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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.

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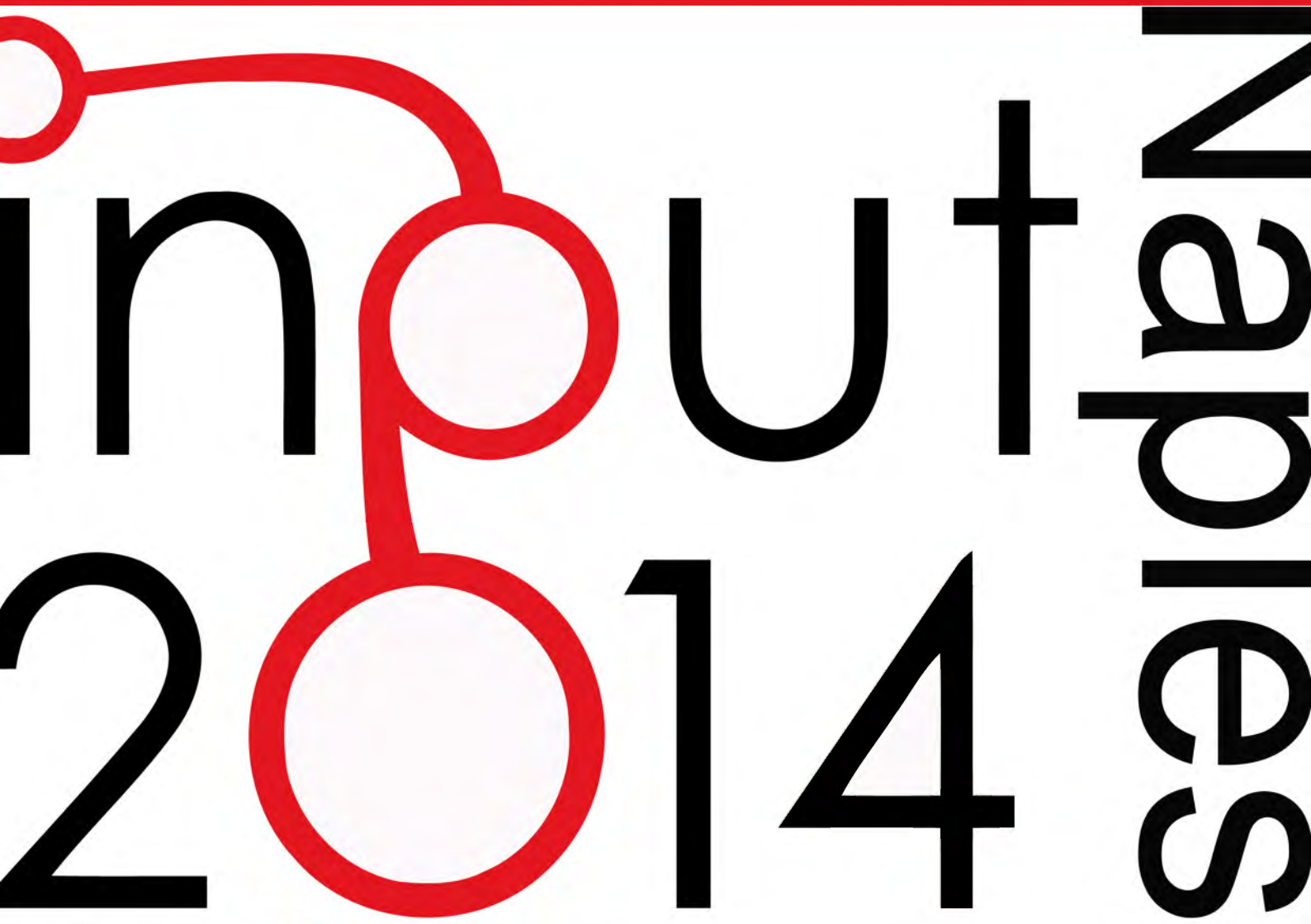


# Smart City

## planning for energy, transportation and sustainability of the urban system

Special issue, June 2014

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# SMART CITY

## PLANNING FOR ENERGY, TRANSPORTATION AND SUSTAINABILITY OF THE URBAN SYSTEM

## Special Issue, June 2014

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**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

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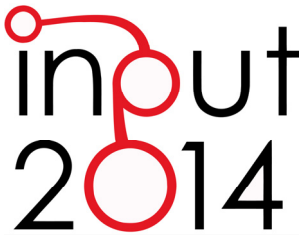
TeMA Journal of Land Use, Mobility and Environment

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.



