

## How knowledge subjectivity affects decision-making: a Geodesign case study for the Cagliari Metro Area

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### 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

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 (Briassuolis, 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.

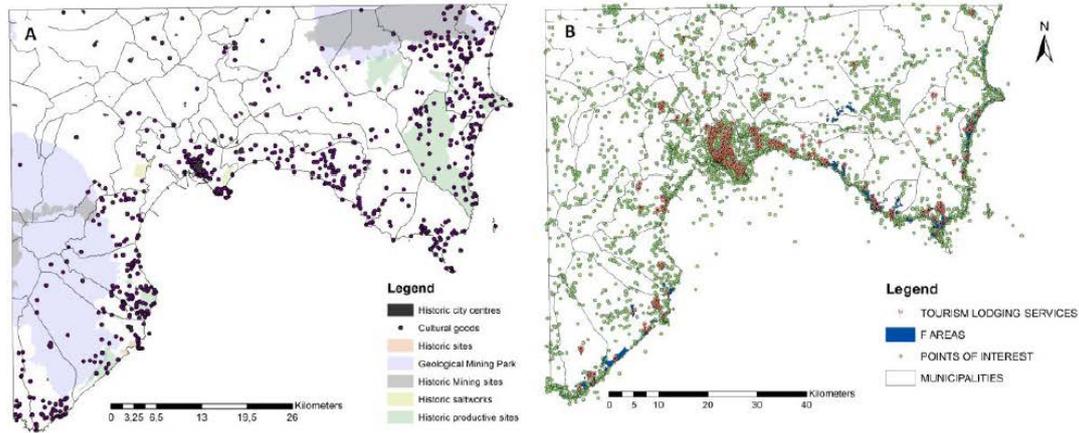


Fig. 1. Representation model of the CULTH and the TOUR systems.

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).

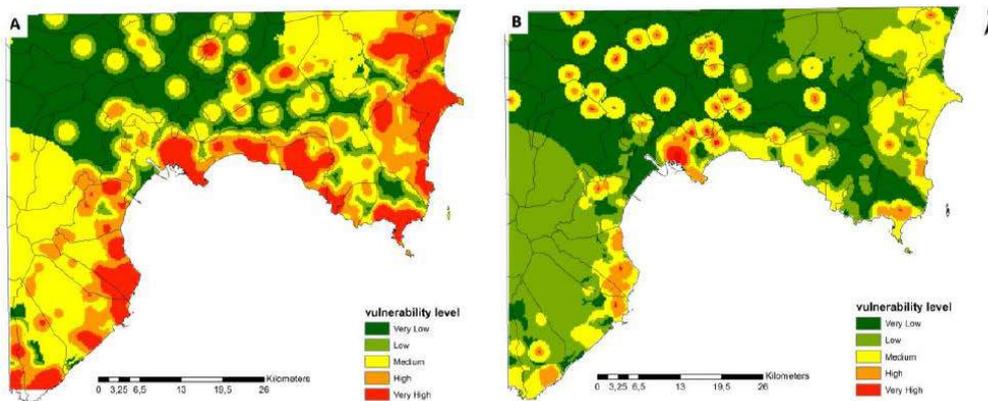


Fig. 2. Evaluation models of the CULTH system.

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).

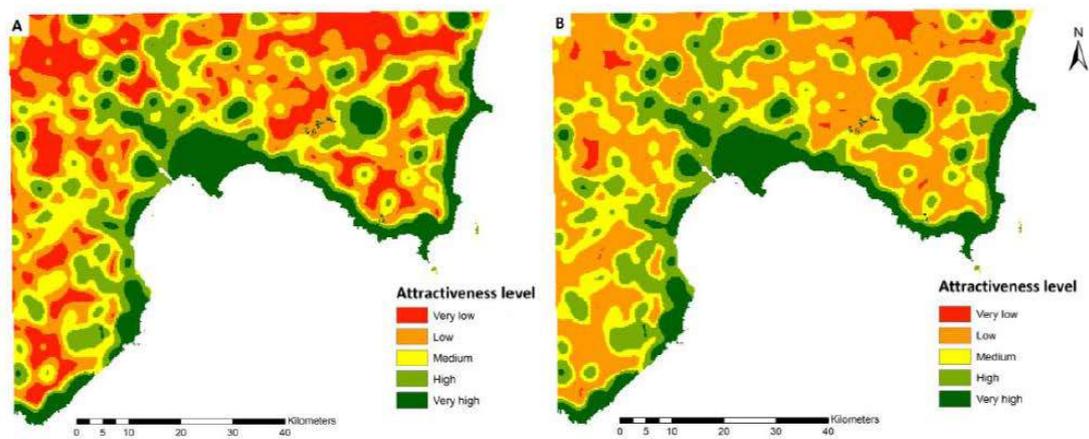


Fig. 3. Evaluation models of the TOUR system.

