

TeMA

Journal of
Land Use, Mobility and Environment

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.

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).



THE TIMES THEY ARE A-CHANGIN'

TeMA

Journal of
Land Use, Mobility and Environment

THE TIMES THEY ARE A-CHANGIN'

3 (2019)

Published by

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

TeMA is realized 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

The cover image is a photo of impacts on transport infrastructure of typhoon Hagibis in Japan (October, 2019)

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 journal in the Area 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. 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, University of Naples Federico II, Italy

EDITORIAL ADVISORY BOARD

Mir Ali, University of Illinois, USA

Luca Bertolini, University of Amsterdam, Netherlands

Luuk Boelens, Ghent University, Belgium

Dino Borri, Polytechnic University of Bari, Italy

Enrique Calderon, Polytechnic University of Madrid, Spain

Roberto Camagni, Polytechnic University of Milan, Italy

Derrick De Kerckhove, University of Toronto, Canada

Mark Deakin, Edinburgh Napier University, Scotland

Aharon Kellerman, University of Haifa, Israel

Nicos Komninos, Aristotle University of Thessaloniki, Greece

David Matthew Levinson, University of Minnesota, USA

Paolo Malanima, Magna Græcia University of Catanzaro, Italy

Agostino Nuzzolo, Tor Vergata University of Rome, Italy

Rocco Papa, University of Naples Federico II, Italy

Serge Salat, Urban Morphology and Complex Systems Institute, France

Mattheos Santamouris, National Kapodistrian University of Athens, Greece

Ali Soltani, Shiraz University, Iran

ASSOCIATE EDITORS

Rosaria Battarra, National Research Council, Institute of Mediterranean studies, Italy

Gerardo Carpentieri, University of Naples Federico II, Italy

Luigi dell'Olio, University of Cantabria, Spain

Isidoro Fasolino, University of Salerno, Italy

Romano Fistola, University of Sannio, Italy

Carmela Gargiulo, University of Naples Federico II, Italy

Thomas Hartmann, Utrecht University, Netherlands

Markus Hesse, University of Luxembourg, Luxembourg

Seda Kundak, Technical University of Istanbul, Turkey

Rosa Anna La Rocca, University of Naples Federico II, Italy

Houshmand Ebrahimpour Masoumi, Technical University of Berlin, Germany

Giuseppe Mazzeo, National Research Council, Institute of Mediterranean studies, Italy

Nicola Morelli, Aalborg University, Denmark

Enrica Papa, University of Westminster, United Kingdom

Dorina Pojani, University of Queensland, Australia

Floriana Zucaro, University of Naples Federico II, Italy

EDITORIAL STAFF

Gennaro Angiello, Ph.D. at University of Naples Federico II, Italy

Stefano Franco, Ph.D. student at Luiss University Rome, Italy

Federica Gaglione, Ph.D. student at University of Naples Federico II, Italy

Carmen Guida, Ph.D. student at University of Naples Federico II, Italy

Rosa Morosini, Ph.D. student at University of Naples Federico II, Italy

Andrea Tulisi, Ph.D. at Second University of Naples, Italy

THE TIMES THEY ARE A-CHANGIN'

3 (2019)

Contents

223 EDITORIAL PREFACE
R. Papa

FOCUS

227 **Defining urban green infrastructure role in analysis of climate resiliency in cities based on landscape ecology theories**
E. Shirgir, R. Kheyroddin, M. Behzadfar

249 **Mega-Event Organization Considering Safety, Security and Resilience**
F. Atun Girgin, O. Edizel Tasci

LAND USE, MOBILITY AND ENVIRONMENT

265 **High speed rail and airport. Future scenarios in Marco Polo Airport in Venice**
P. Pucci, G. Lanza

283 **Walking and talking. The effect of smartphone use and group conversation on pedestrian speed**
L. R. Walsh, T. T. Xian, D. M. Levinson, H. S. Rayaprolu

295 **Elders' quality of life and urban accessibility. A method proposal for spatial planning**
F. Gaglione, C. Gargiulo, F. Zucaro

313 Land-Use and Transport integration policies and real estate values. The development of a GIS methodology and the application to Naples (Italy)
G. Carpentieri, C. Guida, P. Chorus

331 Air Transport Implications in Tourist Destinations. The Trapani Airport in Western Sicily
E. Calderon, P. Ventura, A. Massaro

351 REVIEW PAGES
G. Angiello, F. Gaglione, C. Guida, R. Morosini, A. Tulisi

EDITORIAL PREFACE: TEMA JOURNAL OF LAND USE MOBILITY AND ENVIRONMENT 3 (2019)

THE TIMES THEY ARE A-CHANGIN'

ROCCO PAPA

DICEA - Department of Civil, Architectural and Environmental Engineering

University of Naples Federico II, Italy

ORCID: <https://orcid.org/0000-0003-3355-1418>

e-mail: rpapa@unina.it

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.

For this issue, the section "Focus" contains two articles.

The first article, titled "Defining urban green infrastructure role in analysis of climate resiliency in cities based on landscape ecology theories" by Elmira Shirgir, Reza Kheyroddin, Mostafa Behzadfar (University of Teheran, Iran). The paper addresses the landscape ecology principles and relationship between them and green infrastructure in cities. An application in a neighborhood of Tehran (Yousef Abad) was developed using the aerial images, field surveys and preparation of basic and analytical GIS maps. Finally, the effective qualities in assessing the climate resilience in cities using the urban green infrastructures based on landscape ecology were obtained.

The second article "Guidelines for Mega-event organization considering safety, security and resilience: Insights from London Olympic Games 2012 and Milan EXPO 2015" by Funda Atun and Ozlem Edizel Tasci (University of Twente, Netherland). The paper addresses the issue of mega-event organization, analyzing the Milan World Expo 2015 and London Olympic and Paralympic Games 2012. The paper, in particular, considers the two event under the light of security, safety and resilience of the events. The results are based on the experience of the real actors involved in these two events. The findings suggest several courses of action for decision-makers and emergency planners to safety and security design strategies that can facilitate resilience as a legacy of a mega-event.

The paper addresses the section "Land Use, Mobility and Environment" are five articles.

The first article, titled "High speed rail and airport. Future scenarios in Marco Polo Airport in Venice", by Paola Pucci and Giovanni Lanza (Politecnico di Milano, Italy). This paper introduces an analysis of the possible extension of the catchment area of the Venice Marco Polo Airport, due to the implementation of a direct rail connection and the completion of the high speed/high capacity railway between Milan and Trieste. The study estimates the effects generated by the new railway connections in terms of extension of the Marco Polo airport's catchment area and the related impacts on air traffic, in terms of potential new passengers.

