

Antonio Leone Carmela Gargiulo
Editors

Environmental and territorial modelling for planning and design



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4

Environmental and territorial modelling for planning and design

Antonio Leone Carmela Gargiulo

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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 Conference 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;
- Federica Gaglione;
- 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
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CALL FOR PAPERS: TeMA VOL. 12 (2019)

The Times They Are a-Changin'

In these last ten years, TeMA Journal has published several international studies and researches supporting the scientific debate on the urban complexity and the future challenges of urban areas. Thus, the three issues of the 12th volume will think again the debate on the definition and implementation of methods, tools and best practices connected to the evolution of the main scientific topics examined in depth in previous TeMA Journal volumes.

In detail, the Journal welcomes papers on topics about the interdisciplinary interaction among Land Use, Mobility and Environment, and also urban studies from the domains of engineering, planning, modelling, behaviour, regional economics, geography, regional science, architecture and design, network science, complex systems, energy efficiency, urban accessibility, resilience and adaptation.

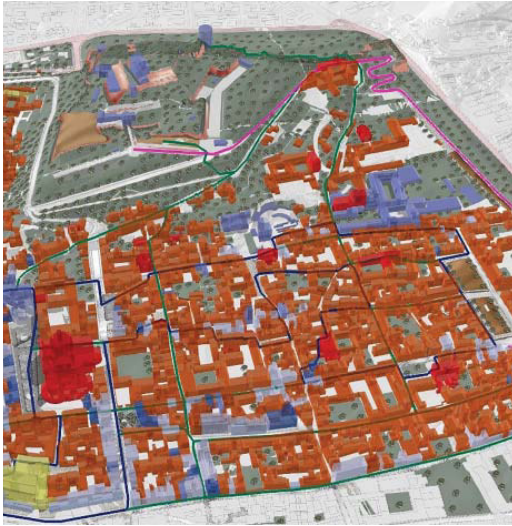
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- second issue: 10th April 2019;
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ENHANCE THE HISTORICAL CITY WITH NEW TECHNOLOGIES

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ABSTRACT

In 2016 the Municipality of Brescia approved the new Urban Plan of the City in which importance was given to the enhancement of cultural heritage. The aim of the Plan is to draw a guideline for sustainable development for the territory and in the urban center this idea was translated into a maintenance program for the protection of historical heritage. The program concerns two aspects: historical buildings and open spaces; this because importance was given to the urban core as a single entity composed by monuments and large squares but also to other types of assets that are important to maintain the identity of the ancient city. The paper illustrates a work done by the authors, which consisted in setting up a methodology aimed at building a database with GIS software. The starting point was the construction of the cognitive framework, collecting data about buildings, open spaces and people, which were put inside the database. With the GIS software it was feasible to highlight these data into specific maps. Then a web-map application, available also on smartphones and tablets, was created with a double value: the first is that it allows to manage all the information about the urban core and, on the other side, it can be used as a guide map during the visit of the site. So, a support tool for the urban plan was provided, to promote the potentiality of the site and to create the conditions for its sustainable development. The paper goal is to explain the method devised and employed and to show its possible future applications considering that the Municipality of Brescia is carrying out many projects in the way of recovering historical buildings and increasing the cultural and tourist attraction of the city.

