collection turns out to be extensive and indexed with a considerable savings of time.

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Present State of Inbound Tourism in Japan and Factors of Destination Choice

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Key-words: Inbound, Tourism, Interaction, Destination choice model, Regional revitalization.

Introduction

Problems such as declining birthrate, aging society and shrinking population continue without abating in Japan. The extreme concentration of population and industry into the Tokyo Metropolitan Area is a serious problem in economic activity and spatial balance of national land. This causes decrease in vigorous activities in local municipalities as well as a decline in the industry of rural regions. Many rural regions have difficulties to sustain their communities. Sustainable development of national land and regions is one of the most important aims of central and local governments.

Acceleration of tourism interaction is attracted as one of solutions to these problems. This interaction includes not only domestic tourism but also international tourism. Because the impact of tourism interaction on region expands to regional economics, employment generation, increase in communication opportunities with people from all over the world, etc..

The aim of this study is to clarify how tourists select the destination in tourism. In other words, we clarify the factors of tourism interaction. We construct a destination choice model concerning inbound tourism in order to clarify the degree of influence of factors on tourism interaction, quantitatively. We construct a model including regional policies as variables, therefore it is useful to know the amount of influence when the local government executes regional policies.

The contents of this study are as follows. First, we grasp present state of foreign tourists to Japan and Japanese tourists visiting overseas countries. Second, we clarify the tourism interaction factors of inbound tourist. Third, we construct a destination choice model of inbound tourist which will be expected to analyze factors contributing to increase visitors to Japan. We will be able to consider new regional policies in the future based on obtained results.
Present State of Tourism and Its Factors

There are many previous studies related to tourism. One of the representative examples concerning to destination image was presented by Martina et al.\(^1\). In this study, conceptual framework of destination image is discussed. In addition, they analyzed previous studies. In one of the significant previous studies\(^3\) related to destination image, it is pointed out that the image of a destination can be divided into two stages. They are the primary image which is developed after visiting a tourist destination and the secondary image which is the image created before a person has travelled to the particular destination. Rajesh\(^2\) arranges previous studies related to impact of tourist perceptions, destination image and tourist satisfaction on destination area systematically.

We clarify the factors of destination choice of inbound tourists in Japan quantitatively. The regional attractions which are considered in destination choice by foreign tourists visiting Japan are analyzed in this study.

Change in the number of foreign tourists to Japan and Japanese overseas tourists

Figure 1 shows change in the number of foreign tourists visiting Japan and the number of Japanese tourists visiting overseas countries since 1964 to 2015. Data of the number of international travellers of visitor arrivals and Japanese overseas travelers from the Japan National Tourism Organization is used.

First, we discuss change in the number of foreign tourist visiting Japan. We can see that it decreased in short term after 2000. The reasons of this decrease are follows. In the case of 2003, the pandemic outbreak of a new strain of influenza occurred. During a period of 2009 there was the global economic depression and new type of pneumonia called SARS had spread widely in Asia. In addition, after the Great East Japan Earthquake, Japan had fewer tourists than usual for a while. In recent years, the number of people visiting the area has increased because of impacts of weakness of yen and increase in the number of global overseas tourists visiting Japan. The global financial crisis has given a negative impact on it, too. Next, we focus on change in the number of Japanese tourists visiting overseas countries. A similar tendency can also be seen in the case of short-term fluctuation as mentioned above. However, there is not remarkable change in recent years. In 2015, the number of inbound tourists finally exceeds the number of outbound after 45 years since 1970. This phenomenon means that inbound tourists have a large impact on the Japanese economics and society. Tourism can contribute to regional revitalization.
Factors of destination choice of foreign tourists to Japan

We clarify factors of destination choice of foreign tourists and their purpose. Table 1 shows the top five prefectures where many foreign tourists visit and proportion of visit. The location of these prefectures is described in Figure 2. The main purposes of foreign tourists (one answer) visiting Japan are shown in Table 2. In addition, the things done during trip in Japan (multiple answers) are shown in Table 3. Data of the number of international travellers of visitor arrivals and Japanese overseas travelers from the Japan National Tourism Organization is used. These data were obtained by conducting sample survey of foreign tourists at airport and port.

Tab. 1. Tourist destination.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Prefecture</th>
<th>Proportion of visit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tokyo</td>
<td>19.89</td>
</tr>
<tr>
<td>2</td>
<td>Chiba</td>
<td>17.07</td>
</tr>
<tr>
<td>3</td>
<td>Osaka</td>
<td>13.38</td>
</tr>
<tr>
<td>4</td>
<td>Kyoto</td>
<td>8.98</td>
</tr>
<tr>
<td>5</td>
<td>Fukuoka</td>
<td>5.22</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>35.46</td>
</tr>
</tbody>
</table>

From Table 1, many tourists choose urban prefectures having big cities like Tokyo and Osaka. Every prefecture ranked in have a capital city or ordinance-designated city. About 65 percentages of foreign tourists choose these five prefectures as destination.

