Antonio Leone Carmela Gargiulo
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Environmental and territorial modelling for planning and design

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Smart City, Urban Planning for a Sustainable Future

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Antonio Leone Carmela Gargiulo

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Environmental and territorial modelling for planning and design editors Antonio Leone, Carmela Gargiulo - Napoli: FedOAPress. 2018. - (Smart City, Urban Planning for a Sustainable Future. 4).

Web link:
http://www.fedoabooks.unina.it

ISBN: 978-88-6887-048-5
DOI: 10.6093/978-88-6887-048-5

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Università degli Studi di Napoli Federico II
Centro di Ateneo per le Biblioteche "Roberto Pettorino"
Piazza Bellini 59-60 - 80138 Napoli, Italy
http://www.fedoapress.unina.it

Published in Italy
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Cover and graphic project: TeMA*LAB*

This book collects the papers presented at the 10th International Conference INPUT 2018 which will take place in Viterbo from 5th to 8th September. The Conferences pursues multiple objectives with a holistic, boundary-less character to face the complexity of today socio-ecological systems following a systemic approach aimed to problem solving. In particular, the Conference aims to present the state of art of modelling approaches employed in urban and territorial planning in national and international contexts.

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This book is the latest scientific contribution of the "Smart City, Urban Planning for a Sustainable Future" Book Series, dedicated to the collection of research e-books, published by FedOAPress - Federico II Open Access University Press. The volume contains the scientific contributions presented at the INPUT 2018 Conference and evaluated with a double peer review process by the Scientific Committee of the Conference. In detail, this publication, including 63 papers grouped in 11 sessions, for a total of 704 pages, has been edited by some members of the Editorial Staff of "TeMA Journal", here listed in alphabetical order:

- Rosaria Battarra;
- Gerardo Carpentieri;
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- Rosa Anna La Rocca;
- Rosa Morosini;
- Maria Rosa Tremiterra.

The most heartfelt thanks go to these young and more experienced colleagues for the hard work done in these months. A final word of thanks goes to Professor Roberto Delle Donne, Director of the CAB - Center for Libraries "Roberto Pettorino" of the University of Naples Federico II, for his active availability and the constant support also shown in this last publication.

Rocco Papa
Editor of the Smart City, Urban Planning for a Sustainable Future" Book Series
Published by FedOAPress - Federico II Open Access University Press

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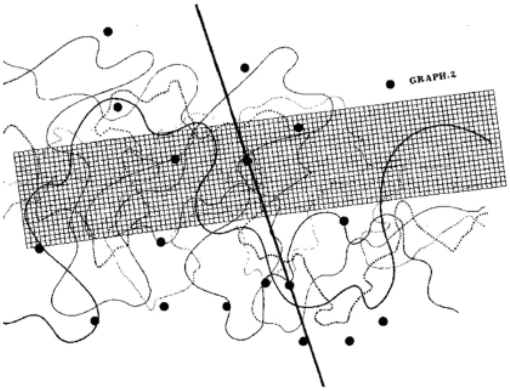
A HYBRID DECISION-MAKING PROCESS FOR WASTESCAPES REMEDIATION

GEODESIGN, LCA, URBAN LIVING LAB INTERPLAY



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How to cite item in APA format:
Cerreta, M. Inglese, P. & Mazzarella, C. (2018). A hybrid decision-making process for wastescapes remediation. Geodesign, LCA, Urban Living Lab interplay
In A. Leone & C. Gargiulo (Eds.), *Environmental and territorial modelling for planning and design*.
(pp. 603-610). Naples: FedOAPress. ISBN: 978-88-6887-048-5, doi: 10.6093/978-88-6887-048-5

ABSTRACT

Horizon2020 REPAiR project, REsource Management in Peri-urban AReas. Going beyond Urban Metabolism (http://h2020repair.eu/), investigates the flows of material looking for those dysfunctions of urban metabolism that determine landscapes of waste, so-called "wastescapes". According to the principles of Circular Economy (CE), wastescape can be considered an innovative resource for the regeneration of territories in crisis, and allow a change of paradigm able to determine multiple and different environmental, economic, social and cultural implications. The methodological approach aims at making operational the concept of Urban Metabolism, according to the CE principles, deepening the dynamics between energy flows, waste, information and people and identifying ecological and innovative solutions deriving from a win-win-win approach, considering the environmental, social and economic impacts of the transformations and the benefits deriving from the intrinsic relationships inherent in metabolic systems. The key challenge is to integrate models and methods to enable stakeholders to use the platform of GeoDesign Decision Support Environment (GDSE) for the interaction between the Life Cycle Assessment (LCA) and Peri-Urban Living Labs (PULLs) in order to develop reliable alternatives for spatial sustainable development strategies able to enhancing waste and resource management. A hybrid decision-making process consists of that tree interactive processes, where results from PULLs and LCA converge in GDSE in a reiterative methodology to enabling decision-makers to assess their decision alternatives.