KEYWORDS

Cultural Heritage; GIS; Smart and Resilient City

1 INTRODUCTION

In 2016 the Municipality of Brescia approved the new Urban Plan of the City (PGT) with the aim of reducing consumption of agricultural soil and promoting a strategy based on the restoration, the refurbishment and the recovery of the parts of the city that have been already built, so the new PGT gives importance to the enhancement of cultural heritage, namely to architectural monuments and to the open spaces. This strategic vision wants to promote the growth of Brescia not under a quantitative point of view but through a sustainable development in which there is a strong collaboration between the Public Administration of the city and the private stakeholders (Tiboni, 2015). At the base of this sustainable development there is the will to use the resources of the territory itself and to create the conditions to make these resources last in time. The Public Administration must promote best practices aimed to increase the value of the areas of the city in a way to encourage the private stakeholders to restore their properties and to create better places to live in. To make these projects feasible, it is important to have a strong system of knowledge that can support the designers. The cognitive framework must collect the features of the assets and of the city users but also, with the will to promote participation, the wishes of citizens. All these operations can help in solving problems for cities of medium dimensions and characterized by a strong industrial vocation. This paper wants to analyze how the Municipality can work on the urban core to develop best practices to protect and enhance the historical heritage and stimulate private owners to do the same, with the aim of emphasizing the peculiarities and potentialities of this part of the city, making it more attractive under a socio-economic point of view. To advance the right strategy, it is important that the projects are strongly linked to the assets features and to the people that enjoy them. The other important topic concerns the use of GIS software to create a database of the heritage in which information is linked to the object it refers to. This database contains data coming from the surveys and from ancient documents like cadastral maps and old paintings of the site. This database must be implemented with data regarding people's behaviour and the way in which they move inside the area. All this material is the system of knowledge that is made available to the Municipality to decide which are the best practices to adopt to enhance the cultural heritage.

The aim of this paper is trying to define a way, starting from the analysis of building, open spaces and people, that can show how new technologies can be implemented to increase the value and the attractivity of a city. To do this it was necessary to develop a methodology that allows to highlight the peculiarities of the site. As case study, the area investigated is the most ancient part of the city centre. This place is very important because it coincides with the first urbanisation of Brescia and, during the centuries, it has been marked by important transformations under an urbanistic and architectural point of view. This is also the part of the city in which there are the most important archaeological evidence and the museums, so it is feasible to say that is the most important area of the city under the touristic point of view.

2 URBANISTIC OVERVIEW OF THE CASE STUDY

The site object of the analysis is located inside the urban core of Brescia. It is the area that, starting from the Castle, goes down on the slopes of the Cidneo hill. The core of the site coincides with the ruins of the ancient Roman city, that are now visible in Piazza del Foro. The borders of the site are Piazza Loggia and Piazza Vittoria in the western part, Piazza Tebaldo Brusato in the eastern side and Corso Magenta in the south (Fig. 1). As it was said before, inside this area there are all the most important monuments that symbolize the transformations occurred during centuries in Brescia. The most important of them are the

Ancient Cathedral and the New Cathedral, the Broletto with its tower and the Loggia Palace which is the core of the Municipality, but there are, also, a lot of other important churches, palaces and squares that are smaller than the others abovementioned but are important to maintain the identity of the ancient city (Lombardi, 1989). It is feasible to say that in this place there is a mix of natural, archaeological and monumental proofs. This is the reason why the Municipality and the Superintendences give such importance to it. This area is also one of the most livable in the city because it is characterized by a high density of houses and, also, there are some of the most important shops and museums so, in every moment of the day there are city-users. Under an urbanistic point of view, the site is characterized by a promiscuity of pedestrian paths and vehicle accessible roads, this is one of the main point of the research about the enhancement of the open spaces. There is also a mix of historical cobblestones and contemporary asphalt streets and this creates huge problems with the Public Transport Lines. It is important to say that the area is well serviced by three underground stations and bike sharing service is also developed on the territory. This means that there is a strong policy that wants to promote pedestrian fruition of the city centre.



Fig. 1 Brescia city centre; satellite view of the case study area

3 SOME PRELIMINARY DEFINITIONS

During the elaboration of the PGT, the Archaeological Superintendence of Brescia asked the Municipality to create a site, called "Archaeological Park", that, according to UNESCO guidelines (UNESCO, 2014), must protect the archaeological evidence such as Capitolium Temple, the Roman Theatre and the old ruins inside the Castle site on Cidneo hill. As UNESCO says, the focus of the area is the part of the city in which there are the most important evidence and it is called "Core Zone" and in the case of Brescia it is the Roman area in Via Musei; all around the Core there is the "Buffer Zone" that is a place in which there are other

archaeological and monumental evidence and has the role of buffer between the rest of the city and the Core. The Buffer Zone coincides with the area of the case study (Fig. 2).