The second article, titled "Walking and talking. The effect of smartphone use and group conversation on pedestrian speed", by Lexie Reynolds Walsh, Tingsen (Tim) Xian, David Matthew Levinson, Hema Sharanya Rayaprolu (University of Sydney, Australia). Distracted walking due to smartphone use is on the rise resulting in growing concern over pedestrian safety and well-being. The study measured the walking speeds of pedestrian groups differentiated by their smartphone use in two different environments - a wide pedestrian bridge at a university, and a narrow footpath on a busy commercial street.

The third article "Elders' quality of life and urban accessibility. A method proposal for spatial planning", by Federica Gaglione, Carmela Gargiulo and Floriana Zucaro (University of Naples Federico II, Italy) deals the issue of the progressive ageing of population is a challenge each city has to tackle by now in order to satisfy the related new commitments. Responding to the needs of the elderly implies rethinking the re-organization and the planning of the urban space to guarantee the best accessibility and usability to urban services of interest for the elderly segment of the population. In this perspective, the paper provides a methodology for classifying the areas of a city according to the levels of mobility and urban services for over 65.

The fourth article "Land-Use and Transport integration policies and real estate values. The development of a GIS methodology and the application to Naples (Italy)", by Gerardo Carpentieri, Carmen Guida (University of Naples Federico II, Italy) and Paul Chours (Province of North Holland, Netherlands). The aim of this study is to develop an ex-post spatial analysis procedure, GIS-based, able to quantify, in terms of real estate values, the impacts in station areas, at micro and macro level, that have been recorded as results of redevelopment and opening of new urban railway lines and stations, as well as of the development of urban requalification and transformation actions. Moreover, a second objective is to apply the methodology to the Naples case study, in order to assess its effectiveness.

The fifth article "Transport Implications in Tourist Destinations. The Trapani Airport in Western Sicily", by Enrique Calderon (Universidad Politécnica de Madrid, Spain), Paolo Ventura, Alessandro Massaro (University of Parma, Italy),. The paper discusses the impact upon the regional development of the tourist traffic of the Trapani Airport sited in the westernmost part of Sicily. Furthermore, it analyzes the important role of connectivity and accessibility in the development of the area and tourism, seeking a maximum involvement of stakeholders.

The section "Review Pages" defines the general framework of the issue's theme, with an updated focus on websites, publications, laws, urban practices and news and events. In particular, the Web section by Rosa Morosini describes three web resources of: (i) The Environmental pollution centers; (ii) European soil data centre and (iii) ECOREMED. The Books section by Carmen Guida briefly reviews three relevant books related to the Issues' theme: (i) Urban Climates; (ii) The Urban Fix: Resilient Cities in the War Against Climate Change, Heat Islands and Overpopulation and (iii) Domus Ecoworld. The Law section by Federica Gaglione keeps readers up to Improve the sustainability of cities through soft mobility. The Urban Practices section by Gennaro Angiello presents two case studies for urban resilience in north America (i) Chicago (United States) and (ii) Toronto (Canada). The News and Event section by Andrea Tulisi, select conferences deliberately deal with different issues not necessarily related to the theme of resilience, but which basically question on the future of cities.

Just few hours before the publication of this third issue of TeMA for 2019, the news of the failure of the International UN Climate Change Conference of Madrid 2019 (COP 25) came. This is not good news for those who take to heart the future of our planet. As partial solage, we report the speech of the President of the European Commission, Ursula von der Leyen, at the opening session of COP25 in Madrid.

"In ten days from now, the European Commission will present the European Green Deal. Our goal is to be the first climate neutral continent by 2050. If we want to achieve that goal, we have to act now, we have to implement our policies now. Because we know that this transition needs a generational change. Three thoughts. The European Green Deal is Europe's new growth strategy. It will cut emissions while also creating jobs and improving our quality of life. For that we need investment! Investment in research, innovation, green technologies. To pull this off, we will deliver a Sustainable Europe Investment Plan – which will support one trillion euros of investment over the next decade. Second thought. Only what gets measured gets done. Therefore, in March next year, we will propose the first-ever European Climate Law to make the transition to climate neutrality irreversible. This will include extending emission trading to all relevant sectors, clean,

affordable and secure energy, the boosting of the circular economy, a farm to fork strategy as well as a biodiversity strategy. The European Green Deal will open new opportunities in all sectors – from transport to taxation, from food to farming, from industry to infrastructure. Third thought. This transition must work for all or it will not work at all. And with a Just Transition Fund we will make sure that we help those who will have to take a bigger step and leave no one behind. The Fund will leverage public and private money, including with the help of the European Investment Bank that has committed itself to become Europe's Climate Bank. We Europeans are ready. If we move together, we will also move faster, in everyone's interest. We will be as ambitious as we can throughout these COP negotiations. We are ready to contribute with our European Deal to a Global Green Deal. Thank you."

TeMA

Journal of
Land Use, Mobility and Environment

Call for Paper

TeMA vol. 13 (2020) The city challenges and external agents. Methods, Tools and Best Practices

The Times They Are a-Changin' and cities have to face challenges which may not be further postponed. In particular, six of these challenges to modify and/or adapt cities physical shape, facilities distribution and their organization as complex systems: climate changes effects, population aging, reduction of fossil-fuel energy consumptions, immigration flows from disadvantaged regions, technological innovation and optimization of land use.

The three issues of the 13th volume will collect articles concerning the challenges that cities are going to face in the immediate future, providing readings and interpretations of these phenomena and, mostly, methods, tools, technics and innovative practices (defined as Climate proof cities, Zero consumption cities, Car Free cities, ..) oriented to gain and keep a new equilibrium between cities and new external agents.

Publishing frequency is four-monthly. For this reason, authors interested in submitting manuscripts addressing the issues may consider the following deadlines:

- First issue: 10th January 2020;
- Second issue: 10th April 2020;
- Third issue: 10th September 2020.