TeMA Journal of Land Use, Mobility and Environment

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# 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.

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## Contents

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TeMA Journal of Land Use, Mobility and Environment

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SPECIAL ISSUE

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

*Naples, 4-6 June 2014*

# RURAL ARCHITECTURAL INTENSIFICATION

## A MULTIDISCIPLINAR PLANNING TOOL

ROBERTO DE LOTTO[a], TIZIANO CATTANEO[b], CECILIA MORELLI DI POPOLO[c], SARA MORETTINI[d], SUSANNA STURLA[e], ELISABETTA VENCO[f]

[a] Department of Civil engineering and Architecture, University of Pavia
e-mail: roberto.delotto@unipv.it
URL: www.unipv.it/rdelotto

[b] Department of Civil engineering and Architecture, University of Pavia
e-mail: tiziano.cattaneo@unipv.it
URL: www.raintensification.com

[c,d,e,f] Department of Civil engineering and Architecture, University of Pavia
e-mail: uplab@unipv.it
URL: http://uplab1.wix.com/uplab

**ABSTRACT**

When approaching a composite territorial problem that involves different scales and disciplines, it is necessary to establish a precise logical framework. Every planning or design activity is an iterative process applied to a complex system; not linear relations among the entities that compose the system are numerous and it is problematic to spell out them.

Authors developed a framework that has a hybrid structure in which different classical tool such as Spatial Decision Support Systems, Knowledge Discovery and Data Mining (KDD), and Expert Systems (ES) converge.

The method is not completely automatic and there is a continuous interaction between user and system.

The main aim of the entire research group who participated to a national research (PRIN 2009) was to define an informed methodology for decision makers, stakeholders and public bureaus who have to (or want to) face the problem of improving and intensifying insediative activities in minor centers located in rural-urban context.

In particular authors defined Rural Architectural Intensification (RAI) as a way to improve territorial features throughout a serie of interventions in small settlements and buildings.

The explanation of the relations among different disciplines, different scales and different related methodologies is the key point of the paper.

After an introduction and the description of RAI, authors introduce the main methodological structure; then each passage is detailed and specified considering the elements involved and the technical operations.

**KEYWORDS**

Rural Architectural Intensification; Multidisciplinar approach; planning tool; methodology explanation.

## 1 INTRODUCTION

The paper describes methodology and results of a branch of a PRIN 2009 research (relevant research at Italian national level) aimed to define theoretical and practical solutions for rurban context. Authors expose a Spatial Decision Support System with a specific application to Rural Architectural Intensification (RAI).
The whole process involves different scales (at least: territorial and architectural) and different disciplinary fields such as: regional planning, landscape and environmental planning, architecture, social sciences, economy (Blaschke 2006).
Within this methodological process many basic concepts of Smart Growth are taken into account. They are: Land Preservation; Preventing urban sprawl; Development Best Practices; Preservation Development; Mix land uses; Take advantage of compact building design; Create a range of housing opportunities and choices; Preserve open space, farmland, natural beauty, and critical environmental areas; Make development decisions predictable, fair, and cost effective; Encourage community and stakeholder collaboration in development decisions.
The entire research bases on a general procedure (quite similar to classical planning ones) in which the main aim is RAI. Applications depend on possible specific aims that put into effect this principal objective.
For each of these two main phases themes, techniques and tools are defined.