Tab. 2. The main purpose.

<table>
<thead>
<tr>
<th>The main purpose</th>
<th>Percentage</th>
<th>The main purpose</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Tourism/leisure</td>
<td>84.49</td>
<td>Incentive travel</td>
<td>0.90</td>
</tr>
<tr>
<td>Visiting family/friends</td>
<td>2.70</td>
<td>Exhibition/trade fair</td>
<td>0.11</td>
</tr>
<tr>
<td>Honeymoon</td>
<td>1.19</td>
<td>Company meeting (held offsite)</td>
<td>1.40</td>
</tr>
<tr>
<td>School-related trip</td>
<td>0.47</td>
<td>International conference</td>
<td>0.47</td>
</tr>
<tr>
<td>Sport/watching sport</td>
<td>1.40</td>
<td>Training</td>
<td>1.48</td>
</tr>
<tr>
<td>Event</td>
<td>0.40</td>
<td>Other business</td>
<td>3.17</td>
</tr>
<tr>
<td>Study</td>
<td>1.01</td>
<td>Transit</td>
<td>0</td>
</tr>
<tr>
<td>Medical treatment/Medical check-up</td>
<td>0.11</td>
<td>Other</td>
<td>0.72</td>
</tr>
</tbody>
</table>

From Table 2, we can understand that the purpose of most people who visit Japan is tourism of leisure. From Table 3, most of them enjoy shopping, eating and drinking, and leisure time such as Japanese food, Japanese sake, hot spring and Kabuki. From another data, the ratios of satisfaction with staying in Japan are 80 percent or more with the exception of items of Stay in a Japanese-style inn and Medical treatment/ Medical check-up, however the satisfaction ratio of these items are 75 percent or more.
Comparison between inbound tourism and domestic tourism in Japan

We grasp a present state of domestic tourism in Japan. Figure 3 shows proportion of tourist destination of Japanese tourist "overnight trip" and "a day trip" in each prefecture. Additionally, the proportion of tourist destination of foreign tourist is shown, too. Concerning domestic tourism, many tourists choose prefectures having big cities, this is a similar tendency as foreign tourists. However, the difference can be seen in distributions between Japanese tourists and foreign tourists. Regional gap of destination choice of foreign tourism is larger than that of Japanese domestic tourism. It is considered that foreign tourists acquire a lot of information about prefectures having big cities. However, they have little information about other areas. Therefore, this tendency can be seen.

<table>
<thead>
<tr>
<th>Done at this trip</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eat Japanese Food</td>
<td>95.8</td>
</tr>
<tr>
<td>Drink Japanese alcoholic beverages (Japanese Sake, Shochu, etc.)</td>
<td>42.9</td>
</tr>
<tr>
<td>Stay in a Japanese-style inn</td>
<td>34.5</td>
</tr>
<tr>
<td>Bathe in a hot spring</td>
<td>37.9</td>
</tr>
<tr>
<td>Nature/scenery sightseeing</td>
<td>64.0</td>
</tr>
<tr>
<td>Walking in shopping districts</td>
<td>71.2</td>
</tr>
<tr>
<td>Shopping</td>
<td>84.1</td>
</tr>
<tr>
<td>Galleries/museums</td>
<td>20.0</td>
</tr>
<tr>
<td>Theme parks</td>
<td>21.7</td>
</tr>
<tr>
<td>Ski/snowboard</td>
<td>3.0</td>
</tr>
<tr>
<td>Nature/scenery sightseeing</td>
<td>64.0</td>
</tr>
<tr>
<td>Enjoy Japanese pop culture (fashions, animations, etc.)</td>
<td>13.8</td>
</tr>
<tr>
<td>Medical treatment/Medical check-up</td>
<td>1.4</td>
</tr>
<tr>
<td>None of the above</td>
<td>0.6</td>
</tr>
<tr>
<td>Total</td>
<td>567.4</td>
</tr>
</tbody>
</table>