TeMA

Journal of
Land Use, Mobility and Environment

TeMA 3 (2019) 227-247
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: 10.6092/1970-9870/6250

paper received 26th August 2019, accepted 14th November 2019
Licensed under the Creative Commons Attribution - 4.0 International License
www.tema.unina.it

How to cite item in APA format:

Shirgir, E., Kheyroddin, R. & Behzadfar, M. (2019). Defining urban green infrastructure role in analysis of climate resilience in cities based on landscape ecology principles. *Tema. Journal of Land Use, Mobility and Environment*, 12(3), 227-247. doi: <http://dx.doi.org/10.6092/1970-9870/6250>



DEFINING URBAN GREEN INFRASTRUCTURE ROLE IN ANALYSIS OF CLIMATE RESILIENCE IN CITIES BASED ON LANDSCAPE ECOLOGY PRINCIPLES

Elmira Shirgir^a, Reza Kheyroddin, Mostafa Behzadfar

School of Architecture and Environmental Design
Iran University of Science and Technology, Tehran, Iran
e-mail: shirgir_e@arch.iust.ac.ir; {[reza_kheyroddin](mailto:reza_kheyroddin@iust.ac.ir); [behzadfar](mailto:behzadfar@iust.ac.ir)}@iust.ac.ir
URL: <http://www.iust.ac.ir/>

^a ORCID: <https://orcid.org/0000-0003-3444-3144>

ABSTRACT

Climate change is a globally widespread phenomenon. Urban development and climate change are closely interrelated; cities are exposed to the risk of climate change and as a result, are very vulnerable. In recent years, to face the challenges caused by the climate change, the concepts of, urban ecological resilience, specifically, climate resilience have been introduced. Climate resilience, is a type of urban ecological resilience, which is defined as the urban resilience to climate change.

Urban green infrastructure has an established role as one of the strategies for adapting to climate change and for developing and promoting climate resilience in cities. Given the theoretical gap existing in this field, this question arises: "How and based on which features of the green infrastructure can we assess and analyze climate resilience in a city?" To answer this question, the landscape ecology principles and relationship between them and green infrastructure in cities were studied. The relationship was developed in the Yousef Abad neighborhood of Tehran and was qualitatively tested using the aerial images, field surveys and preparation of basic and analytical GIS maps. Finally, the 'effective qualities in assessing the climate resilience in cities using the urban green infrastructures based on landscape ecology' were obtained.

KEYWORDS:

Climate change; Urban climate resilience; Urban Green Infrastructures; Landscape Ecology; Yousef Abad Neighborhood in Tehran

TeMA

有关土地使用、交通和环境的杂志

TeMA 3 (2019) 227-247
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: 10.6092/1970-9870/6250

paper received 26th August 2019, accepted 14th November 2019
Licensed under the Creative Commons Attribution - 4.0 International License
www.tema.unina.it

How to cite item in APA format:

Shirgir, E., Kheyroddin, R. & Behzadfar, M. (2019). Defining urban green infrastructure role in analysis of climate resilience in cities based on landscape ecology principles. *Tema. Journal of Land Use, Mobility and Environment*, 12(3), 227-247. doi: <http://dx.doi.org/10.6092/1970-9870/6250>



基于景观生态学原理来定义 城市绿色基础设施在城市气候 弹性度分析中的作用

Elmira Shirgir^a, Reza Kheyroddin, Mostafa Behzadfar

School of Architecture and Environmental Design,
Iran University of Science and Technology, Tehran, Iran
e-mail: shirgir_e@arch.iust.ac.ir; {[reza_kheyroddin](mailto:reza_kheyroddin@iust.ac.ir); [behzadfar](mailto:behzadfar@iust.ac.ir)}@iust.ac.ir
URL: <http://www.iust.ac.ir/>

^a ORCID: <https://orcid.org/0000-0003-3444-3144>

摘要

气候变化是一个全球性的现象。城市发展与气候变化密切相关；城市面临着气候变化的风险，因此非常脆弱。近年来，为了应对气候变化挑战，引入了城市生态弹性度的概念，特别是气候弹性度。气候弹性度是城市生态弹性度的一种，被定义为城市在气候变化面前所表现出的弹性。作为适应气候变化以及发展和促进城市气候弹性度的战略之一，城市绿色基础设施已经确立了其作用。鉴于该领域存在的理论差距，进而引发了这一问题：“我们应该如何以及基于绿色基础设施的哪些功能来评估和分析城市的气候弹性度？”为了回答这一问题，我们对景观生态学原理及其与城市绿色基础设施之间的关系进行了研究。这种关系是在德黑兰的优素福阿巴德街区发展起来的，并通过航拍图像、实地调查以及编制基本和分析 GIS 地图进行了定性测试。最后，得出了“基于景观生态学使用城市绿色基础设施来对城市气候弹性度进行评价的有效质量”。

关键词：

气候变化；城市气候弹性度；城市绿色基础设施；景观生态，德黑兰的优素福阿巴德街区

1 INTRODUCTION

Cities all over the world face a wide range of hazards that are affected by the factors such as increased urban population and climate change (IPCC, 2008). Urban development and climate change are closely related. Cities are exposed to the risk of climate change and are very vulnerable (Mishra, 2017).

In this respect, in recent years, urban resilience concept has been developed to reduce these negative effects. Resilience is the ability of a system to absorb the disturbances while maintaining the basic structure in the same way and the functional methods, the capacity for self-organization and the capacity to adapt to stress and change (IPCC, 2008). Adaption to climate change focuses on reducing vulnerability to these changes (Leichenko, 2011). Resilience has different dimensions, among which 'climate resilience' as a type of urban ecological resilience is considered in this study (Childers & Cadenasso, 2015), which includes adaptation to and mitigation of the risks and adverse effects of climate change (Asian Development Bank, 2014).

Urban green infrastructure has various vital functions, including the environmental, social, etc., according to research, it is effective in reducing the impacts of climate change in cities and enhancing climate resilience (Byrne et al., 2015).

Reviewing the literature on urban green infrastructure related to its role in creating urban (climate) resilience, characteristics of green infrastructure and the amount of effectiveness based on the development, analysis and evaluation of urban resilience to climate change have not been properly addressed so far. In general, no exact factors have been provided to assess this kind of resilience. It seems that these characteristics can be used as important factors for assessing the quality of climate resilience.

To achieve this goal, the relationship between landscape ecology and its principles is useful for analyzing the resilience potential of green urban infrastructure. Consequently, this relationship will be scrutinized in this paper in a theoretical manner. Then, the principles and results obtained from this study, will be implemented in Yousef Abad neighborhood in Tehran, Iran. Tehran is a city with many problems due to climate change, such as air pollution, drought, increased temperature and lack of water resources. By conducting field surveys, use of aerial images of area of study and preparation of basic maps and analysis using GIS software, this research provides a proposed model and framework based on its question for using the existing green infrastructure in a city to assess quality of climate resilience based on principles of landscape ecology. In the following, the theoretical framework required for this research is introduced.