## 2 RURAL ARCHITECTURAL INTENSIFICATION

Rural Architectural Intensification (http://www.raintensification.com/#!home-english/ceab) has been defined by the local research unit of the University of Pavia (coordinated by Prof. Tiziano Cattaneo) inside a general framework (coordinated by University of Ancona) “Architecture as Heritage: innovative instruments for the tutelage and the improvement of the local border systems”. Authors from University of Pavia participated with the research theme: “Regeneration and renewal of rural landscape. Building strategies in the surroundings of new urban centers” (Frampton 1991; Carboz 1998; Thompson, Sorving 2000; Jongam 2002).
Rural Architectural Intensification is an innovative design action for architecture and urban design. This operative action is applicable for regenerate and transforms the contemporary city-landscape into uses that are suitable for contemporary ways of living through the construction of a new paradigm that will shape an architectural and urban project committed to sustainability. Rural Architectural Intensification has three keywords: Rural as environment with richness of history, values, memory and high quality; Architecture as a process and construction product, which can create social, cultural, economic and technological innovation; Intensification as a strategy to create sustainable density of activities and spaces for people in which the natural environment and the rural-urban environment coexist harmoniously.
This issue aims to the regeneration of the rural landscape as cultural heritage (Van der Vaart, 2005; Spaziante, Murano 2009; Fuentes 2013). The crisis in rural areas is essentially a European problem: depopulation and ageing of the population, abandonment and decay of small town centers, difficulty in keeping existing businesses and/or in launching new start-ups, intensive agricultural practices to the detriment of biodiversity, pollution, a lack of infrastructures and services for tourism, as well as a shortage of job opportunities for the population, etc.
Enhancing rural architecture, small towns, farmsteads and ancient relics is one of the main components for the regeneration of the countryside. It is a strategy with a positive outcome, even only if it has been supported simultaneously by the possibility of creating more business (also working from this architectural

heritage), but which nevertheless is planned taking into account the improvement of the perceived aesthetic structure of the countryside.

The main methodological approach here presented, previously defined as a Decision Support System, is a hybrid solution among Spatial Decision Support System (SDSS), Knowledge Discovery and Data Mining (KDD) e Expert System (ES) (Densham 1991; Wang, Feng 1992; Fayyad, Piatetsky-Shapiro, Smyth 1996; Keenan 2003).

## 3 MAIN PROCEDURE AND TERRITORIAL APPLICATION

The following flow diagram (Fig. 1) represents the entire planning method. Authors consider it is essential to specify the sequence of the phases that characterize the whole process because it combines various approaches that can be referred to the different scales and disciplines involved.

The aims are defined by decision makers, stakeholders, public bureaus, developers or private associations and the procedure is addressed to planners and to professional figures that may ease the decision process.

The process starts with the identification of a "main aim", that is the final goal of the whole planning procedure; in this case it is RAI.