## 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' expertise, 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.

## Acknowledgements

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for the transition toward resilient communities

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## Table of Content

<b>INPUT 2016 is the ninth meeting with the name INPUT .....</b>	<b>10</b>
Arnaldo Cecchini	
<b>INPUT 2016 “e-<i>agorà</i>/e-<i>áγopά</i> for the transition toward resilient communities”</b>	<b>11</b>
Giovanni Colombo	
<b>STeHeC - Smart Territories and Healthy Cities .....</b>	<b>12</b>
<i>The role of urban cyclability in promoting public health .....</i>	<i>13</i>
Stefano Capolongo, Lorenzo Boati, Maddalena Buffoli, Marco Gola, Alessandra Oppio and Andrea Rebecchi	
<i>Social inclusion and use of equipped public space for physical activity. Analysis and promotion prospects .....</i>	<i>19</i>
Rossella Maspoli	
<i>Beyond geospatial visualisation: maps for health research .....</i>	<i>25</i>
Enrico Cicalò	
<i>Urban Form from the Pedestrian Point of View: Spatial Patterns on a Street Network .....</i>	<i>32</i>
Alessandro Araldi and Giovanni Fusco	
<i>3D Modelling from Urban Environment to Internal Management of Buildings .....</i>	<i>39</i>
Maurizio Minchilli, Elena Carta, Barbora Slabeciusová and Loredana Tedeschi	
<i>Appropriate Technologies and Deprived Neighbourhoods: Making Technologies Work for Inclusive Urban Development .....</i>	<i>46</i>
Arnaldo Cecchini, Valentina Talu and Andrea Vesco	
<i>Planning, managing and empowering while pursuing change: integrating community map-making and geographic information technologies .....</i>	<i>52</i>
Barbara Dovarch	
<i>Flexible Design to Territory Smart User-Centered .....</i>	<i>60</i>
Cristiana Cellucci and Daniela Ladiana	
<i>Integrated Accessibility: a Macro-Requirement for the Healthy City .....</i>	<i>65</i>
Filippo Angelucci and Michele Di Sivo	
<i>Environment – Cities – Users: a multidisciplinary approach for the quality of urban spaces .....</i>	<i>71</i>
Angela Giovanna Leuzzi, Roberta Cocci Grifoni, Maria Federica Ottone and Enrico Prenna	
<i>Walk, See, Know: Modelling Landscape Accessibilities .....</i>	<i>77</i>
Enrico Cicalò, Arnaldo Cecchini, Nada Beretic, Roberto Busonera, Dario Canu and Andrea Causin	
<i>Recording, management and returning of data for improving accessibility of public spaces by involving users .....</i>	<i>83</i>
Ilaria Garofolo, Elisabeth Antonaglia and Barbara Chiarelli	
<i>Multilevel Infrastructures .....</i>	<i>89</i>
Claudia Di Girolamo	
<i>The built environment as a determinant of the public health. An epidemiological survey of the walking behavior in Sardinia .....</i>	<i>93</i>