Fig. 3. Proportion of destination in each prefecture (Sum of each category = 100).
Where, \( Y_i \): Proportion of visit to prefecture \( i \) of foreign tourists, \( X_{1i} \): The number of important cultural properties, \( X_{2i} \): The number of business establishments of entertainment and amusement, \( a, b, c \): Parameters. Parameters in the Equation (1) are estimated by multiple regression analysis. Result of estimation of this model is shown in Table 4. No multiple collinearity between dependent variables was observed.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Parameter</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>The number of an important cultural properties</td>
<td>0.0024</td>
<td>2.8</td>
</tr>
<tr>
<td>The number of business establishments of entertainment and amusement</td>
<td>0.0021</td>
<td>6.0</td>
</tr>
<tr>
<td>Constant</td>
<td>-1.0079</td>
<td>-2.0</td>
</tr>
<tr>
<td>Coeficient of determination ( R^2 )</td>
<td>0.68</td>
<td></td>
</tr>
<tr>
<td>The number of sample</td>
<td></td>
<td>47</td>
</tr>
</tbody>
</table>

From Table 4, it can be seen that the result of estimation is acceptable in statistical accuracy. The number of business establishments of entertainment and amusement shows a strong correlation with the number of museum, restaurant and business establishments of retail. Therefore, this variable reflects these. In consideration of this situation, we can express behavior of destination choice quantitatively because foreign tourists attract unique Japanese food, culture and so on. as result of the survey.

### Conclusions

We are facing serious problems related to rapid population decline, aging population and low birthrate. In this situation, we analyze the trend of foreign tourists to Japan which is one of the most important factors to revitalize regions. Results obtained here are as follows.

1. The number of inbound tourists to Japan exceeds the outbound in 2015 after 45 years and this trend is projected to continue.
2. It is clarified that most people who visit Japan are on tourism, and they want to enjoy unique Japanese experience. Local municipality should disseminate information of attractiveness to the world. This leads to promotion of tourism.
3. We can construct a destination choice model in consideration of present state of factors. It is possible to do a simulation in case of conduction of regional policies using this model.

Promoting tourism is key point of regional revitalization. From the results of this study, we can understand that the improvement of the regional attraction related to unique Japanese food and culture is important quantitatively. In addition, a higher device in transmission ways of information is required.

### References


A toolkit for sustainable development planning: the Val D’Agri case study

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Key-words: Planning, Tools and techniques, Local development.

Introduction

This work describes the case study concerning the research delivered by authors in designing strategic development perspectives for the Val d’Agri area. It is a peculiar territory where high environmental values and oil-industry generate conflicts (social and environmental) and new instances for planning practice. It is a part of the results of a complex activity of assistance provided by the LISUT to the Val d’Agri Regional Administration, concerning the design of Inter-Municipal Structural Master Plan.

The Val d’Agri is context in which - along with woods and forests- a special territorial feature is represented by water landscapes opening realistic perspectives for tourism purposes development strategies. These opportunities are compared with the presence of oilfields and, actually, the extraction and processing presents significant risks of impact. The strong demand of employment opportunities, the tragic demographic crisis, the vulnerability of the stock housing faced by local communities, represents main critical points to be faced. The composition of these conflicts makes the case study is an example of the challenge of complexity to be handle through a rational approach instruments (we call toolkit).

In this framework, the developed methodology is proposed to build an integrated strategy, characterized by rational procedures ensuring inclusion and cooperation among local stakeholders and citizens. It coincides with the main principles of our proposal: i. efficiency in resource allocation; ii. equity in the distribution of opportunities; iii. protection of irreproducible resources (sustainability). The proposed approach looks at a rational logic in which, starting from the criticalities (the problems), through the implementation of the Logical Framework Approach (LFA), we explicit the link targets-products-activities-means-input.

The methodology is developed on the basis of an operational approach: "proceduralist" by Faludi (1987); in which, starting from objectives identification and strategies design, the plan promotes synergies that ensure the concentration of efforts in a few well-defined directions.
Toolkit: instruments for renewing territorial governance

We identified, among the complex framework of planning tools and models, the relevant methodologies for implementing effectively the overall research approach. The 'cognitive maps' represent an useful elaborations to represent an individual domain of interest by the interaction with "an actor", or of a group of actors. It is simplified and expressive abstractions based on the identification of concepts related to each other in order to form hierarchies and mutual dependencies.

In methodological terms the use of "mind maps" or "cognitive maps" is part of Methods Structuring Issues (Las Casas, Tilio, Tsoukiàs 2012): a family of methods of support of the early stage of the decision process oriented to achieve the involvement of mixed groups of stakeholders.

Among the different techniques, the SODA (Strategic Option Decision Analysis) is a method of identification of general problems, based on the use of cognitive maps to support and record the points of view of individual or collective groups through a discussion supported by a facilitator. It is a useful technique to encompass different points of view (often conflicting) compared to a problematic issue. The technique is based on the personal construct theory of Kelly (1995).

If the concepts are expressed in a map, connected to each other, then the learning process is simplified by the presence of explicit relationships, which help to bind new concepts to concepts already included in the map (Las Casas, Tilio, Tsoukiàs 2012).

