

TeMA

Journal of
Land Use, Mobility and Environment

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

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

INPUT 2014

papers selected

Smart City

planning for energy, transportation
and sustainability of the urban system

SMART CITY

PLANNING FOR ENERGY, TRANSPORTATION AND SUSTAINABILITY OF THE URBAN SYSTEM

Special Issue, June 2014

Published by

Laboratory of Land Use Mobility and Environment
DICEA - Department of Civil, Architectural and Environmental Engineering
University of Naples "Federico II"

TeMA is realised by CAB - Center for Libraries at "Federico II" University of Naples using Open Journal System

Editor-in-chief: Rocco Papa
print ISSN 1970-9889 | on line ISSN 1970-9870
Licence: Cancelleria del Tribunale di Napoli, n° 6 of 29/01/2008

Editorial correspondence

Laboratory of Land Use Mobility and Environment
DICEA - Department of Civil, Architectural and Environmental Engineering
University of Naples "Federico II"
Piazzale Tecchio, 80
80125 Naples
web: www.tema.unina.it
e-mail: redazione.tema@unina.it

TeMA

Journal of
Land Use, Mobility and
Environment

TeMA. Journal of Land Use, Mobility and Environment offers researches, applications and contributions with a unified approach to planning and mobility and publishes original inter-disciplinary papers on the interaction of transport, land use and environment. Domains include engineering, planning, modeling, behavior, economics, geography, regional science, sociology, architecture and design, network science, and complex systems.

The Italian National Agency for the Evaluation of Universities and Research Institutes (ANVUR) classified TeMA as scientific journals in the Areas 08. TeMA has also received the Sparc Europe Seal for Open Access Journals released by Scholarly Publishing and Academic Resources Coalition (SPARC Europe) and the Directory of Open Access Journals (DOAJ). TeMA is published under a Creative Commons Attribution 3.0 License and is blind peer reviewed at least by two referees selected among high-profile scientists by their competences. TeMA has been published since 2007 and is indexed in the main bibliographical databases and it is present in the catalogues of hundreds of academic and research libraries worldwide.

EDITOR- IN-CHIEF

Rocco Papa, Università degli Studi di Napoli Federico II, Italy

EDITORIAL ADVISORY BOARD

Luca Bertolini, Universiteit van Amsterdam, Netherlands

Virgilio Bettini, Università luav di Venezia, Italy

Dino Borri, Politecnico di Bari, Italy

Enrique Calderon, Universidad Politécnica de Madrid, Spain

Roberto Camagni, Politecnico di Milano, Italy

Robert Leonardi, London School of Economics and Political Science, United Kingdom

Raffaella Nanetti, College of Urban Planning and Public Affairs, United States

Agostino Nuzzolo, Università degli Studi di Roma Tor Vergata, Italy

Rocco Papa, Università degli Studi di Napoli Federico II, Italy

EDITORS

Agostino Nuzzolo, Università degli Studi di Roma Tor Vergata, Italy

Enrique Calderon, Universidad Politécnica de Madrid, Spain

Luca Bertolini, Universiteit van Amsterdam, Netherlands

Romano Fistola, Dept. of Engineering - University of Sannio - Italy, Italy

Adriana Galderisi, Università degli Studi di Napoli Federico II, Italy

Carmela Gargiulo, Università degli Studi di Napoli Federico II, Italy

Giuseppe Mazzeo, CNR - Istituto per gli Studi sulle Società del Mediterraneo, Italy

EDITORIAL SECRETARY

Rosaria Battarra, CNR - Istituto per gli Studi sulle Società del Mediterraneo, Italy

Andrea Ceudech, TeMALab, Università degli Studi di Napoli Federico II, Italy

Rosa Anna La Rocca, TeMALab, Università degli Studi di Napoli Federico II, Italy

Enrica Papa, University of Amsterdam, Netherlands

TeMA

Journal of
Land Use, Mobility and
Environment

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



CONFERENCE COMMITTEE

Dino Borri, Polytechnic University of Bari, Italy
Arnaldo Cecchini, University of Sassari, Italy
Romano Fistola, University of Sannio, Italy
Lilli Gargiulo, University of Naples Federico II, Italy
Giuseppe B. Las Casas, University of Basilicata, Italy
Agostino Nuzzolo, University of Rome, Italy
Rocco Papa, University of Naples Federico II, Italy
Giovanni Rabino, Polytechnic University of Milan, Italy
Maurizio Tira, University of Brescia, Italy
Corrado Zoppi, University of Cagliari, Italy

SCIENTIFIC COMMITTEE

Emanuela Abis, University of Cagliari, Italy
Nicola Bellini, Institute of Management, Scuola Superiore Sant'Anna Pisa, Italy
Mariolina Besio Dominici, University of Genoa, Italy
Ivan Blečić, University of Sassari, Italy
Dino Borri, Polytechnic University of Bari, Italy
Grazia Brunetta, Polytechnic University of Turin, Italy
Roberto Busi, University of Brescia, Italy
Domenico Camarda, Polytechnic University of Bari, Italy
Michele Campagna, University of Cagliari, Italy
Arnaldo Cecchini, University of Sassari, Italy
Donatella Cialdea, University of Molise, Italy
Valerio Cutini, University of Pisa, Italy, Italy
Luciano De Bonis, University of Molise, Italy
Andrea De Montis, University of Sassari, Italy
Filippo de Rossi, University of Sannio (Dean of the University of Sannio), Italy
Lidia Diappi, Polytechnic University of Milan, Italy
Isidoro Fasolino, University of Salerno, Italy
Mariano Gallo, University of Sannio, Italy
Lilli Gargiulo, University of Naples Federico II, Italy
Roberto Gerundo, University of Salerno, Italy
Paolo La Greca, University of Catania, Italy
Giuseppe B. Las Casas, University of Basilicata, Italy
Robert Laurini, University of Lyon, France
Antonio Leone, Tuscia University, Italy
Anna Loffredo, Institute of Management, Scuola Superiore Sant'Anna Pisa, Italy
Silvana Lombardo, University of Pisa, Italy
Giovanni Maciocco, University of Sassari, Italy
Giulio Maternini, University of Brescia, Italy