2 TERMINOLOGY

2.1 CLIMATE CHANGE AND URBAN CLIMATE RESILIENCE

Today, direct and indirect effects of climate change on the low-income and middle-income residents can be seen in the countries that have had the least impact on global warming and climate change. Certainly, the low-income class will be mostly effected from climate change (Asian Development Bank, 2014). Urbanization and climate change have a negative impact on quality of life, economic situation and social stability. The areas with the concentration of population, industries and infrastructure (green-grey), are mostly influenced by climate change. Some urban areas are also more vulnerable to greater impacts of climate change including high temperatures, rising sea levels, precipitation fluctuations due to their geographical situation. Urban dynamic intensifies the effects of climate, the rapid growth of cities will replace the vegetation with hard building surfaces (IPCC, 2008), as a result, the precipitation is reduced and temperature rises. This is what will be discussed more in the case study section of this research. Reducing the impacts of climate changes is related to these five key factors: 1) City form, 2) Construction, 3) Artificial environment, 4) Urban

infrastructure, and 5) Transportation and production of carbon (Connell et al., 2017). This research is focused on urban infrastructures, specifically 'green urban infrastructures'.

Concept of urban resilience has been proposed in recent years to reduce and adapt to these changes. In this study, 'climate resilience', a type of urban ecological resilience, will be discussed. To accurately define the concept of climate resilience, it is necessary to first provide an exact definition of the concept of resilience: resilience refers to 'return to the past' and even 'the ability to easily and immediately return to the previous state', meaning the "elasticity" or flexibility (Adhya, 2010). According to the large scientific literature on the resilience concept and namely on its importance for coping with uncertainty, resilience can be a useful concept for driving strategies addressed to urban adaptation in face of climate change, mainly due to these aspects: resilience is conceived as a conceptual approach to deal with uncertainty and future change with respect to traditional approaches mainly focused on system's control; resilience represents a premise for a proactive response to disasters as it embodies the concept of adaptive and learning capacity, which is typical of living systems; resilience gives room to the emergence of new configurations of the system (even more desirable than the previous ones) after a disturbance, as a result of the self-organization capacity that is typical of complex systems, (Galderisi & Ferrara, 2012).

Folke (2006) claims that, 'Resilience deals with complex adaptive system dynamics and true uncertainty and how to learn to live with change and make use of it. In popular terms, resilience is having the capacity to persist in the face of change, to continue to develop with ever changing environments. Resilience thinking is about how periods of gradual changes interact with abrupt changes, and the capacity of people, communities, societies, cultures to adapt or even transform into new development pathways in the face of dynamic change. It is about how to navigate the journey in relation to diverse pathways, and thresholds and tipping points between them.

Types of resilience include: 1) urban ecological resilience, 2) urban-regional-economic resilience; 3) resilience to reduce urban hazards and accidents; and 4) resilience enhancement through urban governance (Childers & Cadenasso, 2015).

Urban ecological resilience refers to the capacity of ecological systems to absorb the disturbances and also to maintain the feedbacks, processes, and structures necessary and inherent to the system. In other words, it is the severity of the disturbance the system can absorb before the structure of the systems is transformed into a different structure by changing the variables and processes that control its behavior. Climate resilience, is a type of urban ecological resilience (Schipper, 2007). According to the definition of ecological resilience and taking the concept of climate change into account, climate resilience includes: the capacity of an independent unit or a group or organization to respond to climate change in a dynamic and effective manner, while still continuing to daily activities in an acceptable level. This feature includes the resistance to change, recovery after the shock, and reorganization to prevent the destruction of the system that is the city, here and for continued life (Dayland & Brown, 2012). A definition of urban climate resilience is also provided by the Environmental Protection Agency (United States Environmental Protection Agency, EPA, 2017): it is a city's ability to reduce exposure and sensitivity to, and recover and learn from, gradual climatic changes or extreme climate events. This ability comes from a city's risk reduction and response capacity, and includes retaining or improving physical, social, institutional, environmental, and governance structures within a city, (Errigo, 2018). In general, climate resilience, is urban resilience to climate change (Fig. 1).

The factors contributing to climate change include infrastructures, institutions, ecosystems, and capabilities of organizations and authorities (Miller et al., 2009) (Fig. 2).

To sum up, infrastructure is among the factors affecting the development and promotion of climate resilience in cities, urban green infrastructure (UGI) are in focus here which will be further discussed.