The use of cognitive maps responds to a more general need for structuring the knowledge. Therefore the usefulness of the instrument belongs to the operation of consultation / participation processes in which the aim is: to define a vision, identifying key concepts ordered through relationships.

Ontologies represents the more conceptualized approach. With reference to recent experience (Zoppi, 2011; Rabino, 2011; Las Casas, Scorza, 2011) the application of ontologies to planning processes and land management, as well as more generally to the governance processes of place-based development, is a research domain that binds information tools operating procedures.

What we call "ontological approach" (Scorza et al., 2012) is an attempt to link the processes of knowledge construction in planning process (Scorza, 2011) to a rigorous approach that passes through the construction of planning ontology in which we represent the program structure, the system of actors, context resources etc.

The ontological approach implies an activity of modeling through a knowledge engineering process in a multidisciplinary framework (Las Casas, Scardaccione, 2008).

We assume the following definition of ontology: "explicit formal description a domain of interest."

In our methodological proposal, and generally in a rational approach to the planning process, in the final stage of synthesis, the The Logical Framework Approach (LFA) serves to structure the logic of the plan in order to facilitate its evaluation at different stages of the project cycle management.


Our proposal seeks to emphasize in addition to the principles of effectiveness and efficiency of public spending to make explicit the coherence and relevance of the policy choices with respect to the context of implementation with a view to looking for place or context based policy (Las Casas, Scorza, 2009).

The following diagram aims to compare these instruments from the degree of complexity and formalization approach and wants to give an overview of which is argued in the following paragraphs with reference to each family of instruments.
The procedure for Case Study implementation

The vision emerged for the case study area (the Val d’Agri) is based on the assumption that - under very strict conditions - the cultivation of oil fields and agricultural vocation can coexist with the maintenance of the most important share of naturalness and the reinforcement of traditional activities and other related innovations to the places characters. At the same time continuing exploration, production and processing of oil in southern part of the Val d’Agri will deliver to the exclusion of other extraction locations, avoiding dissemination of plants in Basilicata in order to limit territorial and environmental degradation to the actual sub areas. On the basis of the past we sized the development strategy on the assumption of about 400 million € over five years from oil extraction royalties according to a principle of concentration on functional targeting investments.

The wider strategic framework is described in Val d’Agri Inter-Municipal Structural Master Plan contributions delivered by LISUT research group, in this paper we intend to go in deep on he procedural aspects of the implementation.

The operational scheme described includes some relevant stages oriented to generate territorial chains of projects and operators managed in an integrated structure provided by the plan. A task force will take care of the opening and management of a conference aimed at sharing strategies and to gather concept proposals and than to the selection and to the whole evaluation cycle with a focus on:

1. the selection and integration of the proposals in order to complete the supply chains in the territorial contexts according to the plan priorities;
2. deepening of such proposals through a competitive call for participation;
3. the selection of those proposal recognized to be:
   A. the most consistent;
   B. the most relevant with respect to the needs and aspirations
   C. delivering positive synergies with other proposals in order to complete the chain and to promote integration.
D. characterized by a strong logical consistency
E. evaluable: ie related to a clear system of objectives
4. The financing of the most promising initiatives;
5. The on-going evaluation of the implementation and conduct of governance actions
6. ex post evaluation which includes a conformity assessment and a final evaluation that extract the "lessons learned" about the effectiveness and efficiency of the actions undertaken;
7. The Task Force will assist applicants in the preparation of the project and in the compilation of the format avoiding inefficiencies.

Conclusions

The research presents a complex problem for the harshness of environmental and social conflicts in the specific area of Val d’Agri. The effort was to reinforce the rationality of the planning exercise. It is an a-priori rationality based on the assumption that a good plan can be managed in condition of being able to have an explicit system of objectives and relations between strategies and local issues.

To this end were improved and applied a set of techniques with the risk to stiffen the process: this, in our opinion, depends on the care and time that the managing authorities and individual applicants can devote to their implementation including strong social interaction.

We look at supporting planning and implementation stages with a process of collective intelligence development based on specific knowledge of evolving set of needs and aspirations of local communities and the connected awareness.

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Indicators of resilience for Strategic Environmental Assessment

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Key-words: Resilience, Strategic Environmental Assessment, Indicators, GIS.