Francesco Domenico Moccia, University of Naples Federico II, Italy
Bruno Montella, University of Naples "Federico II" (Director of DICEA), Italy
Beniamino Murgante, University of Basilicata, Italy
Agostino Nuzzolo, University of Rome, Italy
Sylvie Occelli, IRES Turin, Italy
Rocco Papa, University of Naples Federico II, Italy
Maria Paradiso, University of Sannio, Italy
Domenico Patassini, IUAV, Venice, Italy
Michele Pezzagno, University of Brescia, Italy
Fulvia Pinto, Polytechnic University of Milan, Italy
Giovanni Rabino, Polytechnic University of Milan, Italy
Giuseppe Roccasalva, Polytechnic University of Turin, Italy
Bernardino Romano, University of L'Aquila, Italy
Francesco Russo, Mediterranean University Reggio Calabria, Italy
Michelangelo Russo, University of Naples Federico II, Italy
Ferdinando Semboloni, University of Firenze, Italy
Agata Spaziante, Polytechnic University of Turin, Italy
Michela Tiboni, University of Brescia, Italy
Maurizio Tira, University of Brescia, Italy
Simona Tondelli, University of Bologna, Italy
Umberto Villano, University of Sannio (Director of DING), Italy
Ignazio Vinci, University of Palermo, Italy
Corrado Zoppi, University of Cagliari, Italy

LOCAL SCIENTIFIC COMMITTEE

Rosaria Battarra, ISSM, National Research Council, Italy
Romano Fistola, DING, University of Sannio, Italy
Lilli Gargiulo, DICEA, University of Naples Federico II, Italy
Adriana Galderisi, DICEA, University of Naples Federico II, Italy
Rosa Anna La Rocca, DICEA, University of Naples Federico II, Italy
Giuseppe Mazzeo, ISSM, National Research Council, Italy
Enrica Papa, University of Amsterdam, Netherlands

LOCAL ADMINISTRATIVE TEAM

Gennaro Angiello, TeMA Lab, University of Naples Federico II, Italy
Gerardo Carpentieri, TeMA Lab, University of Naples Federico II, Italy
Stefano Franco, TeMA Lab, University of Naples Federico II, Italy
Laura Russo, TeMA Lab, University of Naples Federico II, Italy
Floriana Zucaro, TeMA Lab, University of Naples Federico II, Italy

EIGHTH INTERNATIONAL CONFERENCE INPUT 2014

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

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

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

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

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

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

SMART CITY PLANNING FOR ENERGY, TRANSPORTATION AND SUSTAINABILITY OF THE URBAN SYSTEM Special Issue, June 2014

Contents

- 1. The Plan in Addressing the Post Shock Conflicts 2009-2014.
A First Balance Sheet of the Reconstruction of L'Aquila** 1-13
Fabio Andreassi, Pierluigi Properzi
- 2. Assessment on the Expansion of Basic Sanitation Infrastructure.
In the Metropolitan Area of Belo Horizonte - 2000/2010** 15-26
Grazielle Anjos Carvalho
- 3. Temporary Dwelling of Social Housing in Turin.
New Responses to Housing Discomfort** 27-37
Giulia Baù, Luisa Ingaramo
- 4. Smart Communities. Social Innovation at the Service of the Smart Cities** 39-51
Massimiliano Bencardino, Ilaria Greco
- 5. Online Citizen Reporting on Urban Maintenance:
A Collection, Evaluation and Decision Support System** 53-63
Ivan Blečić, Dario Canu, Arnaldo Cecchini, Giuseppe Andrea Trunfio
- 6. Walkability Explorer. An Evaluation and Design Support Tool for Walkability** 65-76
Ivan Blečić, Arnaldo Cecchini, Tanja Congiu, Giovanna Fancello, Giuseppe Andrea Trunfio
- 7. Diachronic Analysis of Parking Usage: The Case Study of Brescia** 77-85
Riccardo Bonotti, Silvia Rossetti, Michela Tiboni, Maurizio Tira
- 8. Crowdsourcing. A Citizen Participation Challenge** 87-96
Júnia Borges, Camila Zyngier
- 9. Spatial Perception and Cognition Review.
Considering Geotechnologies as Urban Planning Strategy** 97-108
Júnia Borges, Camila Zyngier, Karen Lourenço, Jonatha Santos

- 10. Dilemmas in the Analysis of Technological Change. A Cognitive Approach to Understand Innovation and Change in the Water Sector** 109-127
Dino Borri, Laura Grassini
- 11. Learning and Sharing Technology in Informal Contexts. A Multiagent-Based Ontological Approach** 129-140
Dino Borri, Domenico Camarda, Laura Grassini, Mauro Patano
- 12. Smartness and Italian Cities. A Cluster Analysis** 141-152
Flavio Boscacci, Ila Maltese, Ilaria Mariotti
- 13. Beyond Defining the Smart City. Meeting Top-Down and Bottom-Up Approaches in the Middle** 153-164
Jonas Breuer, Nils Walravens, Pieter Ballon
- 14. Resilience Through Ecological Network** 165-173
Grazia Brunetta, Angioletta Voghera
- 15. ITS System to Manage Parking Supply: Considerations on Application to the “Ring” in the City of Brescia** 175-186
Susanna Bulferetti, Francesca Ferrari, Stefano Riccardi
- 16. Formal Ontologies and Uncertainty. In Geographical Knowledge** 187-198
Matteo Caglioni, Giovanni Fusco
- 17. Geodesign From Theory to Practice: In the Search for Geodesign Principles in Italian Planning Regulations** 199-210
Michele Campagna, Elisabetta Anna Di Cesare
- 18. Geodesign from Theory to Practice: From Metaplanning to 2nd Generation of Planning Support Systems** 211-221
Michele Campagna
- 19. The Energy Networks Landscape. Impacts on Rural Land in the Molise Region** 223-234
Donatella Cialdea, Alessandra Maccarone
- 20. Marginality Phenomena and New Uses on the Agricultural Land. Diachronic and Spatial Analyses of the Molise Coastal Area** 235-245
Donatella Cialdea, Luigi Mastronardi
- 21. Spatial Analysis of Urban Squares. ‘Siccome Umbellico al corpo dell’uomo’** 247-258
Valerio Cutini

