9th International Conference on Innovation in Urban and Regional Planning

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

Conference Proceedings Book
ISBN 978-88-9052-964-1
INPUT 2016 “e-agorà/e-άγορά for the transition toward resilient communities”

INPUT2016 CONFERENCE COMMITTEE
Arnaldo Cecchini, University of Sassari
Dino Borri, Polytechnic University of Bari
Valerio Cutini, University of Pisa
Alessandro Plaisant, University of Sassari
Giovanni Rabino, Polytechnic University of Milan
Giuseppe Las Casas, University of Basilicata
Michele Campagna, University of Cagliari
Andrea De Montis, University of Sassari
Corrado Zoppi, University of Cagliari
Rocco Papa, University of Naples "Federico II"
Patrizia Lombardi, Politecnico di Turino
Giovanni Colombo, ISMB Istituto Superiore Mario Boella
Giulio Mondini, SiTI Higher Institute on Territorial Systems for Innovation

INPUT2016 SCIENTIFIC COMMITTEE
Ivan Blecic, University of Cagliari
Dino Borri, Polytechnic University of Bari
Grazia Brunetta, Politecnico di Torino
Edoardo Calla, ISMB Istituto Superiore Mario Boella
Domenico Camarda, Polytechnic University of Bari
Michele Campagna, University of Cagliari
Alessandra Casu, University of Sassari
Arnaldo Cecchini, University of Sassari
Giovanni Colombo, ISMB Istituto Superiore Mario Boella
Grazia Concilio, Polytechnic University of Milan
Tanja Congiu, University of Sassari
Valerio Cutini, University of Pisa
Andrea De Montis, University of Sassari
Giovanna Fancelli, Paris-Dauphine University
Romano Fistola, University of Sannio
Sabrina Lai, University of Cagliari
Giuseppe Las Casas, University of Basilicata
Federica Leone, University of Cagliari
Sara Levi Sacerdotti, SiTI Higher Institute on Territorial Systems for Innovation
Patrizia Lombardi, Politecnico di Torino
Giovanni Lombardini, Università degli Studi di Genova
Enrico Macii, Politecnico di Torino
Fabio Manfredini, Polytechnic University of Milan
Stefania Mauro, SiTI Higher Institute on Territorial Systems for Innovation
Giulio Mondini, SiTI Higher Institute on Territorial Systems for Innovation
Eugenio Morello, Polytechnic University of Milan
Beniamino Murgante, University of Basilicata
Silvia Osecelli, IRES Piemonte
Andrea Pacifici, ISMB Istituto Superiore Mario Boella
Rocco Papa, University of Naples “Federico II”
Paola Pittaluga, University of Sassari
Alessandro Plaisant, University of Sassari
Giovanni Rabino, Polytechnic University of Milan
Bernardino Romano, Università degli Studi dell’Aquila
Marco Santangelo, Politecnico di Torino
Francesco Scorza, University of Basilicata
Matteo Tabasso, SiTI Higher Institute on Territorial Systems for Innovation
Valentina Tatu, University of Sassari
Andrea Trunfio, University of Sassari
Andrea Vesco, ISMB Istituto Superiore Mario Boella
Angioletta Voghera, Politecnico di Torino
Corrado Zoppi, University of Cagliari

INPUT2016 ORGANISING COMMITTEE
Cristiana D’Alberto, ISMB Istituto Superiore Mario Boella
Maria Cristina Longo, SiTI Higher Institute on Territorial Systems for Innovation
Stefania Mauro, SiTI Higher Institute on Territorial Systems for Innovation
Luisa Montobbio, Politecnico di Torino
Cinzia Pagano, Politecnico di Torino

Edited by Giovanni Colombo (ISMB Istituto Superiore Mario Boella), Patrizia Lombardi (DIST - Politecnico di Torino), Giulio Mondini (SiTI Higher Institute on Territorial Systems for Innovation)

Editorial coordination by Stefania Mauro
Graphic design by Sara Oggero (ISMB)

ISBN 978-88-9052-964-1
Table of Content

INPUT 2016 is the ninth meeting with the name INPUT .................................................. 10
Arnaldo Cecchini

INPUT 2016 “e-agorà/e-ἀγορά for the transition toward resilient communities” 11
Giovanni Colombo

STeHeC - Smart Territories and Healthy Cities ................................................................. 12