Introduction: regional space as socio-ecological systems

The Strategic Environmental Assessment (SEA), during a process of local or regional spatial planning represents an opportunity to assess the relationship between human actions related to urban and landscape form and the state of the environment in same place: a relationship that has been in crisis for a long time because of the biological diversity of times compared to times marked by the technological systems [1]. In order to reach an evaluation of the effects of potential changes in land use determined by the objectives of planning actions (actions which find their application in the implementing rules of the plan), the first step was to represent the system of relations of mutual influence between the natural system and settlement system, which represents the physical space in which it's possible to materialize the socio-economic territory of an urban community. Built environment and natural context are strongly interrelated. A highly integrated view of man / nature dynamic that recognizes an essential relationship of coevolution between the environment and human behaviours, approaches the concept of regional and urban spaces (or landscapes) to socio-ecological system. Socio-Ecological Systems (SES) are complex adaptive systems as they are based on the interaction of ecological phenomena, economic and social crises that evolve according to / adaptation cycles. The structure of a socio-ecological system consists of a set of relations in space and time of its components, whose mutual relations they shall express the organization and influence its evolutionary trajectory, which develops continuously starting from pre-existing conditions. Like all complex systems is an open system: for the second law of thermodynamics, can record a negative entropy change, which can lead to the development toward states of greater heterogeneity and complexity, which not only means the initial move it away from equilibrium but also the ability to change internally to "respond" to change. It's characterized by the presence of “leverage points”, points in which a perturbation, even minimal, can have an impact in a manner amplified within the entire system, the effect of the feedback circuits. The ability to produce emergent structures keeps the system far from equilibrium (i.e. a low entropy level), in dynamic conditions, which instead lead to an increase of order, and determining the mechanisms of self-organization. Assess the conditions of compatibility of human transformation in their environments means represent the resilient cycle of human-nature trajectories of evolution [2].
Methodology: resilience assessment

In terms of ecology and socio-ecology, the 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 passes from one equilibrium state to another without losing its internal fundamental structure, otherwise also defined in terms of “identity” [3]. Noting that particular type of complex systems such the urban regions and their landscapes, identify two main categories of failure: traumatic changes (shocks) and slow processes of change. While traumatic events (and their consequences and responses) have long been studied in the context of the disasters theories [4]. The second type of change (slow processes of mutation), which are observed in the systems in a gradual but steady transformation, can lead, albeit of longer times and for using of “molecular” transformations and punctual almost imperceptible or little impact if measured individually, also radical changes in the initial conditions. In these cases, the focus is not on the condition of balance and stability, but on the system’s ability to adapt to change and to preserve its identity. This approach to the study of regional resilience [5], which can be called evolutionary, resumes conceptual models developed in the framework of studies on socio-ecological systems (SES).

As argued by Cumming [6], the main question is to define the identity of a system and at the same time the thresholds above which the identity of the system change. The question dealing with building indicators that are able to be used in the assessment of “active” conservation status of a system (and a landscape-system in the case considered here). An urban or regional space is a part of a larger system, which contribute to the environmental dimensions (eco-systemic), social dimensions (civic traditions, common knowledge, relations) and economic and technological perspectives [7], in a constantly changing dynamic way in which external factors (drivers) lead to more or less significant local modifications. External conditions (external drivers: [8]), summarized in the sub-systems social context, economic dynamics, global natural phenomena (e.g.: climate change), culture, legal and regulatory environment, technology, lead to a state of pressure on local systems (and on landscapes in a specific way). Tangible and intangible components of the territory, as well as their relationships, suffer the effects of these stressors and, depending on the local and punctual actions (or sometimes inactions), determined by the response prepared by the local system context (institutions, regulatory model framework, regional economies, local knowledge, technologies applicable), amend their initial conditions.

To frame the landscape components within a single logical-conceptual model, the coastal landscape can be interpreted in three main dynamics of landscape values production [9]:

- Direct production of goods (through the landscape configuration, a local regional system produces goods and services: agricultural products, biodiversity, ecosystem services);
- Generation of values: production and reproduction of economic value, both public and private;
- Creation of identity values: permanence, persistence, transformation of collective recognition elements (territory and landscape as a common good).

While the first two production dynamics of values, what is to be evaluated is the system’s ability to maintain and possibly increase its potential production, in the case of identity values, what is decisive is the ability to preserve the conditions through the territorial-system can materialize the persistence in time of these values.

With regard to the built environment of European medium cities, it can be assumed that the two main phenomena triggered by external drivers (and possibly amplified by local fragility: [10] are attributable: a) to the urbanization categories (understood in the double polarity of the dynamic an spatial differentiated densification vs abandonment and then complex processes
concentration / depletion); b) to real estate conditions (to be understood in the double dimension of the over- or under economic evaluation of land values).

In particular, the process of urbanization may comprise three basic components:

- Intensive land use that results in pressure respect the convertibility of the building soils, and a general over-use of territorial assets;

- Abandonment in many rural areas: the dynamics of neglect of agricultural farms are increasingly serious factors of crisis, causing dangerous erosion or a messy (without regulation) return of nature (re-naturalization), which in turn further increases vulnerability factors (hydrological, fire risk, usability of forest resources, etc.)