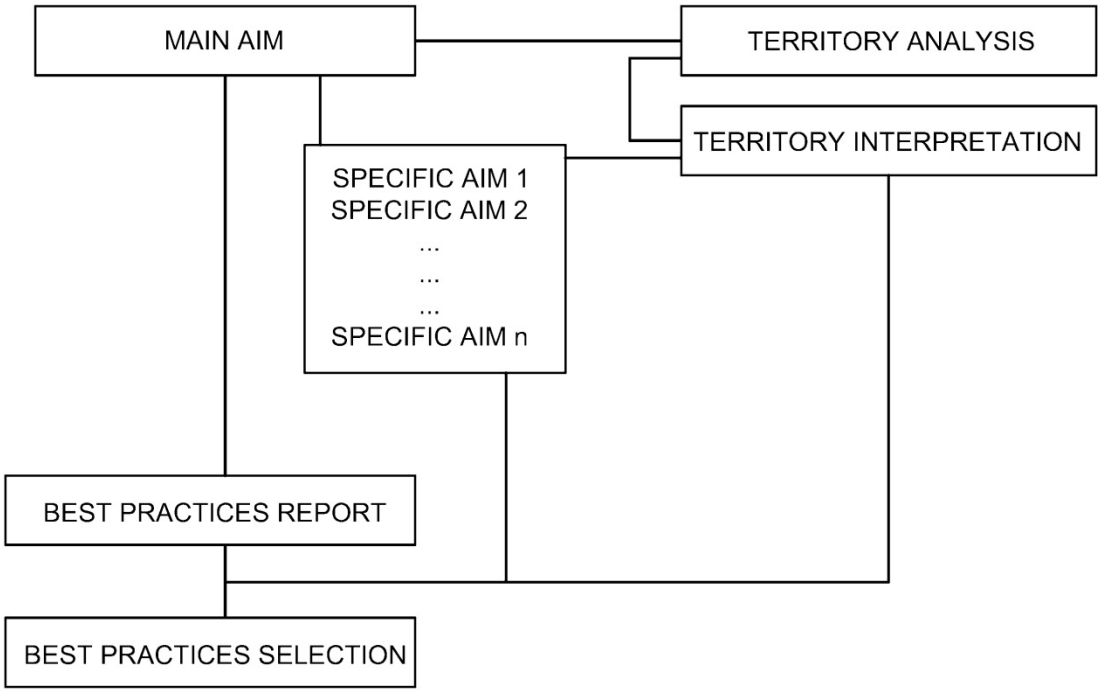


Fig. 1 Logical framework

Considering that RAI application depends on the characteristics of the territory in which it should work, once the main aim is defined, planners analyze the territory starting from available net information (such as Regional and local webgis, DUSAF, CORINE, etc.).

A Best Practices Report was built during the RAI research and it is a basic thematic reference in which many experiences from all over the world are classified and assessed depending on specific criteria.

Considering the characteristics of the analyzed territory, decision makers and stakeholders define specific aims; these are in example: concentration of new commercial activities in existing small centers, creation of a system of mixed use small centers, creation of a decentralized hotel, definition of territorial facilities, distribution of residential settlements in existing underused buildings, renewal of existing rural settlements, etc.

Obviously, territorial interpretation depends on certain specific aims: in fact different spatial or economic factors may have particular relevance for each precise objective. At the same time the entire Best Practice database can be consulted and appropriate examples may be selected.
Lastly a compatibility assessment among the territorial interpretation and the selected case studies carries to possible scenarios that decision makers and stakeholders should consider.
In the following schemes, two phases are singularly analyzed.
The first phase consists on the Territorial Analysis and on the creation of the Best Practices Report (Fig. 2a and 2b).