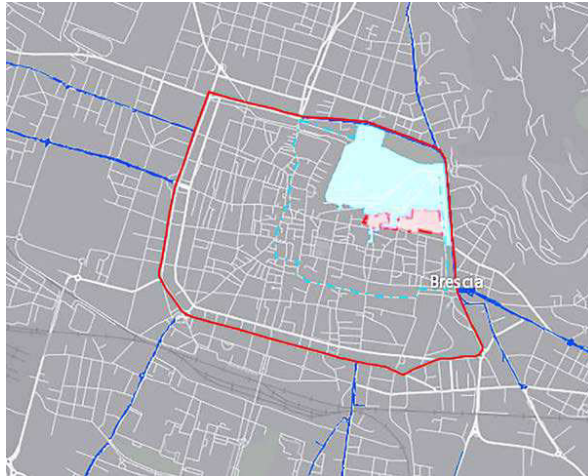


Fig. 2 The definition of the different areas composing Brescia urban core; with the red continuous line there is the perimeter of the city centre, with the blue dashed line there is the Buffer Zone and the red area is the Core Zone

The strategy adopted with the new PGT is to allow this site to grow under the socio-economic sphere. To do this it is important to create an operational method that must protect and enhance the heritage and, at the same time, can make the city centre resilient to sustain touristic flows. Before starting to describe the developed process, it is important to explain the meaning adopted in this paper for the concept of resilience. The background is the sustainable development of the territory and, to do this, it is important to define which are the features that mostly characterize the area. To obtain this kind of growth it is necessary that the features won't deteriorate in time, so, it is needed to create a system in which people can enjoy them without damaging them (Europa Nostra, 2013; Sgobbo & Moccia, 2016). The development of Brescia city centre is given by tourism, so it is demanded to the area to be able to host tourists and city users. This policy, adopted by Brescia Municipality, flows into a deep analysis of the features of monumental architectural and archaeological heritage to create a detailed legislation that regulates operations and works on constrained buildings and open spaces. With this aim, it is necessary to understand how people move and how they use the heritage to avoid wrong behaviours that can damage it. In this case, the resilience is linked with the concept of smart tourism because there is a strong relation between people and site (Russo, 2014; Ventura & Tiboni, 2016). This relation is emphasised also with the use of GIS that permits to create web-maps that can show to users the best way to enjoy the assets. Smart tourism, in this case study, means clever and sustainable tourism that allows to visit places and monuments, also with the support of new technologies, in a way that help maintain the city alive.

4 HOW TO USE GIS TO CREATE A RESILIENT CITY

The surveys were the starting point of this research. The inspections of the area allowed to define the features of the monuments and of the open spaces. On detail, it has been feasible to georefer all the

features needed to define the detailed legislation. Thanks to the GIS software it was possible to create maps in which all the data collected in the database are highlighted to define which parts of the city centre most need a public intervention. The analysis concerns the buildings and the open spaces located inside the Buffer Zone, so two different databases were created. In each database there are information about the typology, the state of conservation, the trigger causes that can damage the object, the potentialities and the weaknesses that can be translated into opportunities or points of strength. This cognitive framework allows to define which is the best strategy of intervention on the heritage and it is a very helpful tool for designers. The purpose is to define a guideline developed by the Municipality but also adopted by the private sphere to create an organic site in which tourists can recognize the Park. The first database created is the one regarding the open spaces. In this phase of the work a help was given by the ancient cadastral maps and ancient representations of the squares and streets. Thanks to this study it was feasible to obtain how the area was in the past and how it evolved in the centuries. Comparing the old paintings with the pictures taken during the surveys allowed to define how the site changed and which are the element that are not compatible with the context and with the history of the site (Fig. 3).