KEYWORDS

Wastescape remediation; Urban Metabolism; Hybrid Decision-making Process; LCA; Living Labs; GeoDesign

1 INTRODUCTION

Waste management is an emergency in the contemporary world because waste production continues to grow up year by year. The World Bank's Urban Development Department has estimated that the municipal solid waste from the current 1.3 billion tons per year will grow to 2.2 billion tons per year by 2025.
Inefficient waste management and ineffective planning policies have gradually generated degradation of landscapes in particular in peri-urban areas with negative consequences on people health, resources loss and social conflicts. At the same time, the current linear economic model has revealed all its dysfunctions, producing loss of resources, disasters and crisis in environment, economic and social contexts.
The European Union has progressively increased systems of programmes and measures to promote the Circular Economy and obtain benefits for both the environment and the economy starting also from the wastes issues. The perspective of European Union is consistent with the United Nations that in 2015 adopted the 2030 Agenda for Sustainable Development, to end poverty, protect the planet and ensure prosperity, identifying 17 goals, with the aims to make cities and human settlements inclusive, safe, resilient and sustainable and ensure sustainable consumption and production patterns (United Nations, 2015).
Starting from the European policies and regulations on waste management (2008/9/EC), and taking into account the recent ISPRA 2017 and 2018 reports on urban waste and special waste, it is possible to identify the specifics of waste landscapes, also in relation to the flows of materials, energy and type of waste, and define if, when and where they can become a productive resource for the local Urban Metabolism (UM).
In Italy, waste management has globally improved over the last decade, but the legacy to be faced remains a serious problem. Improving the whole process of waste management needs a paradigm shift toward Life Cycle Thinking (LCT) to consider waste and wasted landscapes as a resource. In this kind of process Knowledge Management (KM) plays a central aspect, both in the communication of results and in the creation of an enabling context. The work to design solutions to face local regeneration and improve waste management requires communities and contexts prepared to follow and develop new paths. In the field of Knowledge Management (KM) is emerged that creating an enabling context is the first fundamental step to encourages knowledge sharing, creation and use (Choo & Alvarenga Neto, 2010).
The paper describes the hybrid decision-making process implemented in the Horizon 2020 REPAiR project, that integrates different approaches to enable wastescapes regeneration in different European case studies, analyzing the central role of the GeoDesign approach.

2 FROM WASTE TO WASTESCAPES IN REPAIR PROJECT

The waste emergency in Campania, ended in 2009, has left the so-called "Land of Fires" region, a legacy marked by land to be reclaimed, a lack of recycling facilities and extensive landfills authorized and not, whose proximity to residential areas has provided further aggravation of environmental issues of peri-urban districts with consequent irreversible damage to the health of the inhabitants. In this context, the Horizon2020 REPAiR project, REsource Management in Periurban AReas. Going beyond Urban Metabolism (http://h2020repair.eu/), consisting of a consortium of universities, public and private bodies, investigates the flows of material looking for those dysfunctions of Urban Metabolism that determine landscapes of waste, wastescapes, in order to design suitable eco-innovative solutions.