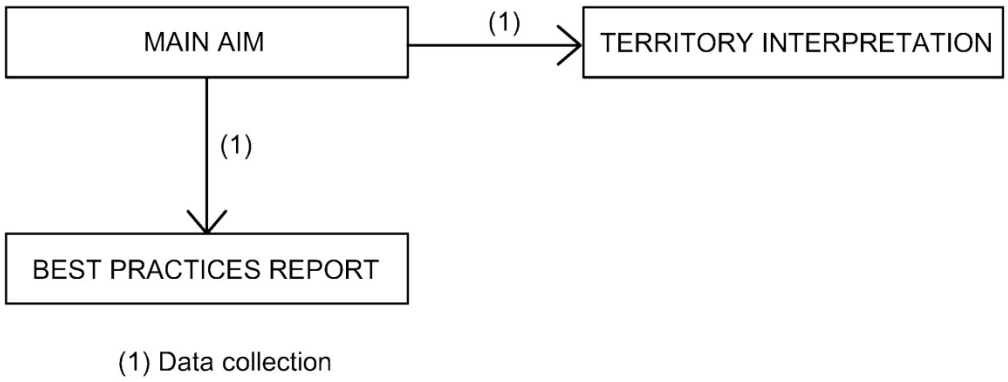


Fig. 2 a First Phase

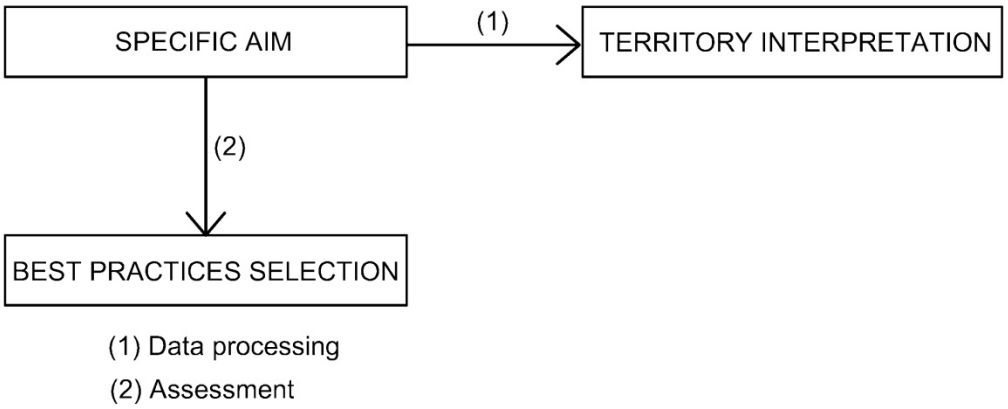


Fig. 2 b First phase

In this phase two actions are developed simultaneously: one is driven mainly by planners (Territorial Analysis) and the other mainly by architects (Best Practices Report). Different scales and disciplines are involved and they may work separately.
Territorial Analysis starts with the creation of a wide GIS-based database about all available information that may be useful for a comprehensive description of the territory under investigation (*Cano, Garzón, Sánchez-Soto 2013*). Together with all environmental and landscape information, in this database a particular attention must be paid to existing and underused architectural assets. In fact they represent the starting point for RAI strategies.
In RAI application a specific best practices database already exists: http://www.raintensification.com /#!case-report/c1zi1. It reports carried out and successful projects related to urban, rural and fringe contexts from all over the world.

In the Best Practice Report built for the main aim RAI, each project is catalogued by four parameters:

a. development of local business capability;
b. development of cultural and tourist activities;
c. environment preserving;
d. facilities for population.

With more details:

a. development of local business capability: business and tourism, diversification into non-agricultural activities, diversification and innovation in agriculture, cultivate the landscape, cooperation and short chain, growth of the bio-economy, business and infrastructure;
b. development of cultural and tourist activities: tourism and architectural heritage, tourism and environment, small-scale tourism services, countryside vs sea and mountain, tourism and water, tourism and infrastructure, tourism in less-favorable areas;
c. environment preserving: environment and biodiversity protection , environment as heritage, environment and water, soil and environment, environment and animals, environmentally sustainable operations, limit consumption of the environment, bioenergy, environmental reservoirs, environment and urban space, environment and infrastructure, environment and waste, environmental risk, environment in disadvantaged areas, diversified environmental redevelopment;
d. facilities for population: population and employment: tourism, population and employment: diversification of agricultural activities, essential services to the population, country-city, population: energy saving, young population, population: infrastructure, cooperation in development, safe population, population and environment.

The characteristics of the specific aim (that decision makers or stakeholders select) guide the data processing that aims to acquire knowledge from the information layers.

At the same time, basing on the thematisms of each example that compose the Best Practices Report, decision makers or professionals circumscribe a coherent selection with the specific aims.

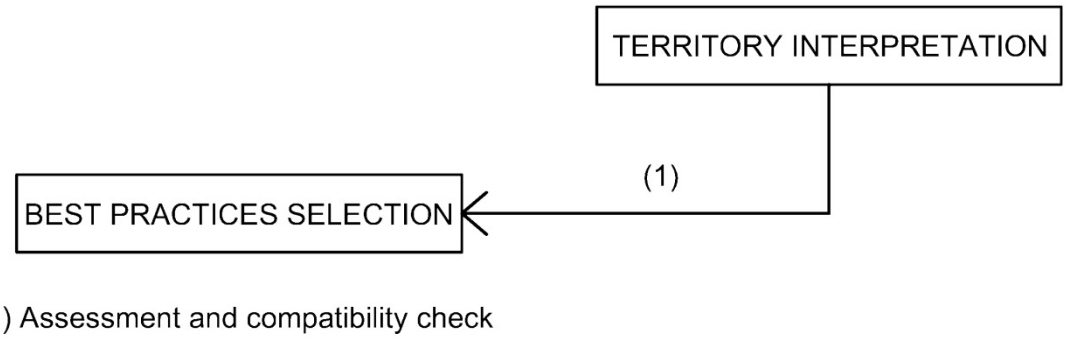


Fig. 3 Second phase

In the second phase (Fig. 3) the output of the Territorial Interpretation defines the boundaries wherein selected case studies have to stay. This assessment among the multiple possible solutions is a compatibility check between the opportunities and limits of the territorial context and the specific goals that each example is able to reach (goals that depend on the specific aim).