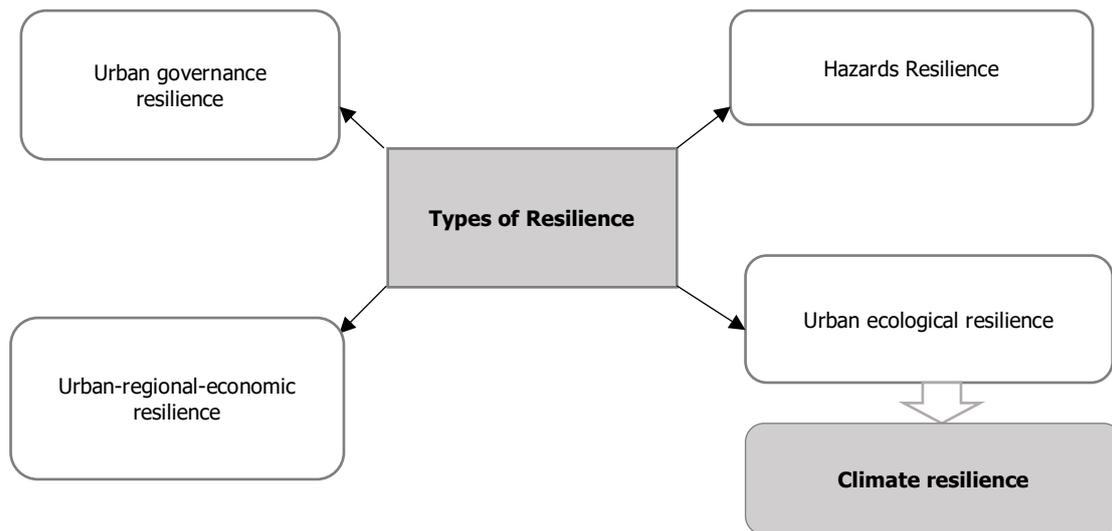


Fig.1 Relationship between climate resilience and other types of resilience

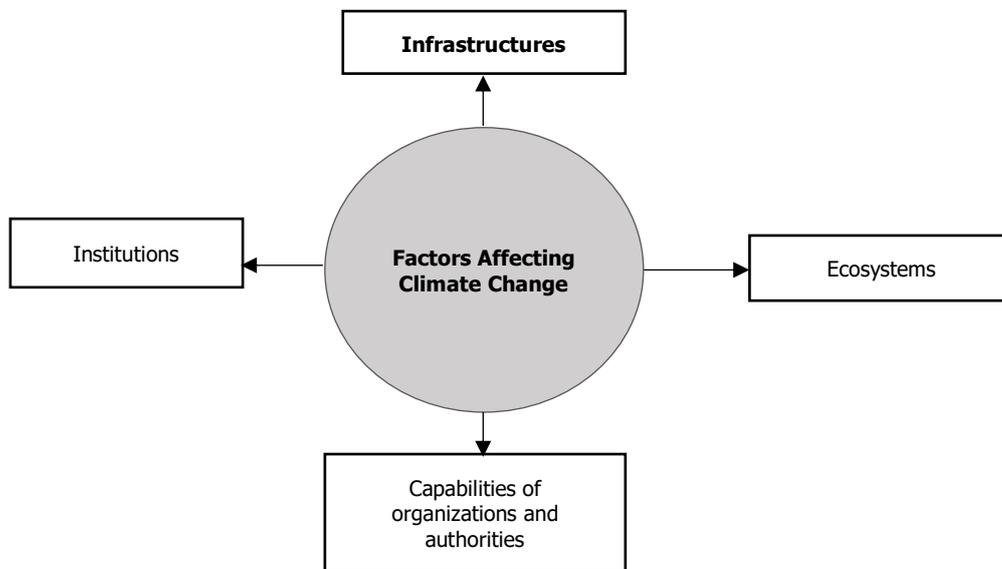


Fig.2 Factors affecting climate change

2.2 URBAN GREEN INFRASTRUCTURES AND THEIR ROLE ON INTEGRATING URBAN CLIMATE RESILIENCE

The influential factors in developing and enhancing climate resilience include various types of infrastructures such as green infrastructures. They are considered as one of the most important urban elements. The term infrastructure as a park and green space was first used in 1996 to define public parks as a subcategory of urban infrastructure. Green Infrastructure (GI) is defined as an ecosystem or a network of ecosystems with specific parts, needs, functions and services, an interconnected network of green space that conserves natural ecosystem values and functions and provides associated benefits to human populations (Bianoci et al., 2018). Green infrastructures include a related network of green spaces that are strategically managed, have many functions, and are useful in ecological, social and economic terms (Pataki et al., 2011). Urban green infrastructure is a kind of ecological social system which results from the interactions of various elements, especially human beings. On the other hand, the components of green urban infrastructure can be considered as a combination of open and closed spaces and a mixture of natural plant habitats, which are of great ecologic, social and economic significance. As a result, the proper design in these spaces can have a profound effect on

everyday life, also resilient design is considered one of the most appropriate principles for the design of such spaces (Oliver, 2014). In general, GI includes green roofs, permeable green surfaces, green paths and streets, urban forests, public parks, neighborhood gardens, and urban wetlands, (Demuzere et al., 2014).

Urban green infrastructure (UGI), is one of the most important 'strategies for adaptation to climate change'. Adaptability has been defined as "the capacity of actors in a system to influence resilience" (Derzken, 2017) and is about adapting within critical social-ecological thresholds. Adaptability is central to persistence. It helps turn changes and surprises into opportunities and, hence, is an important part of social-ecological resilience (Berkes et al., 2016).

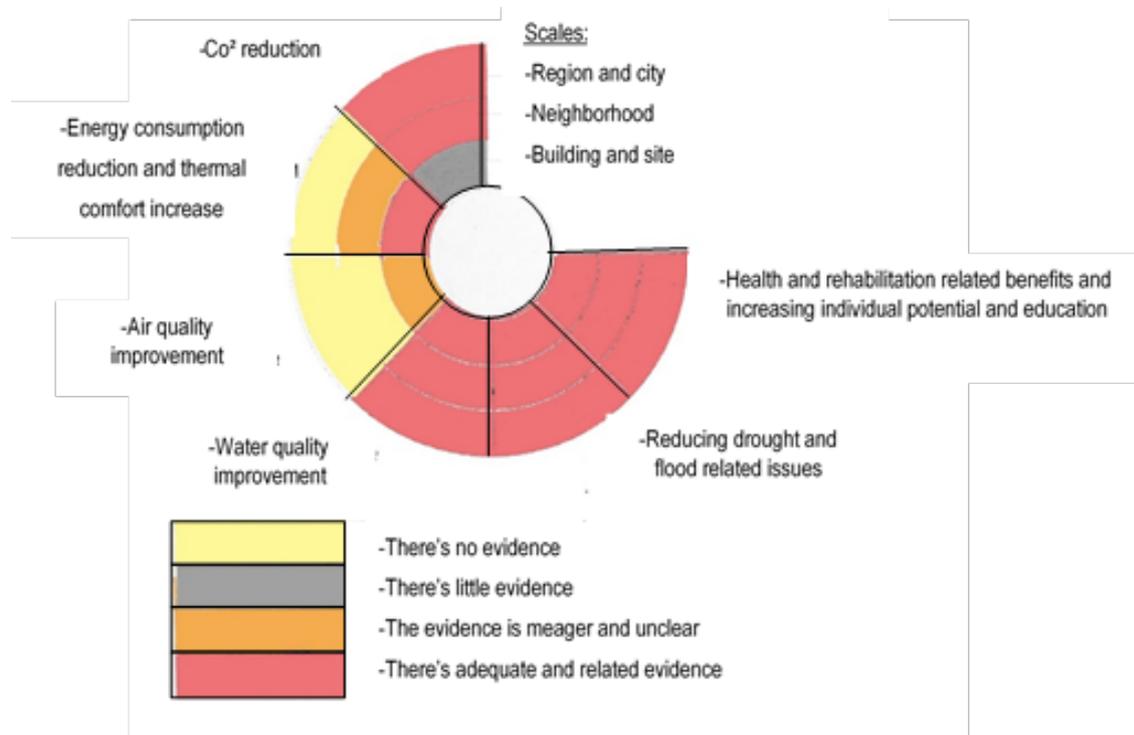


Fig.3 The link between the effects of urban green infrastructure and their impact on climate change reduction and adaptation in three scales and evidence-based

Green infrastructure plays a significant action to mitigate the effects of climate change in the urban environment, promoting adaptation strategies of cities (Salata & Yiannakou, 2016). GI can enhance the cities' climate and reduce the impacts of climate change in future (Foster et al., 2011). It can play an important role for the reduction of emissions, prevention of hydro-geological collapse, soil protection, improvement of air quality and conservation of genetic resources potentially better suited to cope with extreme weather and socio-economic conditions (Bianoci et al., 2018). It also reduces the effects of heat islands and floods in cities as well (Byrne et al., 2015). The effects of green structures on reducing the climate change impacts and increasing the resilience in cities can be divided into several categories: 1) Physical effects; 2) Increased thermal comfort and reduced energy consumption; 3) Reduced negative effects of floods, increased water quality and reduced drought; 4) Impact on air quality; 5) Positive psychological and social effects; 6) Impact on health, social and individual activities, education (Demuzere et al., 2014). In Fig. 3, the impact of urban green infrastructure on climate resilience and adaptation to climate change are displayed. The effects of UGI as an important strategy for adaptation to climate change on: reducing drought, extreme heat, precipitation reduction and air pollution are the main focus of this research, therefore they will be discussed more in the next section.