The role of urban cyclability in promoting public health ...................................................... 13
Stefano Capolongo, Lorenzo Boati, Maddalena Buffoli, Marco Gola, Alessandra Oppio and Andrea Rebecchi

Social inclusion and use of equipped public space for physical activity. Analysis and promotion prospects .......................................................... 19
Rossella Maspoli

Beyond geospatial visualisation: maps for health research .............................................. 25
Enrico Cicalò

Urban Form from the Pedestrian Point of View: Spatial Patterns on a Street Network ........ 32
Alessandro Araldi and Giovanni Fusco

3D Modelling from Urban Environment to Internal Management of Buildings ............... 39
Maurizio Minchilli, Elena Carta, Barbora Slabeciusová and Loredana Tedeschi

Appropriate Technologies and Deprived Neighbourhoods: Making Technologies Work for Inclusive Urban Development ........................................ 46
Arnaldo Cecchini, Valentina Talu and Andrea Vesco

Planning, managing and empowering while pursuing change: integrating community map-making and geographic information technologies .................................................. 52
Barbara Dovarch

Flexible Design to Territory Smart User-Centered .......................................................... 60
Cristiana Cellucci and Daniela Ladiana

Integrated Accessibility: a Macro-Requirement for the Healthy City ................................ 65
Filippo Angelucci and Michele Di Sivo

Environment – Cities – Users: a multidisciplinary approach for the quality of urban spaces ..... 71
Angela Giovanna Leuzzi, Roberta Cocci Grifoni, Maria Federica Ottone and Enrico Prenna

Walk, See, Know: Modelling Landscape Accessibilities .................................................. 77
Enrico Cicalò, Arnaldo Cecchini, Nada Beretic, Roberto Busonera, Dario Canu and Andrea Causin

Recording, management and returning of data for improving accessibility of public spaces by involving users ................................................................. 83
Ilaria Garofolo, Elisabeth Antonaglia and Barbara Chiarelli

Multilevel Infrastructures ................................................................................................. 89
Claudia Di Girolamo

The built environment as a determinant of the public health. An epidemiological survey of the walking behavior in Sardinia ......................................................... 93
Marco Dettori, Andrea Piana and Paolo Castiglia

Shaping urban pedestrian mobility involving users: the Labac case study ................................................. 98

Barbara Chiarelli, Silvia Grion and Ilaria Garofolo

Spatial image of territories. The case study of Sardinia ............................................................................. 102

Miriam Mastinu

An Empirical Study on Factors of Perceived Walkability .............................................................................. 108

Ivan Blečić, Dario Canu, Arnaldo Cecchini, Tanja Congiu, Giovanna Fancelli and Giuseppe Andrea Trunfo

GPS Tracking and Surveys Analysis of Tourists’ Spatio-Temporal Behaviour. The case of Alghero. ................................................................................................................................. 114

Ivan Blečić, Dario Canu, Arnaldo Cecchini, Tanja Congiu, Giovanna Fancelli and Giuseppe Andrea Trunfo

Triggers of urban innovation. The Case of Cavallerizza Reale in Turin .......................................................... 121

Roberta Guido

No more build, but regenerate and reuse ........................................................................................................ 128

Cristiana Cellucci and Daniela Ladiana

A Reflection on Smart Governance in the new Metropolitan City of Cagliari .............................................. 135

Chiara Garau, Ginevra Balletto and Paola Zamperlin

R&S.U.E Resilient & Safe Urban Environment .............................................................................................. 143

Ester Zazzero

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 ............................................................................................................................................................................. 151

Tanja Congiu, Maurizio Napolitano and Alessandro Plaisant

Urban intersections effect on pedestrian accessibility .................................................................................... 157

Ivan Blečić, Arnaldo Cecchini, Tanja Congiu, Dario Canu and Giovanna Fancelli

Built environment and health inequalities: results from a European research project and overview of methods for assessing health impacts in urban areas ..................................................................................... 164

Enrico Eynard, Giulia Melis and Matteo Tabasso

ESSP - Ecosystem Services and Spatial Planning ................................................................................................. 170

Gianni Fenu and Pier Luigi Pau

Graph Representations of Site and Species Relations in Ecological Complex Networks .............................. 171

Federica Leone and Corrado Zoppi

Assessment: land use and capacities to provide ecosystem service. The case study of Tertenia .................. 184