In the following scheme (Fig. 4) logical connectors link all the issues and elements involved in the two phases.

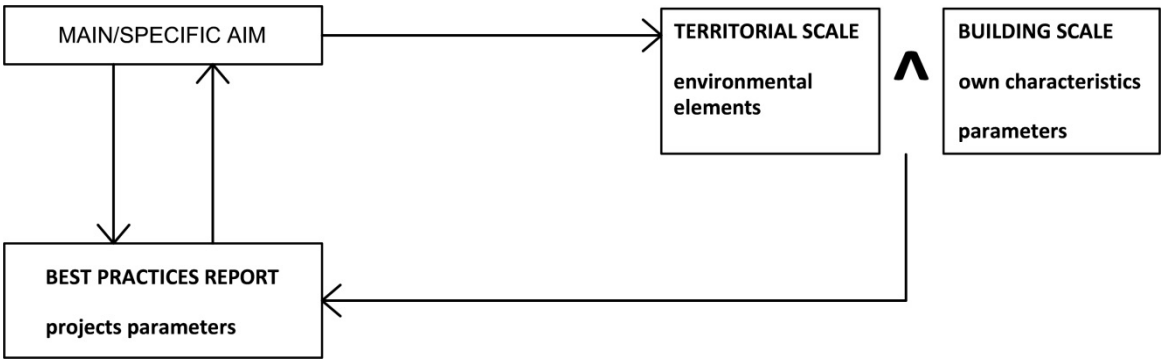


Fig. 4 Involved issues and elements

where:

- Environmental elements are: rows, plantings, hydro-net, land use, REN-regional ecological network, urbanized areas, infrastructures, restrictions;
- Own characteristic are: areas, year of building, state of preservation, state of use, function, restrictions;
- Parameters and projects parameters (a, b, c, d).

With reference to Fig. 4, Fig. 5 illustrates the techniques exploited in each passage.

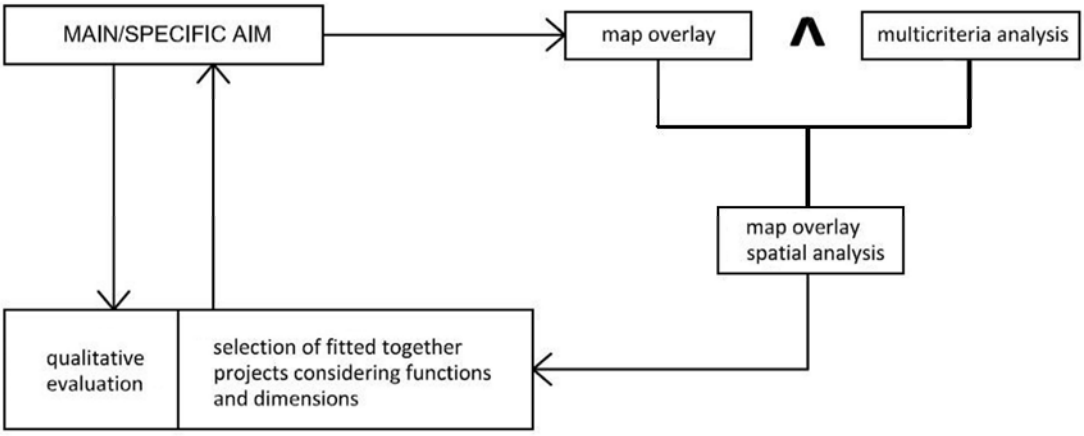


Fig. 5 Exploited techniques

Inside Territorial Scale box the technical operation is basically a map overlay; in Building Scale box the operations are based on a multicriteria analysis that uses the previous four criteria (*Voogd 1983*). In turn the crossroad of the two sets is assessed by map overlay and spatial analysis (*Murgante, Borruso, Lapucci 2009; Murgante, Danese 2011*): in this way the territorial interpretation guided by the specific aim is complete.