2.3 CLIMATE CHANGE ADAPTATION STRATEGIC PRINCIPLES

Using UGI as an adaptive strategy is mostly applicable in areas dealing with extreme heat, drought, precipitation reduction, air pollution and water shortage. These conditions can be generalizable to the current state of climate change in many countries around the globe with the same problems due to climate change. Different countries face different types of climate change challenges according to their location and climate conditions, population and natural resources.

As Gill (2007) states, adaptation strategies to climate change, regarding urban green infrastructure, are categorized in three general strategic principles, (Fig. 4): A) *Preservation and Enhancement of Existing Vegetation*: One of the important strategies for reducing the temperature in the warm seasons is preservation and maintenance of existing vegetation whether in private gardens, public green spaces or in green spaces on the streets. There's a fact that in many urban areas, hard and built infrastructure already exist, and it is impossible to change their land use and replace them with large green spaces. In these circumstances, green infrastructure must be added to the environment creatively, using special methods.

Among these methods, the use of green roofs, green facades, planting of rows of trees along the streets and railroads and turning the streets into green corridors can be referred to. Priority should be given to areas where people's vulnerability to climate change is high. Areas with higher poverty, extreme heat, high population and etc., are the most vulnerable.

B) *Using Climate-tolerant Plants*: Another strategy is the use of drought tolerant plants. It goes without saying that one of the negative effects of climate change is causing droughts. Under such conditions, the use of plants with less water requirements and less susceptibility to climatic conditions is effective. Some types of plants are very resistant to specific climatic conditions, including drought. The use of trees is very suitable in such conditions. These plants continue to shade and evaporate under severe climatic conditions. To plant such trees on the streets, it should be noted that the roots of them have good space and conditions. In addition, their placement must be selected correctly. Conditions of irrigation are also very effective and it must be ensured that enough water will reach these trees. Water for irrigation of plants under drought conditions can be provided by reuse of gray or underground waters in the suburbs or by storing water obtained from flood and precipitation (Gill et al., 2007).

C) *Use of Science of Landscape Ecology in finding Proper Locations for Green infrastructures in New Urban Projects and also in quantitative analysis of the UGI resilience to climate change*: To deal with climate change, the location of the green infrastructures is very important. The last strategy presented here, is the main focus of this research which will be discussed in the following section. To complete the strategic principles mentioned above. Based on the theoretical framework presented previously, some key facts can be discussed in the following section.

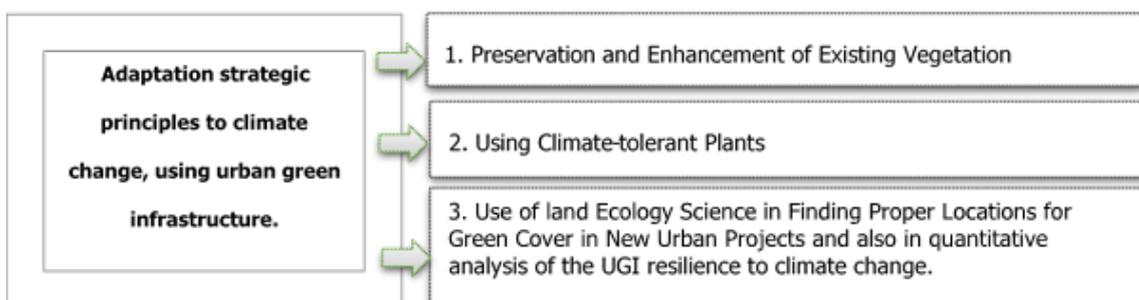


Fig.4 A Framework for Climate Adaption Strategic Principles Using Urban Green Infrastructure to Improve Climate Resilience in cities facing drought, extreme heat, precipitation reduction and water shortage

2.4 RELATIONSHIP BETWEEN LANDSCAPE ECOLOGY AND URBAN GREEN INFRASTRUCTURE AND RESILIENCE TO CLIMATE CHANGE

During the 1980s, advances in the accessibility of computing, remotely sensed satellite and aerial imagery, development of geographic information systems (GIS, ARC/INFO was first released in 1982), and spatial statistical methods (Fortin & Dale 2005), enabled ecologists to observe and analyze spatial heterogeneity ranging from local habitats to entire continents. Landscape ecology, then, involves the study of these landscape patterns, the interactions among the elements of this pattern, and how these patterns and interactions change over time (DucUy & Nakagoshi, 2008). It is best distinguished by its focus on: 1) spatial heterogeneity, 2) broader spatial extents than those traditionally studied in ecology, and 3) the role of humans in creating and affecting landscape patterns and process (Forman, 1995) and by spatial heterogeneity and pattern: how to characterize it, where it comes from, how it changes through time, why it matters, and how humans manage it (Forman & Godron, 1986).

According to Forman and Godron (1986), components of green infrastructure can be classified into three elements: *patch*, *corridor* and *matrix*. A patch is an area of habitat differing from its surroundings, often the smallest ecologically distinct landscape feature in a landscape mapping and classification system. The characteristics of patches are important in landscape ecology, (e.g., the size, shape, or perimeter to area ratio of individual patches). The matrix is the majority of the surrounding landscape (i.e., not the patches); the large proportion of the landscape classified as matrix may have profound influences on the ecological processes in the landscape. Corridors are narrow patches that may act as links or barriers in a landscape. Beyond the image of narrow patches, corridors are functionally important landscape structures influencing dispersal of plants and animals in the landscape (Haddad et al. 2003). Ecologists have been particularly interested in how the spatial distribution of elements affects ecological processes, (McGarigal, 2001).