- Misuse, which manifests itself in distortions in the spatial distribution of land uses (compression of the public space, development of secondary residences, fragmentation of service facilities, etc.), activities and functions.

Similarly the distorting effects of a housing market dominated by external factors, which in cultural landscapes tend to capture value only selectively for specific and narrow product segments (real estate, territorial, functional), can generate effects of impairment of relations between historical settlement and environment. As well as its opposite, i.e. the loss of real estate market value to many areas of crisis, is a factor that accelerates and increases the dropout phenomena.

Results and discussion: a GIS-based model for resilience assessment in SEA

In the GIS-based system for strategic environmental assessment built for the case study (eastern Ligurian coastal region, Italy), the resilience factors have been processed according to the following pairs of elements:

- density / distribution: for some items, such as the provision of services, the spatial density is critical; while in other cases what we must try to ensure, maintain or restore is the diffusive size [11], as in the case of the human presence in the territory, which is in every way encouraged, especially where the abandonment has already started producing distorting effects;

- connection / decoupling: in some situations, the system connectivity is basilar (these refer to the ecological networks, to networks of public services, accessibility), but in some cases the system can be defined more resilient when shows a segmentation capacity: may be the case of the diversification of tourism (in time, space and functions), which can represent an effective densification of distorting control tool as well as a useful aid to the land protection.

- diversity / homogeneity: also in this case may be situations in which a strong diversification is fundamental to the conservation the vitality of a system (the example can be represented in this case by the diversification of the offer); while in other cases the homogeneity can guarantee better performance standards.

- productivity: the regional ability to maintain over time its propensity to produce and process goods and values (tangible and intangible) that ensure the recognition over time image landscape identity and also ensure the preservation of those factors that define the landscape a common good.

- memory: the local system capabilities through adaptive properties developed as part of the self-organizational dimension of the system, to maintain (with innovativeness) the identity historical values.
If the aim is to assess the resilience through indicators, it may be useful to adopt the DPSIR model (i.e.: Driving forces, Pressure, State, Impact and Response: [12], as it allows the spatial physical size to those related to governance (and hence the response actions, which here are understood as adaptive capacity and therefore resilient system). The indicators must be constructed, according to this logic, with the purpose of interpreting and making some extent readable trajectories of change of landscapes, holding together the dynamics arising from external drivers with local characteristics of the landscape-system [13]. The sequence, the intensity, and the period in which the driving forces acting on a particular landscape depend on the characteristics and the susceptibility of the latter, in turn determined by the course of history, from the geographical characteristics and the barriers imposed by beliefs and local practices (cultural, legal, etc.: Lambin [14]). The external drivers modify the landscape according to various sizes, extensions, frequencies and speed, leading to the creation of a fragmented landscape, composed of a mosaic of different natural and manmade systems at different levels of modification and use [15].

The indicators are intended as measurement and evaluation tools that can measure not only static but dynamic in place according to the concept of transition (eg Kaligarič M., and Ivajnišč D [16] using a transition matrix based on neural networks and Markov chains). What the indicator must represent is the historical dynamics of structural regional change phenomena, highlighting the transition from one state to another of different areas.

The themes through which to interpret the changes in the landscape-environmental conditions are related to soils (defined as the quality of the land and as a systematic set of man-made accommodation, mainly for the purpose of agricultural management, for example, terraces, works of drainage and water systems management, excavations and filling, shaping of slopes), the settlement morphology, to the road network [17] and the land cover [18]. The indicators that represent the system transitions and therefore should then form the basis for assessing the resilience of landscapes bring back the reading of the state of landscape components to an interpretation of their transition through retention cycles, re-use, intensification of use, transformation. This dynamic representation allows to consider the elements and factors on which action to promote those system changes that can ensure the adaptability of the system landscape.

**Conclusions**

The GIS-based system assessment model, in this perspective, assumes the character of a system of knowledge based on an unitary ontology [19] that allows the representation of the basic components of environment (geomorphology, hydrology and coastal dynamics, biodiversity, land use and agriculture, settlement patterns, cultural heritage, activities, functions and infrastructure) through indicators measuring levels of fragility, vulnerability and resilience depending on the size of resilience before mentioned: access, distribution, diversity / homogeneity, productivity, memory) refers both to the same components in their integrated and cumulative reading [20]. The dual dynamic of thickening and thinning of artefacts, values, customs (a result of urbanization, which is spatially selective and produce different effects from place to place) is the dynamic that crossed with the state of landscape components provide elements of fragility evaluation of the territory and exposure to the risk of cultural values. Thus, for example, the environmental fragility indicator is the result of the intersection of variables related to real estate values (which have a different role depending on whether they are located: if in urban or rural areas, coastal or interior), to demographic trends, to housing density, the relationship between primary and secondary residences. Similarly, other indicators are derived on the basis of the overlapping of the basic variables that measure in terms of qualitative and
quantitative dynamics of urbanization. The overall evaluation framework that emerges is the result therefore of the spatial representation of the different dynamics of use / abandonment, leading to different local situations of fragility / vulnerability and that measure of potential risk conditions for the maintenance of landscape identity characters.