The qualitative evaluation is described in the next chapter. Once the territory is appropriately read, it is possible to choose the selected case study that fit with the territorial characteristics. In Tab. 1 there is a synthesis of the main considered elements and used techniques.

| | TERRITORIAL SCALE | BUILDING SCALE |
|---|---|---|
| Data source and tools | Gis and cartography | Gis and cartography, hyperlink, bibliography, automatic survey |
| Data processing | Map overlay | Multicriteria evaluation |
| Elements | Water, soil and urban settlements | *Cascine*: rural settlements |

Tab.1 Synthesis of considered main elements and techniques

Fig. 6 reports an example (from ESRI ArcGIS) of an attribute table that contains all the information connected to a single rural settlement (specifically a so called “cascina”).

In addition to the physical parameters obtained by simple spatial interrogations, there is an evaluation of the previous four parameters (a, b, c, d) and the weights (a-Wn, b-Wn, c-Wn, d-Wn) assigned by planners or decision makers considering the specific aim.

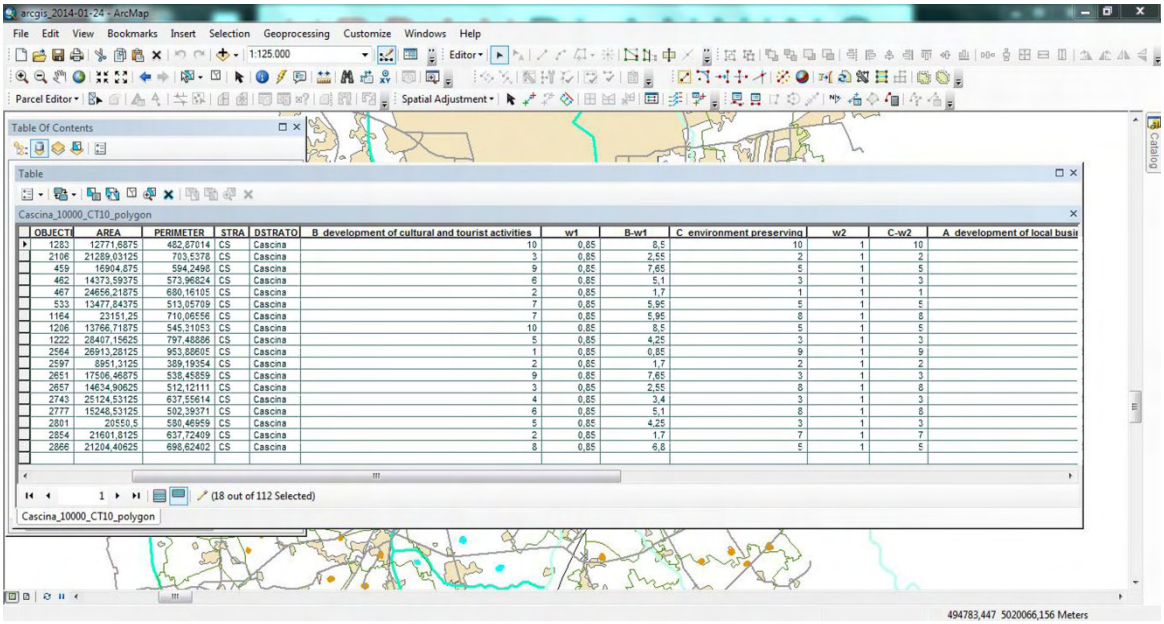


Fig. 6 A single rural settlement attributes table (software: ESRI ArcGIS)

## 4 QUANTITATIVE AND QUALITATIVE ASSESSMENT

It is necessary to specify in which way each project of the Best Practices Report can be assessed in a qualitative and in a quantitative way.

Following what previously mentioned, there are four main criteria that guided the cataloguing procedure. For each specific aim, criteria assume different relevance (or, in other words, each project may have marked performances for certain criteria).