The development and dynamics of spatial heterogeneity in landscapes is a central theme of ecological studies, especially the effects of conversion of natural ecosystems into human dominated systems such as UGI or urban land use. As natural habitat (UGI) is altered in a landscape, (or city) both the composition and the configuration (spatial pattern of patches) change. This conversion is called fragmentation (in cities, green patches are fragmented during time because of city growth). Evidence is mounting that change in composition has a dominant effect on composition of the biota, whereas variation in configuration has a lesser effect, except at very low proportion of patch composition in the landscape (Fahrig, 1997). This interest has led to the emergence of a dynamic mosaic paradigm (Haddad et al., 2003), which complements the patch-corridor-matrix paradigm. Landscape concepts regarding loss and fragmentation of vegetation cover around the world have become fundamental to understanding the carbon cycle, and predicting the consequences of global climate change (Houghton, 1995).

The patch-corridor-matrix paradigm is what will be used later, to analyze the existing UGI, as a climate change mitigation strategy in the area of study, in this research. To deal with climate change, spatial analysis of components of landscape ecology is necessary, the location, of green cover is very important, whether monitored during a length of time or at the exact time of the analysis.

Each of these elements has the following benefits on climate change effects: Corridors are effective in storing the water from flooding and controlling flood flow, patches are mostly effective in restoring the rainwater and preventing it from flooding. The cooling of space through evaporation is further done by patches than matrixes, and the appropriate micro-climates are also created in the patches, Matrixes are more effective in treating the rainwater than the patches (Gill et al., 2007).

When the green spaces are greater than one hectare, they create a good microclimate. Shading occurs in the patches and matrixes, which leads to cooling of residential areas (Forman, 1995). Therefore green patches and their status are important in this study. Generally, green space is effective in reducing the rate and amount

of surface runoff in sandy soils. The creation of protected areas on such soils can be a good strategy for the areas with such soil types (Gill et al., 2007).

	CORRIDOR	PATCH	MATRIX
Retention of water from flood	***	**	*
Water Treatment property	*	**	***
Cooling through evaporation	*	***	**
Shading	*	**	***

* Mark shows the effect of corridor, patch and matrix on various kinds of climate changes.

Tab.1 Typology and influence of urban green infrastructure on adaptation to climate change from landscape ecology point of view (Gill et al., 2007)

Imaging and mapping technology naturally promoted a patch-corridor-matrix approach to landscape ecology. Examining the map or aerial image of an area helps to define important vocabulary, (Clark, 2010). In this article the main purpose is to use the 'patch-corridor-Matrix heterogeneity model', to analyze and read, the quality of existing urban green infrastructure in a city based on its climate resilience potentials. By using this approach, and analyzing the heterogeneity of the components of landscape ecology, the greatest function and relationship of landscape ecology with urban green infrastructure will appear and that is to locate, suggested green cover in new urban projects by reaching solutions to guide green patches and corridors to the their utter heterogeneity and to lesser the fragmentations caused by urbanity during the years. The above cases can be used both for new urban areas and projects and also, to preserve and enhance the vegetation available in an area. As Galderisi (2014) states, for using UGI to face climate change impacts: existing green spaces in cities must be preserved and looked after, authorities and decision makers must provide the city with more green and blue spaces, and green continuous networks (corridors) must be created in cities.

In Tab. 1, types (typology) of green infrastructure based on landscape ecology's classification, displays how elements of landscape ecology, can be effective in integrating resilience to climate change (Gill et al., 2007; Shirgir et al., 2019).

In addition to the type of green infrastructure, the landscape ecology states that the position and location of the patches, corridors and matrixes are effective in promoting the resilience (Gill et al., 2007). Also, the size of these factors can affect climate resilience. This way, the wider the green patches, the more resilient they are, and the more extended and connected the natural and artificial corridors, the more ensured the resilience. These measures and measurable data can play an important role in assessing the climate resilience. By spatially analyzing a city and measuring the number of green patches, corridors and matrixes of the city, their existence or absence, how they are placed beside each other, their connection and fragmentation, their size, health and suitability of existing vegetation in the city, an accurate spatial-qualitative (if more studied into details even a proper quantitate method) assessment of resilience in cities can be provided.

By conducting such analysis, some suggestions and principles can be presented in the next step for improving the current situation and strengthening green spaces of any type in cities. In this respect, the principles and method of assessing and analyzing the situation of urban green infrastructure are depicted based on the landscape ecology (Fig. 5).

According to this figure and using the principles derived from the relationship between the landscape ecology and urban green infrastructure and climate resilience, correct location for a new, strengthened green infrastructure can be found using the patch, corridor and matrix theories (correct location of proposed green infrastructure).

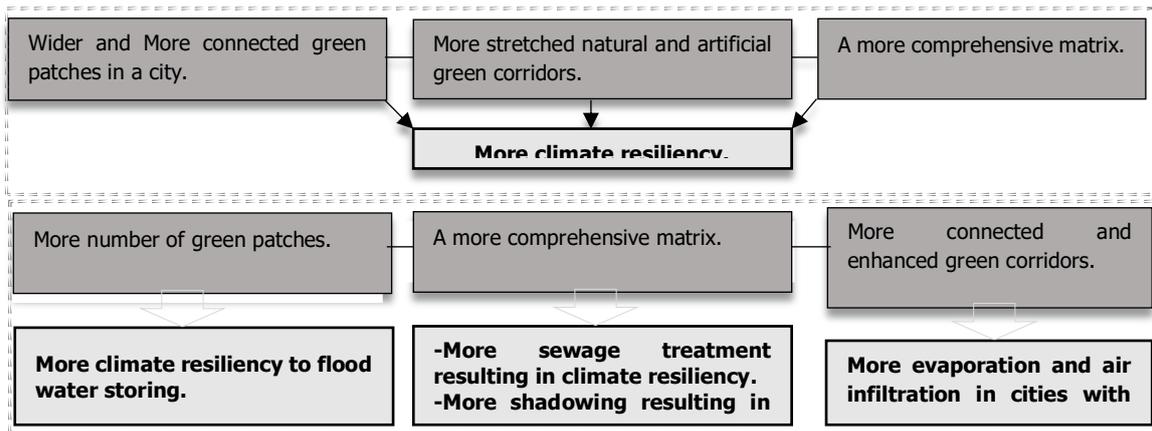


Fig. 5 Principles for analyzing UGI conditions based on their climate resilience role in a city through the language of landscape ecology (Patches, corridors and matrices)

3 RESEARCH METHOD

In order to study the existing green infrastructure in a city scale, a valid method needed to be used. Norton (2015), has suggested a method to study and analyze the existing UGI, based on their potential to mitigate climate effects, in a city especially in the neighborhood scale. This is a 6 step framework to prioritize green infrastructure to mitigate mostly the high temperatures in urban landscapes.