Marco Dettori, Andrea Piana and Paolo Castiglia	
<i>Shaping urban pedestrian mobility involving users: the Labac case study</i> .....	98
Barbara Chiarelli, Silvia Grion and Ilaria Garofolo	
<i>Spatial image of territories. The case study of Sardinia</i> .....	102
Miriam Mastinu	
<i>An Empirical Study on Factors of Perceived Walkability</i> .....	108
Ivan Blečić, Dario Canu, Arnaldo Cecchini, Tanja Congiu, Giovanna Fancello and Giuseppe Andrea Trunfio	
<i>GPS Traking and Surveys Analysis of Tourists' Spatio-Temporal Behaviour. The case of Alghero.</i> .....	114
Ivan Blečić, Dario Canu , Arnaldo Cecchini, Tanja Congiu, Giovanna Fancello and Giuseppe Andrea Trunfio	
<i>Triggers of urban innovation. The Case of Cavallerizza Reale in Turin</i> .....	121
Roberta Guido	
<i>No more build, but regenerate and reuse</i> .....	128
Cristiana Cellucci and Daniela Ladiana	
<i>A Reflection on Smart Governance in the new Metropolitan City of Cagliari</i> .....	135
Chiara Garau, Ginevra Balletto and Paola Zamperlin	
<i>R&amp;S.U.E Resilient &amp; Safe Urban Environment</i> .....	143
Ester Zazzero	
<i>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</i> .....	151
Tanja Congiu, Maurizio Napolitano and Alessandro Plaisant	
<i>Urban intersections effect on pedestrian accessibility</i> .....	157
Ivan Blečić, Arnaldo Cecchini, Tanja Congiu, Dario Canu and Giovanna Fancello	
<i>Built environment and health inequalities: results from a European research project and overview of methods for assessing health impacts in urban areas</i> .....	164
Enrico Eynard, Giulia Melis and Matteo Tabasso	
<b>ESSP - Ecosystem Services and Spatial Planning</b> .....	<b>170</b>
<i>Graph Representations of Site and Species Relations in Ecological Complex Networks</i> .....	171
Gianni Fenu and Pier Luigi Pau	
<i>Conflictual issues concerning land uses related to ecosystem services under the provisions of the Habitats and Birds Directives</i> .....	177
Federica Leone and Corrado Zoppi	
<i>Assessment: land use and capacities to provide ecosystem service. The case study of Tertenia</i> ..	184
Maddalena Floris	
<i>The Natura 2000 Network in the context of the Metropolitan City of Cagliari: an example of Habitat Suitability Approach (part one)</i> .....	190
Daniela Ruggeri and Ignazio Cannas	

<i>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)</i> .....	196
Ignazio Cannas and Daniela Ruggeri	
<i>Ecosystem services within the appropriate assessment of land-use plans: exploring a potential integration</i> .....	202
Sabrina Lai	
<i>Courtyards, Climate regulation services and Nature-based solutions: a modelling approach to support urban regeneration of empty spaces</i> .....	208
Raffaele Pelorosso, Federica Gobattonia, Francesca Calace and Antonio Leone	
<b>TSC - Towards the Smart City</b> .....	<b>213</b>
<i>A critical review of parameters within urban sustainability models: how much do soil and natural resources weight?</i> .....	214
Floriana Zucaro	
<i>The building aspect ratio for an energy efficient green network design</i> .....	220
Carmela Gargiulo and Andrea Tulisi	
<i>Energy efficiency measures for building and their impact on the grid in a Middle East case study</i> .....	226
Paolo Lazzeroni, Sergio Olivero, Federico Stirano, Guido Zanzottera, Carlo Micono, Piercarlo Montaldo and Umberto Fabio Cali	
<i>Energy consumption in hospitals: towards a new benchmark</i> .....	231
Romano Fistola and Marco Raimondo	
<i>Urban Environmental Quality and Sustainability: a proposal for an evaluation method of Neighborhood Sustainable Assessment tools</i> .....	238
Rocco Papa, Chiara Lombardi and Maria Rosa Tremiterra	
<i>DIPENDE – a tool for energy planning of building districts based on energy performance certification data</i> .....	245
Ezilda Costanzo, Bruno Baldissara and Marco Rao	
<i>Energy Efficiency and Participation: a double smart approach in LEO project</i> .....	251
Cristina Marietta, Giulia Melis and Maurizio Fantino	
<i>Identify the sustainable level of local plans and urban sectors. Proposal for an operational procedure</i> .....	258
Giuseppe Mazzeo	
<i>Key Messages: a decision support system based on the integration between city and mobility</i> .	264
Carmela Gargiulo and Maria Rosa Tremiterra	
<i>Accessibility and built environment surrounding metro stations: a GIS-based comparison of Naples line 1, Milan line 3 and London Jubilee line</i> .....	269
Rocco Papaa, Gerardo Carpentieria and Gennaro Angiello	
<i>A GIS-based and socially participative procedure for the location of high vulnerability territorial functions</i> .....	275
Romano Fistola and Rosa Anna La Rocca	