In Fig. 7 there is an example of a qualitative assessment of a certain project. Each criteria is divided in sub-criteria that the project may satisfy or not.


Fig. 7 Example of qualitative assessment

In a quantitative assessment the cited relevance can be synthesized with a weight. The weights are assigned by decision makers, or experts such as planners and architects or also common people if the specific aim demands social involvement. A pairwise comparison is a diffuse methodology that is applied also in this case (Fig. 8).

| Specific Aim | | | | |
|---|---|---|---|---|
| | Local business | Culture + Tourism | Environment | Population |
| Local business | | | | |
| Culture + Tourism | | | | |
| Environment | | | | |
| Population | | | | |

| Evaluation | |
|---|---|
| Local business | x |
| Culture + Tourism | y |
| Environment | z |
| Population | t |

Fig. 8 Example of quantitative assessment

In the compatibility check phase (the final phase of the entire procedure) decision maker compares real information about the minimum built units such as small rural settlements or "cascine" (described using the same parameters a,b,c,d) with the result derived from the qualitative or quantitative assessment of the case report.

Decision maker will select the projects that have performances similar to the studied minimum units.

Qualitative assessment could be transformed into a quantitative one throughout:

- A weighted sum of elements considering how many sub-criteria are satisfied. In Fig. 7 example "Local business" is 1 on 7, "Cultural + Tourism" is 1 on 7, "Environment" is 3 on 15 and "Population" is 1 on 7. These values may become fractions. Once a weight is associated to each parameter decision maker obtains a numerical value (Wa x 1/7 + Wb x 1/7 + Wc x 3/15 + Wd x 1/7). The value itself is not meaningful but it is useful to build a ranking among the selected case studies;
- The well known "Fuzzy logic" (*Terai, Asano, Sugeno 1992; Borri, Concilio, Conte 1998*) can be used to transform such qualitative evaluations (in fact, even if it is possible to define how many sub-criteria a project satisfies, this decision is always highly subjective). With Fuzzy Logic it is also possible to synthesized more complex evaluations derived from non expert judgments. Moreover Fuzzy is also useful in the final phase of compatibility check because the compatibility has often wide ranges of doubts and shades.

## 4 CONCLUSIONS

The research aimed to focus on methodological aspects that regard (and come from) different disciplines. Multidisciplinary is a keyword in recent times but it is not easy to define procedures that can put together quantitative and qualitative, and subjective and objective evaluations into a unique decision process.

The methodology is sufficiently general to be applied to very different contexts and some real applications are needed to test it.

Authors implemented quite all the passages in an automatic tool but some passages need a deeper review.

In example, a semantic indexation of the case study could furnish a more clear (and fast, once well tested) evaluation of the multitude of projects that may respond with more or less coherence to specific needs.

The complete computerization of the process is the main aim that authors would like to reach but the resulting system will always be a DSS in which decision maker interact in all the steps and can control each weight basing on specific aim or personal considerations.
The last passage that still must be faced is the GUI. The interface depends on the typology of users that the system is addressed to and at the moment no specific profile has been defined. Surely authors will start with expert users.

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Fig. 7: http://www.raintensification.com/#!home-english/ceab

**AUTHORS' PROFILE**

Roberto De Lotto

Associate Professor in Urban Planning, DICAR/Department of Civil Engineering and Architecture, University of Pavia.

Tiziano Cattaneo

Assistant Professor in Architectural Composition, DICAR/Department of Civil Engineering and Architecture, University of Pavia.

Cecilia Morelli di Popolo

PhD student in Building Engineering/Architecture XXVI cycle, DICAR/Department of Civil Engineering and Architecture,University of Pavia.

Elisabetta Maria Venco

PhD student in Building Engineering/Architecture XXIX cycle, DICAR/Department of Civil Engineering and Architecture,University of Pavia.

Sara Morettini

Scholarship holder in Urban Planning, UPLab (Urban Planning Laboratory), DICAR/Department of Civil Engineering and Architecture.

Susanna Sturla

Scholarship holder in Urban Planning, UPLab (Urban Planning Laboratory), DICAR/Department of Civil Engineering and Architecture.