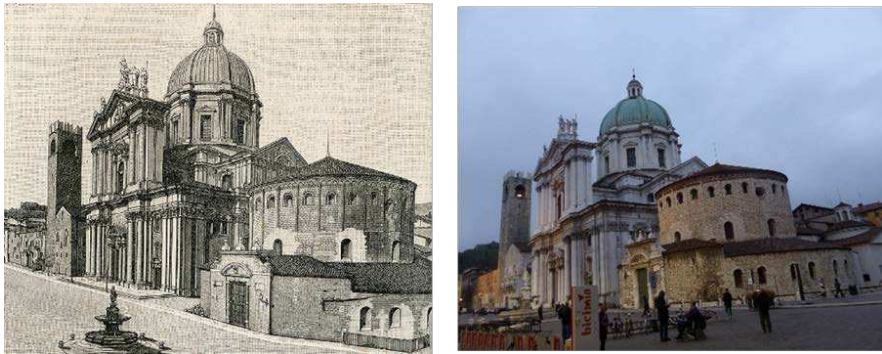


Fig. 3 Comparison between an old print of Piazza Paolo VI and a picture taken during the surveys

The analysis of the open spaces regards the historical value they have and the elements that don't permit to enjoy them. This aspect has deep consequences because it involves various features such as the Public Transport Lines, car parks, viability and accessibility inside the city centre and, also, the street furniture and paving. It emerges how starting from the will to create the condition to make urban core more attractive, there are a lot of consequences in different spheres. This is because in this area there are a plenty of different activities and social functions that require different services but that must operate together to promote the social development of the site. So, it has been necessary to study how people live and how people move inside the Park; this allows to define where and when there are the most intense flows (Rossetti et al., 2015). The analysis allowed to define two different aspects: where people are, that is important because it permits to know which parts of the city are more stressed and, on the other side, it also allows to know if there are part of the Park that are important under touristic point of view and in which there aren't tourists. This data, in the hands of the Municipality, can guide to a strategy of intervention with the aim of promote the parts of the Parks in which there are important monuments, but people don't know (Fig. 4). This is also linked to the creation of itineraries of sustainable mobility in which pedestrians are protected and to rethink the viability and the politics about parking inside the city centre (Carmona, 2003).

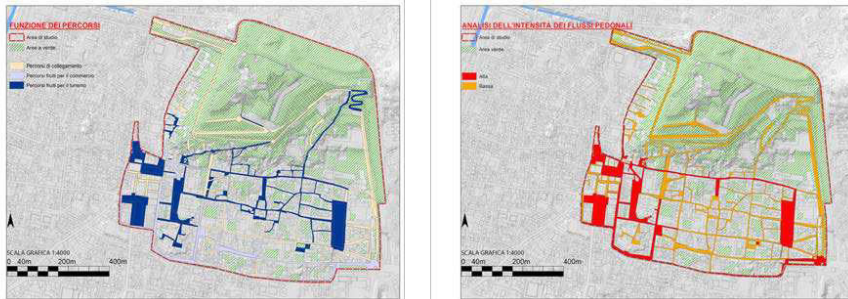


Fig. 4 The maps that show pedestrian flows; in the first one there are the reason why people choose that path and in the second there is the intensity of flows

This policy is thought to enhance the monuments and their fruitions. Now this is obstructed by the strong presence of cars. These operations done by the Municipality have the aim to increase the attractivity both on the touristic side but also on the economic one. Work on the open spaces can create a better city for city users that can visit the Park in an improved way, but also for the citizens that can have healthier spaces in which they can live in. This is because intervention by the Municipality can stimulate the private stakeholders to refurbish their buildings too. To create common guidelines to restore buildings the system of knowledge investigates also their features. That database of buildings starts with the exam of the ancient residential typologies and for each type identifies the architectural characterizing features, then each type was associated to a technological system that has specific properties and specific weaknesses. This is to define which is the best way to restore buildings; the strategy of intervention must be calibrated on the features of each type and, inside the Park, every building belonging to a certain type has to be treated as the others. The aim of this operation is to develop guidelines, shared also with the private sphere, in which it is said how to work to let the monuments to last in time and to create a toolbox in which every designer is oriented in the choice of the correct intervention (Fig. 5, 6). This is an example of how the public intervention on the open spaces can have consequences on the enhancement of monuments and on the increasing of value of the private buildings. This extra value can be used to restore structures with intervention of energy and seismic adaptation to make a part of the city more efficient and attractive. This is also an example of how a Municipality can encourage the private stakeholders.