<i>Modelling and Assessing Pedestrian Isochrones around Public Transport Nodes: a People-Centred Perspective towards Smartness</i> .....	281
Silvia Rossetti, Michela Tiboni and David Vetturi	
<i>Households' willingness to pay in good and bad economy. The case study of Naples</i> .....	287
Carmela Gargiulo, Simona Panaro and Laura Russo	
<b>SMGI - Social Media Geographic Information and collaborative mapping: exploring new trends in spatial analysis</b> .....	<b>294</b>
<i>Social Media Geographic Information Visual Analytics</i> .....	295
Junia Borges, Ana Clara Moura, Priscila de Paula and Pedro Casagrande	
<i>Beyond social networks contents: how Social Media Geographic Information may support spatial planning analysis</i> .....	300
Pierangelo Massa, Roberta Floris and Michele Campagna	
<i>Social Media Geographic Information for urban space analysis: the case of Expo Milano 2015</i> .	307
Raffaele Gallo, Michele Campagna, Pierangelo Massa and Giovanni Rabino	
<i>The use of SMGI in supporting tourism planning practices: an innovative approach for the municipality of Cagliari</i> .....	313
Roberta Floris, Pierangelo Massa and Michele Campagna	
<i>Real society in virtual space: a new platform to share responsibilities</i> .....	319
Lucia Lupi, Alessio Antonini, Guido Boella and Eloheh Mason	
<i>Online tools for public engagement: case studies from Reykjavik</i> .....	325
<b>Iva Bojic, Giulia Marra and Vera Naydenova</b>	
<i>Comparing Traditional Maps with Twitter-Derived Maps: Exploring Differences and Similarities</i> .....	331
Stefano Pensa and Elena Masala	
<i>Mapping the food system in Turin</i> .....	337
Luca Davico, Marina Bravi, Egidio Dansero, Gabriele Garnerò, Paola Guerreschi, Federico Listello, Giacomo Pettenati, Paolo Tamborin and Alessia Toldo	
<i>Crowdmap applied to Geotourism: Case Study of Chapada Diamantina BA - Brazil</i> .....	344
Pedro B. Casagrande, Nicole Rocha, Priscila Lisboa and Ana Clara Mourão Moura	
<i>MiraMap: an e-participation tool for Smart Peripheries</i> .....	350
Francesca De Filippi, Cristina Coscia, Guido Boella, Alessio Antonini, Alessia Calafiore, Anna Cantini, Roberta Guido, Carlo Salaroglio, Luigi Sanasi and Claudio Schifanella	
<i>Production of spatial representations through collaborative mapping. An experiment</i> .....	356
Angioletta Voghera, Rossella Crivello, Liliana Ardissono, Maurizio Lucenteforte, Adriano Savoca and Luigi La Riccia	
<b>UF<sub>e</sub>PC - Urban Form and Perception of the City</b> .....	<b>362</b>
<i>THE FRIENDLY CITY [LA CIUDAD AMABLE]. Andalusian Public Space Programme Awareness raising, training and interventions regarding cities, public space and sustainable mobility</i> .....	
363	

Gaia Redaelli	
<i>Space Syntax applied to the city of Milan</i> .....	370
Valerio Cutini, Denise Farese and Giovanni Rabino	
<i>Configurational Approaches to Urban Form: Empirical Test on the City of Nice (France)</i> .....	376
Giovanni Fusco and Michele Tirico	
<i>Physical factors affecting the citizens' security feeling in communal spaces (case study: BandarAbbas city)</i> .....	383
Ali Shahdadi and Marziyeh Rezanejad	
<i>Conurbations and resilience. When growth makes us fragile</i> .....	389
Valerio Cutini	
<b>IMPC – ICT Models: Planning for inclusive Communities</b> .....	<b>395</b>
<i>Virtual Environments as a Technological Interface between Cultural Heritage and the Sustainable Development of the City</i> .....	396
Georgios Artopoulos	
<i>Visualisation Tools in Grasshopper+Rhino3D to Improve Multi-Criteria Analysis in Urban Policies – Case Study of Pampulha, Brazil</i> .....	404
Ana Clara Mourão Moura, Suellen R. Ribeiro, Diogo C. Gualdalupe and Silvio R. Motta	
<i>Studies of Volumetric Potential in Pampulha, Brazil</i> .....	411
Suellen R. Ribeiro and Ana Clara Mourão Moura	
<i>When the parametric modeling reveals a collapse in the future urban landscape: The case of Divinópolis – Minas Gerais/Brazil</i> .....	418
Diogo de Castro Guadalupe, Bruno Amaral de Andrade and Ana Clara Mourão Moura	
<i>A Spatial Decision Support System for Industrial Re-Use</i> .....	424
Alessia Movia and Maria Vittoria Santi	
<i>How knowledge subjectivity affects decision-making: a Geodesign case study for the Cagliari Metro Area</i> .....	429
Elisabetta Anna Di Cesare, Roberta Floris and Michele Campagna	
<i>Knowledge Organization for Community Revitalization: An Ontological Approach in Taranto Industrial City</i> .....	436
Rossella Stufano, Dino Borri, Domenico Camarda and Stefano Borgo	
<i>Integrating VGI system in a Participatory Design Framework</i> .....	441
Alessia Calafiore, Junia Borges, Ana Clara Mourão Moura and Guido Boella	
<i>Evaluation of social benefits generated by urban regeneration: a stated preference approach</i> .....	447
Marta Bottero and Giulio Mondini	
<b>URTL - Urban-Rural Transitional Landscapes</b> .....	<b>453</b>
<i>Urban-rural-natural gradient analysis using CORINE data: an application to the Italian regions of Friuli Venezia Giulia, Umbria, and Calabria</i> .....	454