References


Scenarios’ evaluation of territorial transformation in the province of Belluno through the application of the AHP methodology

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Introduction

The Italian Alpine region is characterized by a socio-economic structure that has its main source of wealth in the cross-border traffic roads. Veneto, whose territory belongs to the Alps, is the only Italian region that does not have a direct mountain pass linking the next foreign country. The border territory of this region is in the North and it is represented by the Province of Belluno, a real cul-de-sac between the regions of Trentino Alto Adige and Friuli Venezia Giulia. In spite of this “communication obstruction” towards Europe, in the territory of the province of Belluno a strong manufacturing industry has developed in time, which is above all represented by the worldwide excellence of the eyewear district. Globalization processes are but progressively undermining the economic model of this province due to the absence of an international infrastructure transport route which allows it to rapidly connect to Europe and its markets.

Several strategies were proposed in the past and others have been presented nowadays. The goal of every presented proposal has always been to improve the socio-economic context and the accessibility to the territories of the Province of Belluno, with the purpose of equilibrating the economic-manufacturing as well as the employment context, where the tourist field, in some places, predominates. In other places, this context is instead characterized by a progressive abandonment. Starting from the main proposals of development made throughout the years, the present survey offers as follows: a) an overall picture of the features of “strategic” transport scenarios; b) a comparative evaluation of these proposals referring to the AHP methodology (Analytic Hierarchy Process). In detail, several projects – railways and roads – have been analysed, including the one regarding the realization of an important road infrastructure, which links the territory of Belluno province with the Austrian one in a direct way. This has allowed to define and contextualize the problem and consider the stakeholders and their aims. Therefore the criteria and sub-criteria which influence this problem have been identified and four different alternated scenarios have been supposed, aiming at defining the advisable infrastructure scenario linking Veneto (the Belluno province) with Austria (the Lienz district).
Methodology

The economy and the infrastructure level of a territory are two aspects which are clearly connected, but having different features according to the geographic and economic context. There are indeed situations where it is necessary to adjust a transport infrastructure to the needs of a leading economy and of an emerging demand – in this case the transport sector is the dependent variable compared with the economic determinant –. There are but also conditions where it is necessary to fulfil a transport infrastructure to reinforce the social and economic activities able to vitalize a territory – an effect coming from a choice which has created favourable conditions –. In the environmental evaluation of a territory – in a broader sense: the economic, social and ecological environmental evaluation – it is not possible to leave out its level of infrastructure, which is still considered the fundamental prerequisite for the socio-economic development. In the last decades the attention to the environment has been visibly growing, thus leading to a change of the planning methods. Even if this change has not homogeneously improved all territories, it is still going on and it is clear that a greater importance is given to the environmental elements. It should be remembered that in the past the environmental approach was pushed into the background to choices purely oriented to economic goals. It is a cross sectional change, which involves different aspects, such as the political, technical – professional – and disciplinary, and, not last, the public participation. Evaluating the opportunity to develop policies of infrastructural intervention is inevitable, but this point has a special meaning for the contexts that are characterized by strong natural, landscape and environmental values. In this circumstance, the role of the environmental evaluation is fundamental to help clarify the conflicting issues among different perspectives, such as the improvement of the accessibility of the Belluno province in order to sustain the economic development of the existing activities, but also to avoid the marginalisation of some particularly isolated built-up areas. The application of environmental evaluation models allows to determine the type, the hierarchy and the importance to be given to strategic actions, in order to manage the transformations, in relation to the features of geographical areas, of environmental strengths – potentialities – and weaknesses – criticalities – of the established fact and the wishes of local communities. In these cases, it is essential to use multi-criteria analysis models (MCMD, Multi-Criteria Method Decision) that allow to compare and arrange the options existing in the problem on the basis of data about often contrasting objectives. In this regard, the multi-criteria analysis aims at providing a support to the decision-taker to realize an acceptable compromise among different objectives to be followed, which are previously transformed into criteria. These obtained criteria will allow the comparison of the various options existing in the problem and, in turn, they will become part of the whole called “alternative” (Campeol, Carollo and Masotto, 2015). A discipline belonging to the MCMD and aimed at supporting the decision-maker during many and conflicting evaluations is the Multi-Criteria Decision Analysis (MCDA), which permits to obtain a compromise solution in a clear way. The Multi-Criteria Analysis methods support the decision-maker during the organization and the synthesis of complex and often heterogeneous information (Mocen, 2010). The MCDA measurement system, among the most widely used, permits to solve such kinds of problems and therefore we have consequently chosen it. AHP, introduced by Saaty (Saaty, 1980), is a common method dealing with MCDA problem. It benefits users for its simplicity in theory. It is very useful because it helps to manage the “uncertainty” that is a key concept in risk conceptualization and risk assessments (De Felice and Petrillo, 2014). It is a hierarchical analytic process that permits to take a decision among different options when we have multiple criteria. Through the application of the AHP four alternative scenarios of socio-economic development have been studied, that could arise in the territories of the Belluno
province. This methodology indeed allows to evaluate the priorities of actions and intervention strategies (Saaty, 1986).