ISBN:978-88-6887-048-5
DOI:10.6093/978-88-6887-048-5

Land of Fires, Italian case study, is one the most complex areas of Campania region. Waste management and planning policies are the results of decades of political inefficiency and of continuous illegal actions, that underline inner difficulties of administrations in waste management, cooperation and social obstacles.
REPAiR project involves 18 partners from six countries: Italy, Netherlands, Germany, Belgium, Hungary and Poland. The Italian partner is the Department of Architecture (DiARC) of University of Naples "Federico II" in cooperation with the Campania Regional Authority (CRA). The ambition of the project is to elaborate eco-innovative solutions, investigating simultaneously wastescape and waste flows, by the support of a hybrid methodology to achieve this goal, able to combine soft and hard approaches and tools.
A key issue is related to the concept of Urban Metabolism (UM), starting from the interpretation of Kennedy et al. (2007) as the sum total of the technical and socio-economic processes that occur in cities, resulting in growth, production of energy, and elimination of waste. According to Broto et al. (2012) UM links material flows with ecological processes and social change by the understanding of flows and circularity. Ultimately, UM describes the continuous flows of resources (as water, energy, food, materials, waste, information, people) into, out of, and within metropolitan areas. Considering an urban area as the result of interacting complex systems means analysing the city as an ecosystem, where improving technical and socioeconomics processes mean to reduce waste and loss of resources flows.
According to the above perspective, cities dysfunctions are investigated through measurable impact in the wastescapes, patches of damaged lands in peri-urban areas, where urban and rural environments intersect. Wastescapes have been defined as "patches of landscape related to waste cycles both by functional relations and because they are 'wasted-lands': anomalous areas inconsistent with the peri-urban metabolism that become neglected spaces" (Russo et al., 2017). The Italian case study in REPAiR project, Naples Focus area, is composed of 11 selected municipalities (Acerra, Afragola, Caivano, Cardito, Casoria, Casalnuovo di Napoli, Cercola, Crispano, Frattamaggiore, Napoli, Volla), all composing the Land of Fire: an area that has been affected by waste emergency since 2009 and whose legacy is its biggest problem to address (Fig. 1).

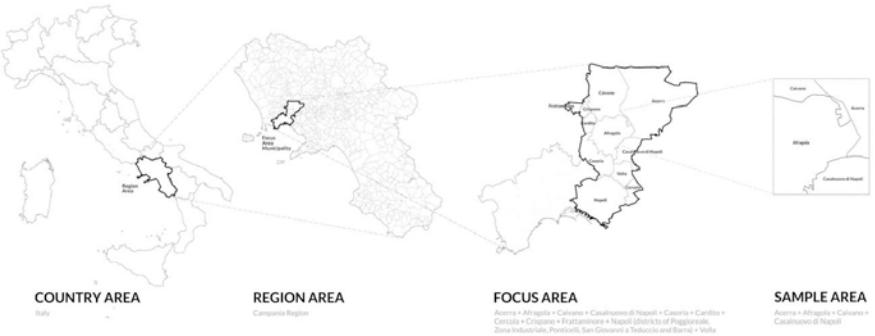

Fig.1 Project REPAiR – Italian Case Study – Naples Focus Area (source: REPAiR D3.3, 2018)

In a Circular Economy (CE) perspective, wastescapes can be considered a resource. Six categories of wastescapes have been selected as innovative resources to be reintegrated in the metabolic dynamics, to improve quality of the peri-urban areas. Some of these categories could be found at the scale of the entire focus area; other categories could be mapped instead only at a local scale, thanks to the interactions with local stakeholders and communities. Some categories are likely to overlap each other in the mapping process. The main wastescapes categories are identified as: Degraded land (W1), Degraded water and

ISBN:978-88-6887-048-5
DOI:10.6093/978-88-6887-048-5

connected areas (W2), Declining fields (W3), Settlements and buildings in crisis (W4), "Dross" of facilities and infrastructures (W5) and Operational Infrastructures of Waste (W6) (Geldermans et al., 2018).
The challenge to design suitable solutions for these kinds of landscapes, considering material flows and local communities knowledge and involvement, has been pursued structuring a methodology that systematize three different approaches in one hybrid framework, considering the following main objectives: To provide decision-makers with comparative assessments of different integrated spatial resource management strategies by combining forecasting methods, strategy conceptualizations and an integrated assessment of economic, environmental and social sustainability in a collaborative decision support environment; to develop an understanding of the characteristics, mechanisms and dynamics of European resource management systems by analyzing the relations between waste flows, environmental and spatial quality, allocation and governance in six peri-urban areas using life cycle thinking; to better interpret the link between metabolic flows and urban processes, by extending the assessment of urban metabolism to include urban driver concepts and urban patterns, as well as environmental and spatial quality, and co-benefits; to improve the knowledge and reliability of waste related data by reversed material flow accounting; to implement living labs in peri-urban areas (Peri-Urban Living Lab - PULL) in order to develop, test, implement and assess place-specific eco-innovative solutions for resource management to improve environmental and spatial quality and quality of life; to understand decision-making structures and processes in the case study areas with regard to interests and priorities of different stakeholders in order to add transparency to the decision making process; to disseminate and ensure the further uptake of the project's insights on aspects of resource management and GDSE development by including local and regional planning authorities, NGOs, public and private waste management companies, and future urban planners in the project. Moreover, open dissemination of insights, tools and technologies is provided across Europe, establishing the foundation for knowledge-based consultancy services that support local implementation of policies and spatial investments aimed at developing a CE.