- 22. Co-Creative, Re-Generative Smart Cities.
Smart Cities and Planning in a Living Lab Perspective 2** **259-270**
Luciano De Bonis, Grazia Concilio, Eugenio Leanza, Jesse Marsh, Ferdinando Trapani
- 23. The Model of Voronoi's Polygons and Density:
Diagnosis of Spatial Distribution of Education Services of EJA
in Divinópolis, Minas Gerais, Brazil** **271-283**
Diogo De Castro Guadalupe, Ana Clara Mourão Moura
- 24. Rural Architectural Intensification: A Multidisciplinary Planning Tool** **285-295**
Roberto De Lotto, Tiziano Cattaneo, Cecilia Morelli Di Popolo, Sara Morettini,
Susanna Sturla, Elisabetta Venco
- 25. Landscape Planning and Ecological Networks.
Part A. A Rural System in Nuoro, Sardinia** **297-307**
Andrea De Montis, Maria Antonietta Bardi, Amedeo Ganciu, Antonio Ledda,
Simone Caschili, Maurizio Mulas, Leonarda Dessena, Giuseppe Modica,
Luigi Laudari, Carmelo Riccardo Fichera
- 26. Landscape Planning and Ecological Networks.
Part B. A Rural System in Nuoro, Sardinia** **309-320**
Andrea De Montis, Maria Antonietta Bardi, Amedeo Ganciu, Antonio Ledda,
Simone Caschili, Maurizio Mulas, Leonarda Dessena, Giuseppe Modica,
Luigi Laudari, Carmelo Riccardo Fichera
- 27. Sea Guidelines. A Comparative Analysis: First Outcomes** **321-330**
Andrea De Montis, Antonio Ledda, Simone Caschili, Amedeo Ganciu, Mario Barra,
Gianluca Cocco, Agnese Marcus
- 28. Energy And Environment in Urban Regeneration.
Studies for a Method of Analysis of Urban Periphery** **331-339**
Paolo De Pascali, Valentina Alberti, Daniela De Ioris, Michele Reginaldi
- 29. Achieving Smart Energy Planning Objectives.
The Approach of the Transform Project** **341-351**
Ilaria Delponte
- 30. From a Smart City to a Smart Up-Country.
The New City-Territory of L'Aquila** **353-364**
Donato Di Ludovico, Pierluigi Properzi, Fabio Graziosi
- 31. Geovisualization Tool on Urban Quality.
Interactive Tool for Urban Planning** **365-375**
Enrico Eynard, Marco Santangelo, Matteo Tabasso

- 32. Visual Impact in the Urban Environment.
The Case of Out-of-Scale Buildings** 377-388
Enrico Fabrizio, Gabriele Garnerò
- 33. Smart Dialogue for Smart Citizens:
Assertive Approaches for Strategic Planning** 389-401
Isidoro Fasolino, Maria Veronica Izzo
- 34. Digital Social Networks and Urban Spaces** 403-415
Pablo Vieira Florentino, Maria Célia Furtado Rocha, Gilberto Corso Pereira
- 35. Social Media Geographic Information in Tourism Planning** 417-430
Roberta Floris, Michele Campagna
- 36. Re-Use/Re-Cycle Territories:
A Retroactive Conceptualisation for East Naples** 431-440
Enrico Formato, Michelangelo Russo
- 37. Urban Land Uses and Smart Mobility** 441-452
Mauro Francini, Annunziata Palermo, Maria Francesca Viapiana
- 38. The Design of Signalised Intersections at Area Level.
Models and Methods** 453-464
Mariano Gallo, Giuseppina De Luca, Luca D'acierno
- 39. Piano dei Servizi. Proposal for Contents and Guidelines** 465-476
Roberto Gerundo, Gabriella Graziuso
- 40. Social Housing in Urban Regeneration.
Regeneration Heritage Existing Building: Methods and Strategies** 477-486
Maria Antonia Giannino, Ferdinando Orabona
- 41. Using GIS to Record and Analyse Historical Urban Areas** 487-497
Maria Giannopoulou, Athanasios P. Vavatsikos,
Konstantinos Lykostratis, Anastasia Roukouni
- 42. Network Screening for Smarter Road Sites: A Regional Case** 499-509
Attila Grieco, Chiara Montaldo, Sylvie Ocelli, Silvia Tarditi
- 43. Li-Fi for a Digital Urban Infrastructure:
A Novel Technology for the Smart City** 511-522
Corrado Iannucci, Fabrizio Pini
- 44. Open Spaces and Urban Ecosystem Services.
Cooling Effect towards Urban Planning in South American Cities** 523-534
Luis Inostroza

- 45. From RLP to SLP: Two Different Approaches to Landscape Planning** 535-543
Federica Isola, Cheti Pira
- 46. Revitalization and its Impact on Public. Space Organization A Case Study of Manchester in UK, Lyon in France and Łódź in Poland** 545-556
Jaroslaw Kazimierzak
- 47. Geodesign for Urban Ecosystem Services** 557-565
Daniele La Rosa
- 48. An Ontology of Implementation Plans of Historic Centers: A Case Study Concerning Sardinia, Italy** 567-579
Sabrina Lai, Corrado Zoppi
- 49. Open Data for Territorial Specialization Assessment. Territorial Specialization in Attracting Local Development Funds: an Assessment. Procedure Based on Open Data and Open Tools** 581-595
Giuseppe Las Casas, Silvana Lombardo, Beniamino Murgante, Piergiuseppe Pontrandolfi, Francesco Scorza
- 50. Sustainability And Planning. Thinking and Acting According to Thermodynamics Laws** 597-606
Antonio Leone, Federica Gobattoni, Raffaele Pelorosso
- 51. Strategic Planning of Municipal Historic Centers. A Case Study Concerning Sardinia, Italy** 607-619
Federica Leone, Corrado Zoppi
- 52. A GIS Approach to Supporting Nightlife Impact Management: The Case of Milan** 621-632
Giorgio Limonta
- 53. Dealing with Resilience Conceptualisation. Formal Ontologies as a Tool for Implementation of Intelligent Geographic Information Systems** 633-644
Giampiero Lombardini
- 54. Social Media Geographic Information: Recent Findings and Opportunities for Smart Spatial Planning** 645-658
Pierangelo Massa, Michele Campagna
- 55. Zero Emission Mobility Systems in Cities. Inductive Recharge System Planning in Urban Areas** 659-669
Giulio Maternini, Stefano Riccardi, Margherita Cadei