Marco Vizzari, Sara Antognelli, Maurizia Sigura and Giuseppe Modica	
<i>Liveability services in transitional landscapes: a spatial-MCDA model for assessment and mapping</i> .....	461
Sara Antognelli and Marco Vizzari	
<i>Big data and environmental management: the perspectives of the Regional Environmental Information System of Sardinia, Italy</i> .....	468
Andrea De Montis, Sabrina Lai, Nicoletta Sannio and Gianluca Cocco	
<i>Quantifying transport infrastructures and settlement fragmentation: strategic measures for rural landscape planning</i> .....	474
Andrea De Montis, Antonio Ledda, Vittorio Serra and Mario Barra	
<i>Multi-temporal satellite imagery for soil sealing detection and urban growth mapping in the city of Ranchi (India)</i> .....	480
Andrea Lessio, Vanina Fissore, Barbara Drusia and Enrico Borgogno-Mondino	
<i>Temporal variation of ecological network's structure: some insights on the role of Natura 2000 sites</i> .....	486
Giuseppe Modica, Luigi Laudaria, Andrea De Montis, Simone Caschili, Maurizio Mulas, Amedeo Ganciu, Leonarda Dessena and Carmelo Riccardo Fichera	
<i>Reducing land take and preserving land quality. A methodology for the application of the Lombardy Regional Law</i> .....	493
Raffaele Sigon and Giulio Senes	
<i>GIS advanced tools for urban growth reading and management for best practices in town-planning</i> .....	498
Enrico Borgogno-Mondino and Barbara Drusi	
<i>The bioremediation of polluted areas as an opportunity to improve ecosystem services</i> .....	505
Lorenzo Boccia, Alessandra Capolupo, Elena Cervelli, Stefania Pindozi, Marina Rigillo and Maria Nicolina Ripa	
<i>Landscape Bionomics: A Comparison Between Two Rural-Suburban Landscapes from Brussels and Milan</i> .....	512
Vittorio Ingegnoli, Ernesto Marcheggiani, Hubert Gulinck, Fredrik Larouge and Andrea Galli	
<i>Mapping Cilento: Visual analysis of geotagged Twitter data to study touristic flows in southern Italy</i> .....	519
Ernesto Marcheggiani, Alvin Chuac, Loris Servillo and Andrew Vande Moere	
<i>Association between a spectral index and a landscape index for mapping and analysis of urban vegetation cover</i> .....	526
Nicole A. da Rocha, Ítalo S. Sena, Bráulio M. Fonseca and Ana Clara Mourão Moura	
<b>MMSD - Methods and Models for Sustainable Development</b> .....	<b>532</b>
<i>Mobility Flow Estimates at Sub-Regional level: an Application to Piedmont</i> .....	533
Simone Landini, Sylvie Occelli	
<i>A parametric method to analyze and enhance the cultural heritage and its context</i> .....	538
Roberto De Lotto, Veronica Gazzola, Cecilia Morelli di Popolo and Elisabetta Maria Venco	
<i>Present State of Inbound Tourism in Japan and Factors of Destination Choice</i> .....	545

Akiko Kondo and Akio Kondo

*A toolkit for sustainable development planning: the Val D'Agri case study* .....551

Giuseppe Las Casas and Francesco Scorza

*Indicators of resilience for Strategic Environmental Assessment* .....557

Giampiero Lombardini

*Scenarios' evaluation of territorial transformation in the province of Belluno through the application of the AHP methodology* .....563

Giovanni Campeol, Fabio De Felice, Nicola Masotto, Antonella Petrillo and Giuseppe Stelin