3 THE METHODOLOGICAL FRAMEWORK

Research methodology of REPAiR project follows three iterations framework connected each other, according to Steinitz (2012) and Campagna (2014) methods, where GeoDesign Spatial Environment (GDSE) can be considered as the digital enabling context, where research results converge in reiterative phases of co-design and co-evaluation. Enabling conditions are the premise for the identification of an enabling context (Nonaka et al., 2000) and can be related to:

- social/behavioural: social relationships and interactions based on norms and values such as trust, care, empathy, attentive enquiry and tolerance;
- cognitive/epistemic: the need for both epistemic diversity and common knowledge or shared epistemic practices and commitments;
- information systems/management: the use of information systems and information management processes to support knowledge activities;
- strategy/structure: the need for the organisation and its management to provide direction and structure.

Therefore, in REPAiR projects, enabling contexts can be defined considering the following parameters (Geldermans et al., 2018):

ISBN:978-88-6887-048-5
DOI:10.6093/978-88-6887-048-5

- they may be wastescapes: depending on the factor of use, underused areas might more easily accommodate new eco-innovative processes;
- they may be public or private areas. In fact, abandoned public areas could be re-used more easily as compared to similar private areas. Moreover, experiments in the public areas could be a catalyst for the private areas, where the owner could follow the example of the public initiatives;
- they may be easily accessible. The importance of the accessibility is crucial for the implementation of the eco-innovative solutions; in fact, the possibility to access the area via public transportation, by bike or on foot can determine the choice of one solution over another as well as its success or failure;
- local stakeholders may or may not be interested in the transformation of the area. This is a quite clear parameter that guides the selection of a specific location for the implementation of a solution;
- they may be crucial in relation to the waste-specific geography, as being crossed by relevant flows, sources/delivery points of the waste-flows for which the case study providing deeper knowledge.

In the above conditions, it could be relevant to activate a hybrid decision-making process in order to systematize the work of several expert teams from industrial ecology, economy, sustainability analysis, spatial planning, environmental policies and to build the suitable context where it is possible to generate eco-innovative solutions. The decision-making process is structured by interactive parts of the three main frameworks where the main steps are developed in each framework context as in the following scheme (Fig. 2): A. wastescape/waste cycle selection; B. integrated spatial analysis, material flow analysis and social analysis; C. end-of-life scenarios; D. eco-innovative implementation; E. local/global impact assessment; F. suitable scenario selection.

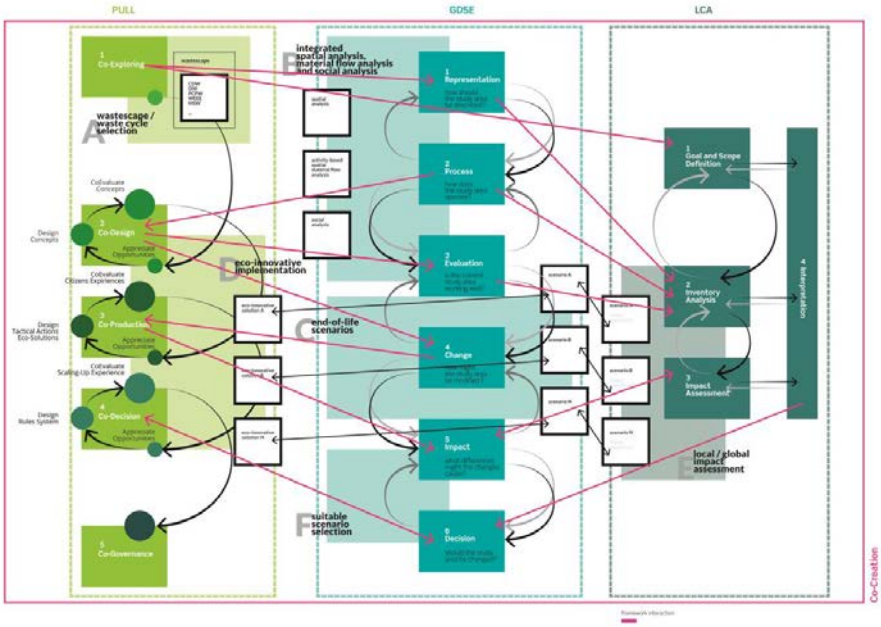

Fig. 2 The methodological framework where PULL, GDSE and LCA interact (source: Geldermans et al., 2017)