- 56. Urban Labelling: Resilience and Vulnerability as Key Concepts for a Sustainable Planning** 671-682
Giuseppe Mazzeo
- 57. Defining Smart City. A Conceptual Framework Based on Keyword Analysis** 683-694
Farnaz Mosannenzadeh, Daniele Vettorato
- 58. Parametric Modeling of Urban Landscape: Decoding the Brasilia of Lucio Costa from Modernism to Present Days** 695-708
Ana Clara Moura, Suellen Ribeiro, Isadora Correa, Bruno Braga
- 59. Smart Mediterranean Logics. Old-New Dimensions and Transformations of Territories and Cites-Ports in Mediterranean** 709-718
Emanuela Nan
- 60. Mapping Smart Regions. An Exploratory Approach** 719-728
Sylvie Occelli, Alessandro Sciuolo
- 61. Planning Un-Sustainable Development of Mezzogiorno. Methods and Strategies for Planning Human Sustainable Development** 729-736
Ferdinando Orabona, Maria Antonia Giannino
- 62. The Factors Influencing Transport Energy Consumption in Urban Areas: a Review** 737-747
Rocco Papa, Carmela Gargiulo, Gennaro Angiello
- 63. Integrated Urban System and Energy Consumption Model: Residential Buildings** 749-758
Rocco Papa, Carmela Gargiulo, Gerardo Carpentieri
- 64. Integrated Urban System and Energy Consumption Model: Public and Singular Buildings** 759-770
Rocco Papa, Carmela Gargiulo, Mario Cristiano
- 65. Urban Smartness Vs Urban Competitiveness: A Comparison of Italian Cities Rankings** 771-782
Rocco Papa, Carmela Gargiulo, Stefano Franco, Laura Russo
- 66. Urban Systems and Energy Consumptions: A Critical Approach** 783-792
Rocco Papa, Carmela Gargiulo, Floriana Zucaro
- 67. Climate Change and Energy Sustainability. Which Innovations in European Strategies and Plans** 793-804
Rocco Papa, Carmela Gargiulo, Floriana Zucaro

- 68. Bio-Energy Connectivity And Ecosystem Services.
An Assessment by Pandora 3.0 Model for Land Use Decision Making** 805-816
Raffaele Pelorosso, Federica Gobattoni, Francesco Geri,
Roberto Monaco, Antonio Leone
- 69. Entropy and the City. GHG Emissions Inventory:
a Common Baseline for the Design of Urban and Industrial Ecologies** 817-828
Michele Pezzagno, Marco Rosini
- 70. Urban Planning and Climate Change: Adaptation and Mitigation Strategies** 829-840
Fulvia Pinto
- 71. Urban Gaming Simulation for Enhancing Disaster Resilience.
A Social Learning Tool for Modern Disaster Risk Management** 841-851
Sarunwit Promsaka Na Sakonnakron, Pongpisit Huyakorn, Paola Rizzi
- 72. Visualisation as a Model. Overview on Communication Techniques
in Transport and Urban Planning** 853-862
Giovanni Rabino, Elena Masala
- 73. Ontologies and Methods of Qualitative Research in Urban Planning** 863-869
Giovanni Rabino
- 74. City/Sea Searching for a New Connection.
Regeneration Proposal for Naples Waterfront Like an Harbourscape:
Comparing Three Case Studies** 871-882
Michelangelo Russo, Enrico Formato
- 75. Sensitivity Assessment. Localization of Road Transport Infrastructures
in the Province of Lucca** 883-895
Luisa Santini, Serena Pecori
- 76. Creating Smart Urban Landscapes.
A Multimedia Platform for Placemaking** 897-907
Marichela Sepe
- 77. Virtual Power Plant. Environmental Technology Management Tools
of The Settlement Processes** 909-920
Maurizio Sibilla
- 78. Ecosystem Services and Border Regions.
Case Study from Czech – Polish Borderland** 921-932
Marcin Spyra
- 79. The Creative Side of the Reflective Planner. Updating the Schön's Findings** 933-940
Maria Rosaria Stufano Melone, Giovanni Rabino

- 80. Achieving People Friendly Accessibility.
Key Concepts and a Case Study Overview** 941-951
Michela Tiboni, Silvia Rossetti
- 81. Planning Pharmacies: An Operational Method to Find the Best Location** 953-963
Simona Tondelli, Stefano Fatone
- 82. Transportation Infrastructure Impacts Evaluation:
The Case of Egnatia Motorway in Greece** 965-975
Athanasios P. Vavatsikos, Maria Giannopoulou
- 83. Designing Mobility in a City in Transition.
Challenges from the Case of Palermo** 977-988
Ignazio Vinci, Salvatore Di Dio
- 84. Considerations on the Use of Visual Tools in Planning Processes:
A Brazilian Experience** 989-998
Camila Zyngier, Stefano Pensa, Elena Masala