Maddalena Floris

The Natura 2000 Network in the context of the Metropolitan City of Cagliari: an example of Habitat Suitability Approach (part one) ................................................................................................................. 190

Daniela Ruggeri and Ignazio Cannas
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) ................................................................. 196
Ignazio Cannas and Daniela Ruggeri

Ecosystem services within the appropriate assessment of land-use plans: exploring a potential integration ................................................................. 202
Sabrina Lai

Courtyards, Climate regulation services and Nature-based solutions: a modelling approach to support urban regeneration of empty spaces ................................................................. 208
Raffaele Pelorosso, Federica Gobattonia, Francesca Calace and Antonio Leone

TSC - Towards the Smart City ........................................................................................................................................................................................................ 213

A critical review of parameters within urban sustainability models: how much do soil and natural resources weight? ..................................................................................................................................................... 214
Floriana Zucaro

The building aspect ratio for an energy efficient green network design ................................................................. 220
Carmela Gargiulo and Andrea Tulisi

Energy efficiency measures for building and their impact on the grid in a Middle East case study .................................................................................................................................................................. 226
Paolo Lazzeroni, Sergio Olivero, Federico Stirano, Guido Zanzottera, Carlo Micono, Piercarlo Montaldo and Umberto Fabio Calì”

Energy consumption in hospitals: towards a new benchmark ............................................................................................................................................................ 231
Romano Fistola and Marco Raimondo

Urban Environmental Quality and Sustainability: a proposal for an evaluation method of Neighborhood Sustainable Assessment tools .................................................................................................................................................. 238
Rocco Papa, Chiara Lombardi and Maria Rosa Tremiterra

DIPENDE – a tool for energy planning of building districts based on energy performance certification data ........................................................................................................................................................................ 245
Ezilda Costanzo, Bruno Baldissara and Marco Rao

Energy Efficiency and Participation: a double smart approach in LEO project .......................................................................................................................................................... 251
Cristina Marietta, Giulia Melis and Maurizio Fantino

Identify the sustainable level of local plans and urban sectors. Proposal for an operational procedure ............................................................................................................................................................ 258
Giuseppe Mazzeo

Key Messages: a decision support system based on the integration between city and mobility ............................................................................................................................. 264
Carmela Gargiulo and Maria Rosa Tremiterra

Accessibility and built environment surrounding metro stations: a GIS-based comparison of Naples line 1, Milan line 3 and London Jubilee line ........................................................................................................................................................................ 269
Rocco Papaa, Gerardo Carpentieria and Gennaro Angiello

A GIS-based and socially participative procedure for the location of high vulnerability territorial functions ................................................................................................................................................................. 275
Romano Fistola and Rosa Anna La Rocca
Modelling and Assessing Pedestrian Isochrones around Public Transport Nodes: a People-Centred Perspective towards Smartness .................................................................281
Silvia Rossetti, Michela Tiboni and David Vetturi

Households’ willingness to pay in good and bad economy. The case study of Naples ..............287
Carmela Gargiulo, Simona Panaro and Laura Russo

SMGI - Social Media Geographic Information and collaborative mapping: exploring new trends in spatial analysis ..........................................................................................294

Social Media Geographic Information Visual Analytics .............................................................................295
Junia Borges, Ana Clara Moura, Priscila de Paula and Pedro Casagrande

Beyond social networks contents: how Social Media Geographic Information may support spatial planning analysis ..................................................................................300
Pierangelo Massa, Roberta Floris and Michele Campagna

Social Media Geographic Information for urban space analysis: the case of Expo Milano 2015 307
Raffaele Gallo, Michele Campagna, Pierangelo Massa and Giovanni Rabino

The use of SMGI in supporting tourism planning practices: an innovative approach for the municipality of Cagliari ......................................................................................313
Roberta Floris, Pierangelo Massa and Michele Campagna

Real society in virtual space: a new platform to share responsibilities ..................................................319
Lucia Lupi, Alessio Antonini, Guido Boella and Eloheh Mason

Online tools for public engagement: case studies from Reykjavik ..........................................................325
Iva Bojic, Giulia Marra and Vera Naydenova

Comparing Traditional Maps with Twitter-Derived Maps: Exploring Differences and Similarities ..............................................................................................................331
Stefano Pensa and Elena Masala