The alternative scenarios being evaluated are as follows:

1. Scenario with railway for passenger transport (mainly with tourist function);
2. Scenario with High-Speed/Capacity Railway (HSR-HCR) with mixed system of partly regional trains and partly Frecce trains (passenger transport), also with possible transit of freight trains;
3. Scenario with arrangement of the local road practicability;
4. Scenario with highway and accessory works.

Results and discussion

Through the AHP technique priorities to a set of decision alternatives were assigned. Furthermore, qualitative and quantitative evaluations were carried out in order to identify the performing territorial scenarios for the Belluno province (Campeol, Carollo and Masotto, 2015).

The present research allowed to verify that the realisation of an important cross-border transport infrastructure, which is able to link the Veneto region with the European markets, can transform the Belluno province from a “barrier” into a geographical “pivot” with crucial economic and social effects not only in the Italian context but also in the Austrian one. Even if the evaluation process with the elaboration of data is still on, we can report that the more advisable scenarios resulting from the AHP are up to now as follows:

- the arrangement of the local road practicability by creating a tunnel which links the Belluno province with the Austrian territory in a direct way;
- the extension of the current railway going from Calalzo di Cadore to Lienz (Austria). It deals with the fulfilment of a railway of passenger transport (mainly with tourist function), with probably eight intermediate new railway stations. This allows to link the Belluno province with Austria through the tunnel in a direct way.

Conclusions

The quality of territorial development cannot be defined a priori, but only through environmental evaluation models that use appropriate techniques to evaluate impacts and alternative scenarios. Therefore the development cannot be defined in a univocal way; in fact, according to the socio-economic, ecological, geomorphological conditions, etc., the evaluation models permit to identify the typologies of development and the actions of implementation. The AHP evaluation approach has allowed to implement an efficacious decision support aid for the choice of the best strategies to be adopted for the benefit of the territory, that is to identify the more advisable “strategic scenario” in order to get to the best performance for the socio-economic development of the Belluno province.
References


INPUT, the International Conference on Innovation in Urban and Regional Planning is managed by an informal group of Italian academic researchers working in many fields related to the exploitation of informatics in planning. Since the first conference, held in 1999, INPUT has represented an opportunity to provide innovative and original contribution to the ongoing debate on the Innovation and the use of ICT in planning, management and evaluation issues and to improve the process of knowledge acquisition, by means of the development of new techniques and methods.

INPUT 2016 “e-agorà | e-ayopà for the transition toward resilient communities”, the 9th International Conference on Innovation in Urban and Regional Planning has been held the 14th and 15th of September 2016 in Turin at the Castello del Valentino.

Jointly organized by SiTI - Higher Institute on Territorial Systems for Innovation, DIST - Interuniversity Department of Regional and Urban Studies and Planning of the Politecnico di Torino and Università di Torino, and ISMB - Istituto Superiore Mario Boella on the Information and Communication Technologies, the Ninth Edition, starting from an open and critical view of the Smart City paradigm, aimed at raising a comprehensive spectrum of new and interdependent problems showing a multidisciplinary character and extends the horizon over which the urban growth strategies and, more generally, the regional development strategies are defined. This view not only calls into question technical or systemic issues, but heavily challenges societal and ethical aspects, assigning a new kind of responsibility to the needed research and innovation efforts.

Almost 90 contributions, more than 200 national and international authors have presented their research during 8 thematic sessions:

- STeHeC - Smart Territories and Healthy Cities
- ESSP - Ecosystem services and spatial planning
- TSC - Towards the Smart City: procedures, parameters, methods and tools
- SMGI - Social Media Geographic Information and collaborative mapping: exploring new trends in spatial analysis
- UFePC - Urban Form and Perception of the City
- IMPC - ICT Models: Planning for inclusive Communities
- URTL - Urban-Rural Transitional Landscapes
- MMSD - Methods and Models for Sustainable Development