TeMA

Journal of
Land Use, Mobility and Environment

TeMA INPUT 2014
Print ISSN 1970-9889, e- ISSN 1970-9870

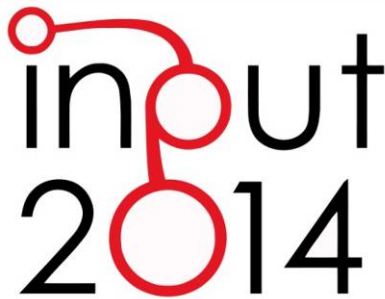
DOI available on the on-line version

Licensed under the Creative Commons Attribution
Non Commercial License 3.0
www.tema.unina.it

SPECIAL ISSUE

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

Naples, 4-6 June 2014



GEODESIGN FOR URBAN ECOSYSTEM SERVICES

DANIELE LA ROSA

Department Civil Engineering and Architecture
e-mail: dlarosa@darco.unict.it

ABSTRACT

This paper argues about the use of Geodesign tools in planning for enhance the Ecosystem Services provision in a urban context. Recently evolved from GIScience, Geodesign is an emerging field dealing with 2D and 3D representation tools developed for environmental design. On the other hand, the ES concept has become a central issue in environmental planning and research, dealing with the services provided by ecosystems to sustain and fulfill human life and well being. However, both Geodesign and ES still lack of a real integration in planning practices. While Geodesign tools appear to be stuck in rendering realistic 3D urban environments, the use of the ES concept in planning processes is still largely missing. For these reasons this paper will take advantage of concepts and tools from Geodesign and Ecosystem Services disciplines and will explore how they can be integrated in a methodological framework to generate Geodesign solution aimed at increasing the provision of urban ecosystem services.

KEYWORDS

Geodesign, Urban Ecosystem Services, Urban Planning

1 INTRODUCTION

Geodesign is an emerging, interdisciplinary field that has evolved from Geographic Information Systems (GIS) and encompasses digital, 2 and 3 dimensional representation tools developed for environmental design (Goodchild 2010). Over a relatively short span of time, Geodesign has moved from a neologism to the focus of contemporary researches on urban design integrated with modern IT tools (Miller 2013), thanks to the swift development of IT world and computational capability of personal computers. The advantage of Geodesign tools is that they can handle a wide spectrum of spatial complexity. This tools show a promising role in involving many stakeholders in planning processes by ensuring a feedback between future visions of changes and present actions and offering a learning process also known as “higher order learning” (Brown, Vergrat, Green and Berchicci 2003). Yet, despite this central role in urban planning and design, Geodesign isn't currently integrated in land-use processes and still remains the domain of IT applications, mainly because it is non-intuitive and relatively difficult to use. Contemporary Geodesign approaches are mainly focused on single rendering of 3D urban landscapes, but they are often disconnected from general objectives of sustainability planning.

Ecosystem Services (ES) are the conditions and processes through which natural ecosystems and the species that compose them sustain and fulfil human life (Daily 1997). These services include, among others, purification of air and water, mitigation of floods and droughts, detoxification and decomposition of waste, generation and renewal of soil fertility, regulation of climate, moderation of temperature extremes, provision of aesthetic beauty and intellectual stimulation (Bolund and Hunhammar 1999; MEA 2005). The concept of ES represents a consolidated theoretical reference for a number of different disciplines, such as ecology, forestry, agricultural science, environmental economics and urban/landscape planning. However, the inclusion of ecosystem services in planning processes is still very limited, especially in Italian urban planning, where there is a general lack of knowledge by decision makers about these issues.

The field of urban and landscape planning appears to be to most straightforward destinations for the outcomes of Geodesign and Ecosystem Services disciplines. Geodesign tools are naturally and closely intertwined with urban planning and have very recently emerged as a specific opportunity, to better accommodate landscape architects, urban and regional planners, and architects with geospatial technologies (Wilson 2014). They can act as a mean to make complex urban planning problems more readily understandable, in order to broaden public participation, and to improve decision making (Steinitz 2008).

On the other hand, the fast and widespread evolution of the ES concept is seen by a number of scholars and scientists as a not-to-be-missed opportunity to inform planning authorities in finding solutions that respond to competing social and environmental needs.

For these reasons, the integration of concepts and tools from Geodesign and Ecosystem Services disciplines is a promising way for urban planning to achieve significant results of long term sustainability in the urban environment.

2 GEODESIGN TOOLS FOR URBAN ECOSYSTEM SERVICES

There is very limited research ongoing about the relation between Geodesign and Ecosystem Services: querying these two words in academic databases (Scopus, ISI Web of Knowledge) returns only a couple of occurrences.

Current literature have clearly underlined the importance of ES. To prevent a decrease of the quality of ecosystems, the ES concept has become a central issue in environmental planning (Fisher and Turner 2008), allowing the assessment and mapping of services provided by different ecosystems. The concept is also view

as useful for communicating the multiple ways in which natural systems contribute to human well-being and highlighting the (monetary) value of provided ecosystem services (MEA 2005; Pavola and Hubacek 2013).

Despite the growing body of literature on ES, still many challenges remain to structurally integrate ES in planning (de Groot et al., 2010) and the use of the ES concept in planning is still largely missing.

Even more limited is the application of ES concept to urban planning field (Gómez-baggethun and Barton 2013), where the ways of including ES into planning choices about future land-use assets are still fairly unexplored (La Rosa and Privitera 2013). Moreover, general approaches of ES assessment do not consider information about detailed land cover composition in urban contexts: having a look at land cover compositions at finer scale reveals significant differences in terms of provision of ES (Lakes and Kim 2012). 3D dimension (height of tree or buildings and building and consequent volume of leaves and built structures) has been never considered in current ES assessment.

In this direction, the use of Geodesign solutions can overcome the limited applications of ES concept in urban planning. Testing and assessing designed spatial configurations of land-use and land cover at detailed scale would be a crucial information to decision makers especially at the municipal level, where the most relevant choices about land-use are taken and the pressure from different stakeholders is higher. In synthesis, the use of Geodesign for planning ES in urban context would allow to:

- increase the credibility of decision on land-use with a detailed design of land-use and land cover;
- improve the communication of key messages, such as the right choice of design element might maximize the provision urban ES;
- explore and communicate alternative decisions about land-use according to available financial resources.