ISBN:978-88-6887-048-5
DOI:10.6

The three main frameworks identify three different approaches:

- GeoDesign Decision Support Environment (GDSE) is the central approach, and the platform where hard and soft data converge;
- Life Cycle Assessment (LCA) is the approach used to assess the different impacts;
- Peri-Urban Living Lab (PULL) is the approach used to interact with the real-life context (De Bonis et al., 2014), where knowledge is shared and where co-design process becomes effective using GDSE platform.

REPAiR project applies a GDSE approach aims to reveal both local and space-specific challenges of waste and resource management as well as integrated and place-based eco-innovative solutions for these challenges. In the terminology of the REPAiR project, a "solution" is a technical, organisational or juridical approach to solve one specific material and waste management challenge. Combinations of solutions are called "strategies". Thus, a GDSE is a tool to develop and comparatively assess alternative strategies in the field of material and waste management (Arciniegas et al., 2016).

One of the aims of the REPAiR project is to develop, test and apply the GDSE, conceived as an open source product designed for a use within workshop session of the Peri-Urban Living Labs (PULLs), where small groups of participants cooperatively develop strategies consistent with CE model and with a special focus on waste and resource management.

REPAiR adapts Steinitz's (2012) GeoDesign framework, comprising six questions that are asked at, at least three points in a GeoDesign project to understand the study area, to specify the methods and to perform the study: 1. How should the study area be described? 2. How does the study area operate? 3. Is the current study area working well? 4. How might the study area be altered? 5. What differences might the changes cause? 6. How should the study area be changed?

As much as it is helpful to the REPAiR, Steinitz's approach was not yet extensively applied to research questions in the field of waste and recycling. Waste and recycling are closely linked to production chains, and the degree to which production chains are meeting the requirements of the "cradle to cradle" vision can be measured using Life Cycle Assessment (LCA). In REPAiR, LCA is therefore added as an essential component to Steinitz's approach, for analyzing the impacts of products along with all steps of its production chain and therefore as part of the co-evaluation of eco-innovative strategies aiming to use waste as a resource. Linking LCA to Steinitz approach includes some methodological challenges, with specific attention to the spatial dimension, not included in the current state-of-the-art of the LCA methodology. Therefore the GSDE aims to find a way of combining GeoDesign and LCA by using different levels of spatial differentiation inside and outside to specific, mostly peri-urban, focus areas. At the same time, GSDE interacts with PULL phases and is the core element of communication and co-designing with the stakeholders involved in the different PULLs in order to transparently develop, access and discuss requirements and alternative options for eco-innovative solutions. The defined approach follows up on the work of Arciniegas and Janssen (2012) related to collaborative GIS-based tools and their integration in workshop settings. At the end of the REPAiR project, the GDSE will be made available as an open source tool in order to facilitate its application in other research and policy-making contexts. Once the GDSE will be published in 2019, all the materials will be available on REPAiR website.

ISBN:978-88-6887-048-5
DOI:10.6093/978-88-6887-048-5

4 CONCLUSIONS

"Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction" is the Priority 4 of Sendai Framework for Disaster Risk Reduction. It suggests to "adopt public policies and actions that support the role of public service workers to establish or strengthen coordination and funding mechanisms and procedures for relief assistance and plan and prepare for post-disaster recovery and reconstruction", among others. Wastescape is frequently man-made high-risk landscapes. Natural disaster is louder and more striking than man-made ones, but these produces silent effects much more compound "to repair". REPAiR project is testing an hybrid decision-making process, that take place in GeoDesign environment, regards this complexity enabling to interplay expert knowledge and local communities, crossing methods, approaches and tools, because just collaborative processes can build back better damaged landscapes, and communities active awareness is the most important component for long-term sustainable transformations.

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ISBN:978-88-6887-048-5
DOI:10.6093/978-88-6887-048-5

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ISBN:978-88-6887-048-5
DOI:10.6093/978-88-6887-048-5