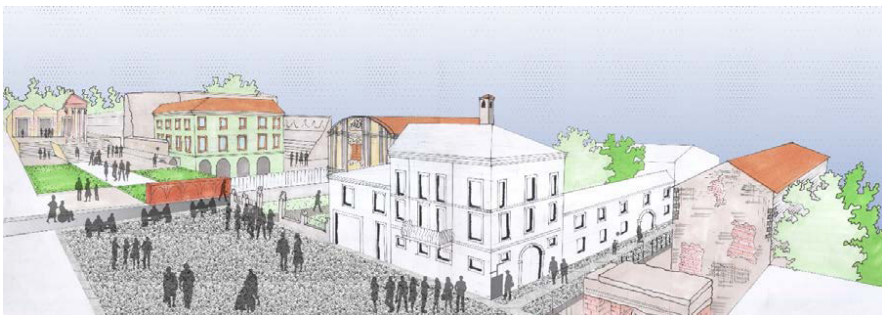


Fig. 5 Example of restoration of the open spaces according to the guideline: Piazza del Foro



Fig. 6 Example of restoration of the open spaces according to the guideline: Piazza Paolo VI

Increasing the flow of tourists can increase the visibility of an area and so people are stimulated to operate in that part of the city because they will have an economic response. In this case study importance was given to the creation of the system of knowledge at the base of urban planning. GIS software is very useful in spreading information because it allowed to draw thematic maps, one for every feature contained inside the databases. It also permitted to create a web-site in which all the databases are displayed at the same time (Fig. 7).



Fig. 7 The display of the web-map; it is possible to see that by clicking on a polygon appears the database related to that element with all the information

This is an important instrument because it gives a picture of the Park in which there are all the information needed to develop a plan for maintenance and management which is also demanded from the UNESCO (UNESCO, 2014). Inside the web-map it is possible to link all the information that are inside the database and it is also possible to implement it with sheets and pictures. The web-map has a double meaning: on one side it is a tool for designers because it contains the guidelines for interventions inside the Park and on the other side it can be used as a guide map for tourists. The web-map can be displayed on smartphones and tablets, so it is feasible to have a look at it while tourists are visiting the area. This can help people to find monuments and places that are important under historical point of view but not so famous as the most important monuments of the site. With this map the users can see different paths and which monuments are located on the route they choose. This map is organized with many paths: the most important is the one that links the most part of monuments and squares and let the tourists walk along the ancient streets to see very different things coming from different centuries. The other routes are the secondary ones and they are

called “thematical” because they link parts of the city belonging to the same historic period such as the Roman path, the Medieval path, the Baroque path and so on (Fig. 8).

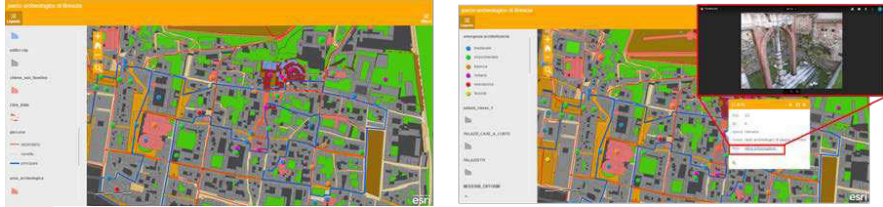


Fig. 8 In the first picture there are the different paths: the blue one is the main path and the red ones are the thematical paths. In the second one there is the related database in which it is possible to see the photo of the monuments that are placed along the routes

5 FROM SMART TOURISM TO SUSTAINABLE DEVELOPMENT

As it was said before, inside the database it is feasible to put links to external elements.