Despite the link between of Geodesign and urban planning is claimed to be central (McElvaney 2012), current applications of Geodesign are mainly focused on producing complex, appealing 3D virtual urban landscapes, but often show no sound objectives or policies of urban sustainability as their bases. For this reason, the integration within urban planning of ES concept and Geodesign techniques appear to be of great importance to achieve relevant results for a sustainable the urban environment. A proposal for using Geodesign tools for integrating Urban Ecosystem Services into planning follows below.

2.1 A METHODOLOGICAL PROPOSAL

The main assumption of the methodological proposal here presented is that physical features such as land-use/land cover and socio-ecological variables are identified as the main components of urban ecosystems, thus influencing the production of ES (Bolund and Hunhammar 1999). These features can act as the main information sources for ES assessments, as they are able to provide information about environmental, physical and social characteristics of the urban environment. They can be represented by the following variables:

- land-use classes (according to the 4 level of the legend of Corine Land Cover data set);
- land-cover classes (trees, shrubs, grass, herbaceous vegetation, buildings, streets, other impermeable surfaces);
- census data (total population, children, elderly people, ...).

These variables can be used for the calculation of a set of spatial indicators for the assessment of ES, as explained below.

A first set of ecosystem services can be derived from literature (Burkhard *et al.* 2009; de Groot *et al.* 2010; MEA 2005), trying to encompass the most relevant categories of service. The set includes: (1) provision of

food and fodder, (2) provision of wood/timber, (3) clean air provision, (4) local climate regulation, (5) global climate regulation, (6) water balance regulation, (7) clean water provision, (8) soil erosion protection, (9) recreation and ecotourism, (10) aesthetic value, and (11) biodiversity.

The criteria for the choice of the ES are: to be among the most used assessed ES in current literature, to span all categories of ES according to MEA (2005). Each of the previously identified ES can be assessed by one or more indicators. An initial set of indicators available in literature is reported in reported table 1. This set should be always subject to a check aimed at verifying the possible use of indicators according to data availability.

ECOSYSTEM SERVICES CATEGORIES	SERVICES	INDICATORS
Regulating	Water balance regulation	Water balance regulation: water retention capacity [$m^3 * ha^{-1}$], run-off coefficient [Ψ], soil sealing [%]
	Climate regulation	Local climate regulation: albedo [%] C-Sequestration - storage of C in soil and biomass [$kg C ha^{-1}$]
	Soil erosion protection	C-factor (USLE model)
	Capacity for biological regulation	Number of habitats for pest control species
Provisioning Ecological integrity	Biological diversity	Composition of flora and fauna communities
	Ecological Connectivity	Connectivity index
	Water cycles	Ground water recharge [$m^3 * ha^{-1}$]
	Evapotranspiration	Evapotranspiration [area of evapotranspiring land covers/ total area]
	Production of plant biomass	Food and fodder from plants [$t * ha^{-1} * a^{-1}$] Biomass for industrial use / processing [$t * ha^{-1} * a^{-1}$]
	Bio-resource production	Biomass for energy production [$t * ha^{-1} * a^{-1}$] Food from livestock [$t * ha^{-1} * a^{-1}$]
Human health and well-being	Cool air production	Clean air production [$m^3 * ha^{-1} * h^{-1}$]
	Recreation and social values	Number/area of green spaces Number of visitors of green space Aesthetical value (expert opinion)

Tab.1 A possible set of indicators for urban Ecosystem Services

The second step of the method assesses the ES using spatial indicators selected in the previous phases. First indicators are calculated in a GIS environment on the base of available land-use, land cover and census data. Since indicators are expressed with different units and scales of values/scores, they need be transformed to a relative scale from 0 – 100 by mathematical normalization. Moreover, some ES, i.e. regulating and cultural services and to a minor extent some provisioning and supporting services, depend strongly on the geographic location of urban ecosystems or land-use/land cover classes. For example, cultural services provided by urban green spaces can be dramatically increased when these areas are well distributed in the urban context. These aspects are always excluded from ES assessments and require the inclusion of urban ecosystem mosaic (or mosaic of land uses) in the assessment models. Thus the spatial configurations of land-use/land cover must be expressed in terms of specific spatial features (heterogeneity, density, contiguity) and used to assess some of the indicators.

The third step is the definition of a set of Geodesign solutions (2D and 3D) according to literature review and environmental features of the study areas. Each Geodesign solution include a combination of base elements of land-use and land-cover (Fig. 1). Examples of design solutions encompass different combinations of buildings and/or streets/public space layout with different area covered by trees, shrubs, lawns and water and thus presenting different permeability/evapotranspiring ratio. All Geodesign solutions are sketched and mapped with 3D GIS software (for example, ESRI City Engine) and will be based on vector base GIS information (shapefile) containing the 2D spatial composition of land-use and land cover. This would allow to include the designed solutions in a geodatabase that comprehend all attributes and features related to each solution (land-use, land-covers, covered area, height, permeability ratio, cost of implementation per area unit) as well as the relative geographic vector information.