Mapping the food system in Turin ..............................................................................................................337
Luca Davico, Marina Bravi, Egidio Dansero, Gabriele Garnero, Paola Guerreschi, Federico Listello, Giacomo Pettenati, Paolo Tamborrin and Alessia Toldo

Crowdmap applied to Geotourism: Case Study of Chapada Diamantina BA - Brazil .........................344
Pedro B. Casagrande, Nicole Rocha, Priscila Lisboa and Ana Clara Mourão Moura

MiraMap: an e-participation tool for Smart Peripheries ...........................................................................350
Francesca De Filippi, Cristina Goscia, Guido Boella, Alessio Antonini, Alessia Calafiore, Anna Cantini, Roberta Guido, Carlo Salaroglio, Luigi Sanasi and Claudio Schifanella

Production of spatial representations through collaborative mapping. An experiment ...........356
Angioletta Voghera, Rossella Crivello, Liliana Ardissono, Maurizio Lucenteforte, Adriano Savoca and Luigi La Riccia

UFePC - Urban Form and Perception of the City ....................................................................................362

THE FRIENDLY CITY [LA CIUDAD AMABLE]. Andalusian Public Space Programme Awareness raising, training and interventions regarding cities, public space and sustainable mobility .....363
Gaia Redaelli

Space Syntax applied to the city of Milan ................................................................. 370

Valerio Cutini, Denise Farese and Giovanni Rabino

Configurational Approaches to Urban Form: Empirical Test on the City of Nice (France) ........ 376

Giovanni Fusco and Michele Tirico

Physical factors affecting the citizens’ security feeling in communal spaces (case study: BandarAbbas city) ................................................................. 383

Ali Shahdadi and Marziyeh Rezanejad

Conurbations and resilience. When growth makes us fragile ........................................ 389

Valerio Cutini

IMPC – ICT Models: Planning for inclusive Communities ........................................... 395

Virtual Environments as a Technological Interface between Cultural Heritage and the Sustainable Development of the City ................................................................. 396

Georgios Artopoulos

Visualisation Tools in Grasshopper+Rhino3D to Improve Multi-Criteria Analysis in Urban Policies – Case Study of Pampulha, Brazil ................................................................. 404

Ana Clara Mourão Moura, Suellen R. Ribeiro, Diogo C. Guadalupe and Silvio R. Motta

Studies of Volumetric Potential in Pampulha, Brazil .................................................. 411

Suellen R. Ribeiro and Ana Clara Mourão Moura

When the parametric modeling reveals a collapse in the future urban landscape: The case of Divinópolis – Minas Gerais/Brazil ................................................................. 418

Diogo de Castro Guadalupe, Bruno Amaral de Andrade and Ana Clara Mourão Moura

A Spatial Decision Support System for Industrial Re-Use ............................................ 424

Alessia Movia and Maria Vittoria Santi

How knowledge subjectivity affects decision-making: a Geodesign case study for the Cagliari Metro Area ......................................................................................... 429

Elisabetta Anna Di Cesare, Roberta Floris and Michele Campagna

Knowledge Organization for Community Revitalization: An Ontological Approach in Taranto Industrial City ................................................................. 436

Rossella Stufano, Dino Borri, Domenico Camarda and Stefano Borgo

Integrating VGI system in a Participatory Design Framework ...................................... 441

Alessia Calafiore, Junia Borges, Ana Clara Mourão Moura and Guido Boella

Evaluation of social benefits generated by urban regeneration: a stated preference approach 447

Marta Bottero and Giulio Mondini

URTL - Urban-Rural Transitional Landscapes .......................................................... 453

Urban-rural-natural gradient analysis using CORINE data: an application to the Italian regions of Friuli Venezia Giulia, Umbria, and Calabria ................................................................. 454
Marco Vizzari, Sara Antognelli, Maurizia Sigura and Giuseppe Modica

Liveability services in transitional landscapes: a spatial-MCDA model for assessment and mapping ................................................................. 461

Sara Antognelli and Marco Vizzari

Big data and environmental management: the perspectives of the Regional Environmental Information System of Sardinia, Italy .......................................................................................................................... 468

Andrea De Montis, Sabrina Lai, Nicoletta Sannio and Gianluca Cocco

Quantifying transport infrastructures and settlement fragmentation: strategic measures for rural landscape planning ....................................................................................... 474