So, in the web-map there are links to pictures of the monuments and of the squares. It is enough to choose one of the path and then the users can see which things there are and, most important, where they are. This aspect can be implemented with information about other things beyond monuments such as shops, restaurants, and info points. This can give a more complete picture of the Park and a wider range of information for tourists and, on the other side, it can increase the value of the services already existing in the site that can be known and found easily and it can be an incentive for other stakeholders to open new services inside the Park. This feature can increase also the quality of life for the citizens because they can find near their home more services. At the end, it is possible to say that starting from the surveys it was possible to create a cognitive framework useful to do a project for the enhancement of the Archaeological Park (but in general, the system of knowledge is an important tool that can help to calibrate projects on the demands of people and spaces) and most of all, to create a management plan that allows to enhance and protect the heritage (Sgobbo & Basile, 2017; Tiboni & Rossetti, 2014; Tira et al., 2018). Using a web-map allows to implement participation of people such as citizens, city users and stakeholders and can help in spreading information and data about the assets involved. All these things go in the direction of creating the condition for a sustainable development of the territory (Fig. 9). Smart tourism is important because it can maintain an area alive and this can promote the creation of new services and the strengthening of the existing ones. It is possible to say that the wrong use, and most of it, the absence of functions in a building or in a place, is the first cause that produce degradation so, under this point of view, implementing tourism contribute to maintain the heritage of the city. This method can be the base for a process in which the problems and the weaknesses of a site are resolved in a holistic way. Smart tourism goes in the direction of the creation of a strong system of sustainable mobility so, knowing, at the beginning of the design phase, the main features of the streets and of the site is important to take the right choices. The process can be applied not only for the Park, but it can be used to define any type of area. The aim is to create a system that contains the main features of a part of the city that the Municipality wants to promote. GIS can help in the creation of this system of knowledge and it can be used to define the best strategy because it permits to link the wishes of the city users to the features of the area. In this context it is feasible to set the concept of sustainable mobility because it is necessary to put attention both to services and users. It is also necessary to link to this data all the information about the streets and about the existing services.

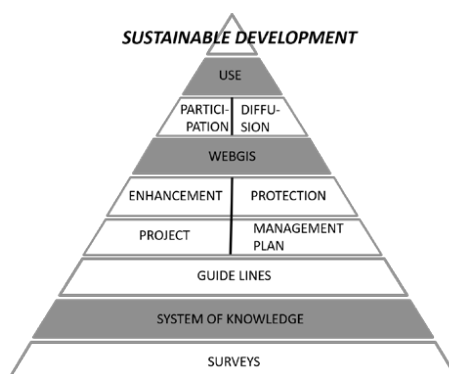


Fig. 9 The process from surveys to sustainable development

At the end it is feasible to say that resilience is strongly linked to knowledge. Using GIS allows to link and spread data about assets, so it is possible to promote a site and its monuments. This method is thought to simplify the fruition of Brescia urban core in the way to sensitize people to take care of the peculiarities of the area. This goes in the direction of resilience because sustainable development must involve the users and the way in which they enjoy the cultural heritage.

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Francesco Botticini, graduated in 2017 in Building Engineering and Architecture at University of Study of Brescia with a thesis about the enhancement and the protection of the cultural heritage of Brescia urban core. He is PhD student since November 2017 and his researches concern new ways for urban regeneration of cities with strong historical industrial vocation, namely he studies how to use GIS to create functional databases with the aim to develop a methodology to enhance the heritage.

Michele Pezzagno is an associate Professor in Town and Country Planning (SSD ICAR/20), Department of Civil engineering, architecture, land, environment and mathematics, University of Brescia. She had been expert in the EU Action COST C6 "Town and infrastructure quality for safety and urban quality for pedestrians" and she is involved in COST C15 "Improving relations between technical infrastructure and vegetation". She is member of the Phd school committee in "Places and times of the cities and territories" and of the Scientific committee of CeSCAm (Friendly City Study Center of the University of Brescia).

Michela Tiboni, since 2005 Associate Professor of Town planning at the University of Brescia (Italy), graduated in Civil Engineering, she obtained a PhD in Town planning at the Polytechnic of Milan (2003). Author of books, papers and other publications, her main fields of research are Land-use dynamics and environmental hazards, Evaluation of plan previews for a safe and sustainable town, Urban policies and techniques towards a safer town. She took part in many projects about Mobility safety as a management objective of urban transformation and Developing Urban Management and Safety, particularly working on the application of Geographic Information System (GIS), with attention to the monitoring of the effects of planning and traffic safety measures. Since 2013 she is Councillor for urban planning in the Municipality of Brescia