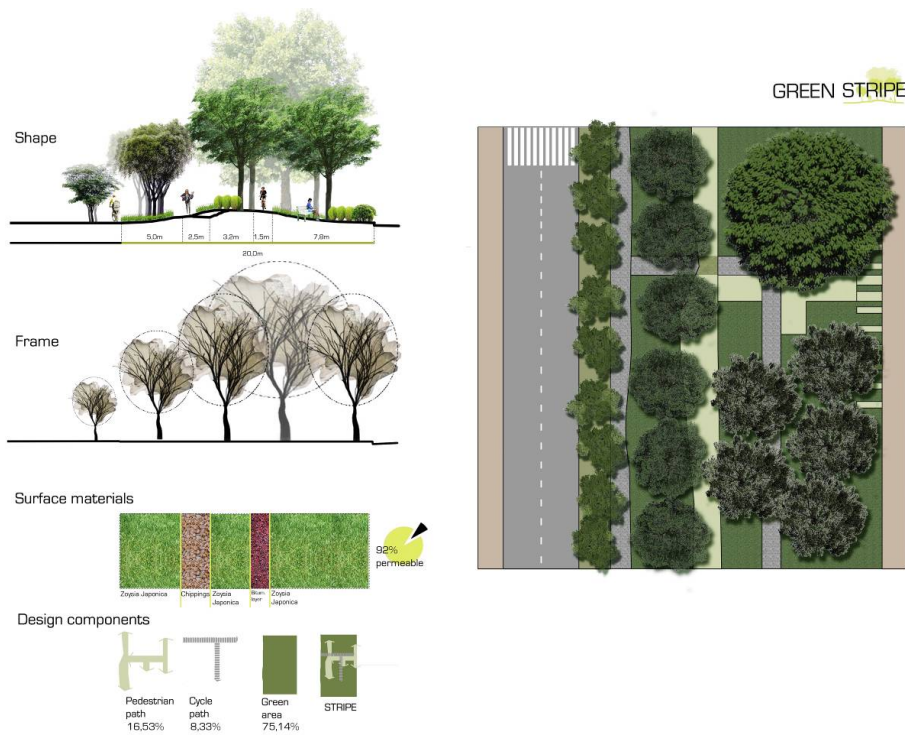


Fig. 1 Example of green corridor and bike/pedestrian pathway

Figure 1 and Figure 2 show a couple of examples of Geodesign solutions for two green urban corridors integrate with bike and pedestrian pathways. They have a width varying from 20 m to 14 m, with a total percentage of green cover varying from 75% to 70% and permeable surface at 92% and 100% respectively. They can composed by a bed of arboreal species with a width between 7.8 m and 6.8 m. Trees have their maximum height between 5 m and 12 m and canopy width between 3 m and 6 m. Species of *Ligustrum japonicum*, *Phillyrea Agustifolia*, *Magnolia grandiflora*, *Celtis Australis* can be used. One way cycle (1.5 m wide) and pedestrian are paths (from 2.1 m to 2.5 m) included in this solution. Corridors can be paved with bituminous layer. Cycle and pedestrian paths are always paved with natural permeable materials. *Zoysia Japonica* specie can be used for lawns, as it is a very resistant specie for Mediterranean climate. The result of this Geodesign solution is a configuration of public green spaces where usability (cultural services), thermal comfort (regulating services) and safe mobility can be achieved. The shade along cycle and pedestrian paths is a key element considering the climate condition of the city, characterized by long and hot summers (regulating services).

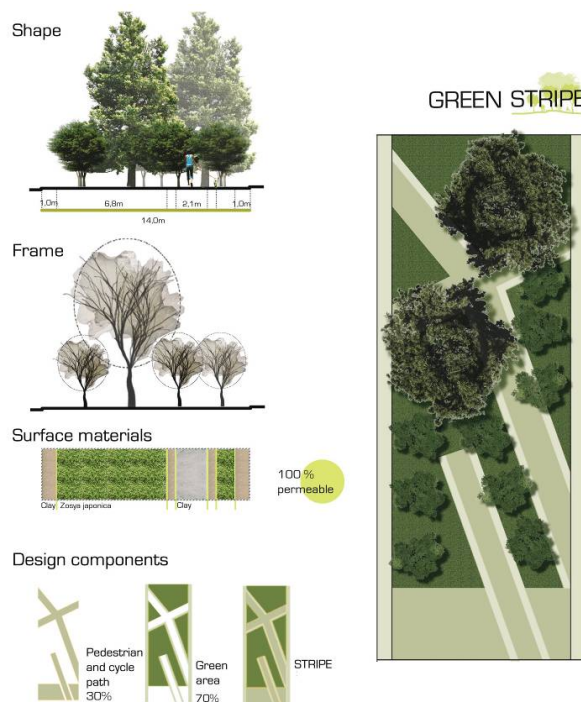


Fig. 2 Example of green corridor

Particular importance should be attributed to the vertical dimension of proposed design solutions, since the provision of ES can be very different when, for example, being equal the area covered by a land-use, there are different heights of buildings and trees or different permeability ratios. Of course, the costs for each solutions need to be evaluated, based on appropriate literature and urban design projects' reviews. This represents a crucial information that will allow to quantify the effectiveness of proposed solution in terms of benefits/cost ratio.

The last step of the method quantifies the changes in ES provision according to Geodesign solutions identified in the previous phase. To achieve this, Geodesign solutions can be structured into two groups of planning scenarios, that represent the spatial modification of current land-use pattern in the study area and are aimed at understating which ES and to what extent it may change according to these modifications. For example, planning Scenarios can be grouped in urban development and green spaces provision scenarios and each group of scenarios can be further divided in 3 sub-scenarios, according to the intensity (low, medium, high) of proposed urban transformations and thus considering an increasing cost for their implementation. This would allow to explore the changes on ES provision by Geodesign solutions in a more continuous way, moving from low intensity to high intensity transformations.

Each scenario results in a change of provided ES ad different scales, such as neighbourhood and the entire municipality scales. Within each scenario, different combinations of Geodesign solutions are tested, so to find an optimal set of solutions in terms of ES enhancement and relative costs. This means that the a single planning scenario can be constituted by different combination of Geodesign solutions. For example, a scenario of low urban development with a 30% of covered floor area can be obtained by several combination of single high rise buildings, lawn and trees or, as an alternative, semi-detached houses, ornamental orchards and shrubs. To find an optimal set of GeoDesign solutions, a Multi Criteria Model can be used, by defining an objective (the maximization of the ratio between provided ES and relative costs) and weighting each ES according to Analytical Hierarchy Process (Saaty 1980).