Andrea De Montis, Antonio Ledda, Vittorio Serra and Mario Barra

Multi-temporal satellite imagery for soil sealing detection and urban growth mapping in the city of Ranchi (India) ................................................................. 480

Andrea Lessio, Vanina Fissore, Barbara Drusia and Enrico Borgogno-Mondino

Temporal variation of ecological network’s structure: some insights on the role of Natura 2000 sites .......................................................................................................................... 486

Giuseppe Modica, Luigi Laudaria, Andrea De Montis, Simone Caschili, Maurizio Mulas, Amedeo Ganciu, Leonardo Dessena and Carmelo Riccardo Fichera

Reducing land take and preserving land quality. A methodology for the application of the Lombardy Regional Law ................................................................. 493

Raffaele Sigon and Giulio Senes

GIS advanced tools for urban growth reading and management for best practices in town-planning ................................................................................................. 498

Enrico Borgogno-Mondino and Barbara Drusi

The bioremediation of polluted areas as an opportunity to improve ecosystem services .......... 505

Lorenzo Boccia, Alessandra Capolupo, Elena Cervelli, Stefania Pindozzi, Marina Rigillo and Maria Nicolina Ripa

Landscape Bionomics: A Comparison Between Two Rural-Suburban Landscapes from Brussels and Milan ................................................................................................. 512

Vittorio Ingegnoli, Ernesto Marcheggiani, Hubert Gulinck, Fredrik Larouge and Andrea Galli

Mapping Cilento: Visual analysis of geotagged Twitter data to study touristic flows in southern Italy .......................................................................................................................... 519

Ernesto Marcheggiani, Alvin Chuac, Loris Servillo and Andrew Vande Moere

Association between a spectral index and a landscape index for mapping and analysis of urban vegetation cover ................................................................................................. 526

Nicole A. da Rocha, Ítalo S. Sena, Bráulio M. Fonseca and Ana Clara Mourão Moura

MMSD - Methods and Models for Sustainable Development .................................................. 532

Simone Landini, Sylvie Occelli

A parametric method to analyze and enhance the cultural heritage and its context .......... 538

Roberto De Lotto, Veronica Gazzola, Cecilia Morelli di Popolo and Elisabetta Maria Venco

Present State of Inbound Tourism in Japan and Factors of Destination Choice ........................................ 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 Stellin
**A Reflection on Smart Governance in the new Metropolitan City of Cagliari**

Chiara Garau, Ginevra Balletto, and Paola Zamperlin

*Dep. of Civil and Environmental Engineering and Architecture (DICAAR), University of Cagliari, Cagliari (Italy). (cgarau@unica.it, balletto@unica.it, [corresponding author] and p.zamperlin@gmail.com)

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 1. Synopsis of the functions and objectives of the Metropolitan City of Cagliari

<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 (Piano Territoriale di Coordinamento) will contain not only the contents of the Provincial Urban Plan (Piano Urbanistico Provinciale), but also forecasts of border contexts among urbanized settlements, in order to ensure good coordination between the Urban Masterplans (UMPs) of the municipalities involved</td>
</tr>
<tr>
<td></td>
<td>The Metropolitan Urban Masterplan (Piano Urbanistico Metropolitano) will contain the contents of the UMPs</td>
</tr>
<tr>
<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. B, 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.

![Fig. 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

This paper is the result of the joint work of the authors. In particular, the Conclusions were written collaboratively. Chiara Garau wrote the section titled the Context of the Metropolitan City of Cagliari. Ginevra Balletto prepared the Methodology and Results and discussion sections, and Paola Zamperlin drafted the Introduction.

This study is supported by the MIUR (Ministry of Education, Universities and Research [Italy]) through a project entitled Governing the smart city: a governance-centred approach to SmartT urbanism—GHOST (Project code: RBSI14FDPF; CUP Code: F22115000070008), financed through the SIR (Scientific Independence of young Researchers) programme. We authorize the MIUR to reproduce and distribute reprints for governmental purposes, notwithstanding any copyright notations thereon. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors, and do not necessarily reflect the views of the MIUR.

References


Balletto, Ginevra. A Cura di, La Pianificazione Sostenibile Delle Risorse (Sustainable planning of environmental resources); Franco Angeli: Milano, Italy, 2005.