Figure 3 presents an example of the generation of a 2d design solution for an Non Urbanized area within the dense urban fabric of the city of Catania (Italy). The detailed layout include a proposal for an optimal localization of buildings, public facilities and greenspaces in the area in terms of provided Ecosystem Services (Martinico *et al.* 2014). This area is characterized by different function and land covers. For example, within the two designated Development Zones, multi-storey apartments, buildings for offices and retails up to five storeys can be allocated and a required minimum percentage of permeability of 30% is fixed in order to allow the natural infiltration of rain waters and decrease the urban surface run-off. In the new public greenspaces (representing about 50% of the area), the tree coverage is set to be higher than 25%. Moreover, new land uses such as allotment gardens and Community Supported Agriculture farms can be included allowing the increasing of provisioning services.



Fig. 3 A planning scenario to optimize Ecosystem Services provision

3 CONCLUSIONS

This paper proposes to understand how modern Geodesign spatial tools for urban planning can be used to provide design solutions aimed at the maximization of urban Ecosystem Services. Recently evolved from GIScience, Geodesign is an emerging field dealing with 2D and 3D representation tools developed for environmental design. The ES concept has become a central issue in environmental planning and research, dealing with the services provided by ecosystems to sustain and fulfill human life and well being. However, both Geodesign and ES still lack of a real integration in planning practices. While Geodesign tools appear to

be stuck in rendering realistic 3D urban environments, the use of the ES concept in planning processes is still largely missing. For these reasons the integration of the two concepts and relative tools can be used by urban planning to achieve results of long term sustainability for the urban environment.

The proposed method can be considered as an initial framework to use Geodesign tools in urban planning aimed at the optimization/increasing of urban Ecosystem Services. In this method, different GeoDesign solutions can be defined as combination of land-use/land cover elements of the urban environment such as building, paved areas, roads, trees, shrubs and grass. They are based on 3D GIS software modelling, able to sketch, render and map both at 2D and 3D scale. Different GeoDesign solutions are and their spatial configurations can included in planning scenarios to test and quantify the achieved change in provided Ecosystem Services. A set of planning scenarios involving different Geodesign solutions (in terms of number and types) can thus be tested and assessed in terms of costs for its implementation and enhancement of Ecosystem Services.

Through these Scenarios, planners of municipalities and decision makers will be able to understand precisely the effects of decisions on land-use on the provision of ES and to quantify the related cost for such decisions. Implementation of urban policies aimed at enhancing ES can be rather expensive and several Italian public administrations are suffering by a strong lack of resources. For this reason an accurate choice of Geodesign solutions that optimize the cost-effectiveness in increase ES can be of the utmost importance. Finally, the proposed methodological framework might be able to provide some significant scientific and socio-economical advancements:

- by obtaining a quantitative and documented assessment of the impacts of Geodesign solutions on ES provision at different urban scale;
- by quantifying the role of spatial configurations of land uses and land covers in the provision of ES;
- by making ES concept more appealing, actionable and useful by public administrations with the modern tools of Geodesign;
- by providing some practical tools (planning scenarios of Geodesign solutions) to public administrations, allowing them to make more efficient and sustainable decisions on future land-use assets of their urban contexts.

REFERENCES

- Brown, H., Vergrat, K., Green, K., Berchicci, L. (2003), "Learning for sustainability transition through bounded social-technical experiments in personal mobility", *Technology Analysis and Strategic Management*, 15, 291-315.
- Bolund, P., Hunhammar S. (1999), "Ecosystem services in urban areas", *Ecological Economics*, 29, 293-301.
- Burkhard, B., Kroll, F., Müller, F., Windhorst, W. (2009), "Landscapes' capacities to provide ecosystem services - a concept for land-cover based assessments", *Landscape Online*, 15, 1-22.
- Daily, G. (1997), *Nature's Services: Societal Dependence on Natural Ecosystems*, Island Press, Washington.
- de Groot, R.S., Alkemade, R., Braat, L, Hein, L., Willemen, L. (2010), "Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making", *Ecological Complexity*, 7, 260-272.
- Fisher, B., Turner, K.R. (2008), "Ecosystem services: classification for valuation", *Biological Conservation*, 141, 1167-1169.
- Gómez-baggethun, E., Barton, D.N. (2013), "Classifying and valuing ecosystem services for urban planning", *Ecological Economics*, 86, 235-245.
- Goodchild, M.F. (2010), "Towards geodesign: Repurposing cartography and GIS?", *Cartographic Perspectives*, 66, 7-21.

Lakes, T., Kim, H-O. (2012), "The urban environmental indicator "Biotope Area Ratio" - An enhanced approach to assess and manage the urban ecosystem services using high resolution remote-sensing, *Ecological Indicators*, 13, 93-103.

Martinico, F., La Rosa, D., Privitera, R. (2014), *Green Oriented Urban Development for urban ecosystem services provision in a medium sized city in Southern Italy*, in press, iForest, doi: 10.3832/ifor1171-007.

McElvaney, S. (2012), *Geodesign for Regional and Urban Planning*, Esri, Redlands.

Millennium Ecosystem Assessment (2005), *Ecosystems and Human Wellbeing: Biodiversity Synthesis*, DC: World Resources Institute, Washington.

Miller, W., (2013), *Introducing Geodesign: The Concept*, ESRI, Redlands.

Paavola, J., Hubacek K. (2013), "Ecosystem services, governance, and stakeholder participation: an introduction", *Ecology and Society*, 18, 42.

Saaty, T.L. (1990), *Multicriteria Decision Making: The Analytic Hierarchy Process*, McGraw-Hill, New York.

Steinitz, C. (2008), "Landscape planning: A brief history of influential ideas", *Journal of Landscape Architecture*, 5, 68-74.

Wilson, M.W. (2014), "On the criticality of mapping practices: Geodesign as critical GIS?", *Landscape and Urban Planning*, in press, <http://dx.doi.org/10.1016/j.landurbplan.2013.12.017>.

AUTHORS' PROFILE

Daniele La Rosa

PhD in Urban and Regional Planning. He is Researcher at the Department Civil Engineering and Architecture of the University of Catania (Italy). His research interests include urban and landscape planning, environmental indicators, Ecosystem Services, Environmental Strategic Assessment, GIS, Land Cover and Spatial Analysis. He is author of more than 50 among books, papers and book chapters about urban environmental planning.