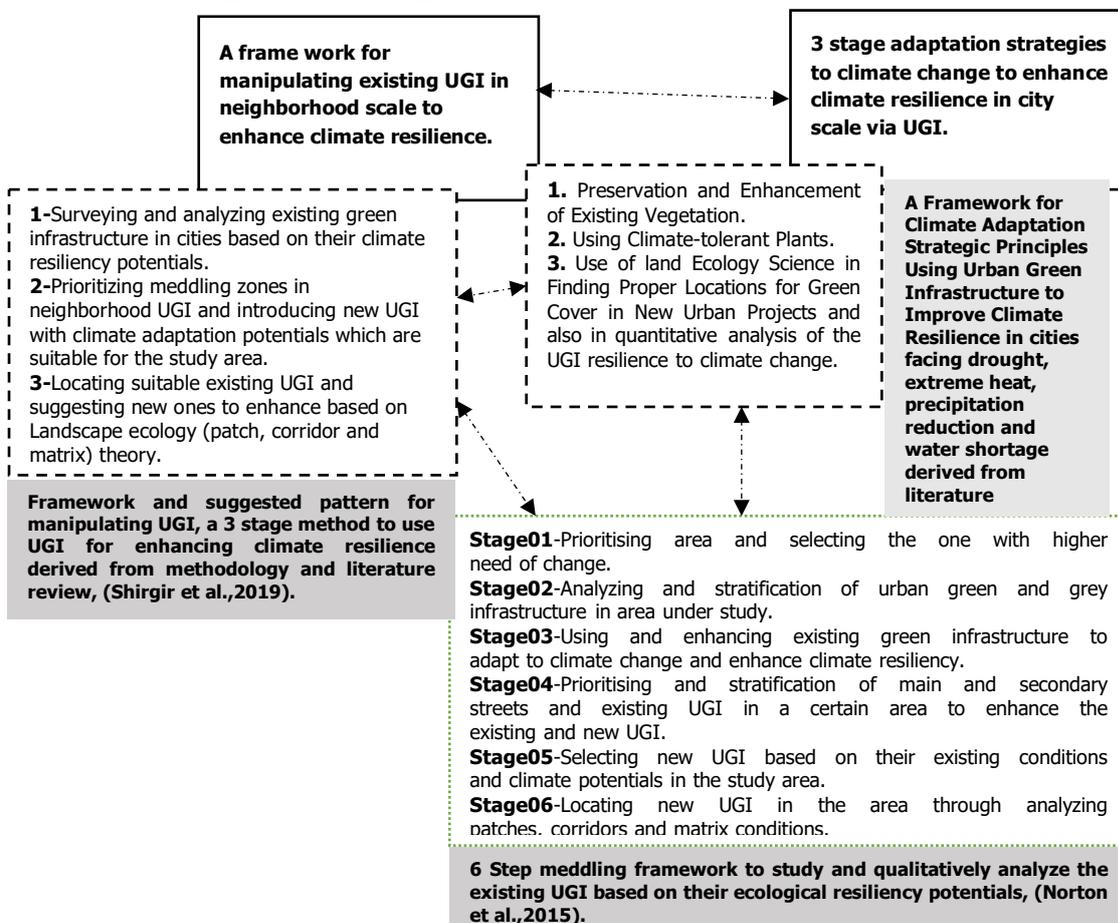


Fig. 6 Framework for meddling in UGI in city and neighborhood scale to enhance resilience to climate change

The 6 steps in a city scale are: 1. Prioritizing neighborhoods and choosing a neighborhood with a higher priority, 2. Identifying and categorizing green and gray infrastructure existing in the selected area, 3. Using

and strengthening existing green infrastructure to adapt to climate change and increasing climate resilience, 4. Sequencing and prioritizing streets in the area of study based on strengthening of existing and new green infrastructure, 5. Selecting new and appropriate green infrastructure, taking current situation of neighborhood and its climate potential into account, 6. Accurately locating green infrastructure of the area by qualitative analysis of green patch, corridor and matrix situation (Norton et al., 2015).

Here, by combining, the 3 strategic principles derived from the literature review section (Gill et al., 2007) (Fig. 4), with the '6 step framework to qualitatively analyze the existing UGI based on their ecological resiliency potentials' (Norton et al., 2015), and landscape ecology principles to read the existing UGI in order to integrate climate resilience (Forman & Gordon, 1986) (Fig. 6), a method is produced in this research. In other words this combination, provides a framework and pattern, for manipulating UGI in city and neighborhood scale to enhance resilience to climate change (Shirgir et al., 2019).

3.1 AREA OF STUDY: YOUSEF ABAD NEIGHBORHOOD IN TEHRAN

Tehran is of the most suitable city for assessing the resilience to climate change. Due to global warming and rapid growth of the city and the population growth, the climate change has affected the city severely. As a result, the necessary measures should be taken into account on all factors affecting urban ecological resilience and especially, climate resilience. Given the climate change situation in Tehran, including air pollution, temperature rise over recent years, rainfall shortage and rainfall variations and decrease, lack of water resources and their decreased quality, increase of dust and drought, all quarters and areas of Tehran and the suburban areas are at risk of climate change (Sheikhi & Rafeian, 2016). As a result, conducting the study.



Fig. 7 Situation of plant species in Yousef Abad, Tehran (left), aerial image of Yousef Abad quarter (right) (Source. Author),(Aerial image Google n.d., 2019)

Yousef Abad area of Tehran is one of the old quarters of Tehran, located in the 6th district of Tehran (Fig. 7).

UGI situation in Yousef Abad area was qualitatively analyzed and evaluated using the aerial images, GIS software and field surveys. This method and its results can change the scale from the neighborhood to the city and can be used to analyze the current situation in cities. It is important to clarify that based on the papers' main goal, the first 2 stages of the framework above were skipped to focus more on stages that would lead to the exact results.

4 RESULTS

The 6 stages that were used, are summarized in part A and B:

A) The first step taken here is a combination of stage 03 and 04 (Fig. 6). In order to use and enhance existing green infrastructure to adapt to climate change and enhance climate resiliency, the existing green infrastructure was documented on a map in Yousef Abad neighborhood of Tehran, to determine the type, position and situation of green spaces by conducting the field study, using the GIS software and aerial images (Bartesaghi-Koc, 2019).

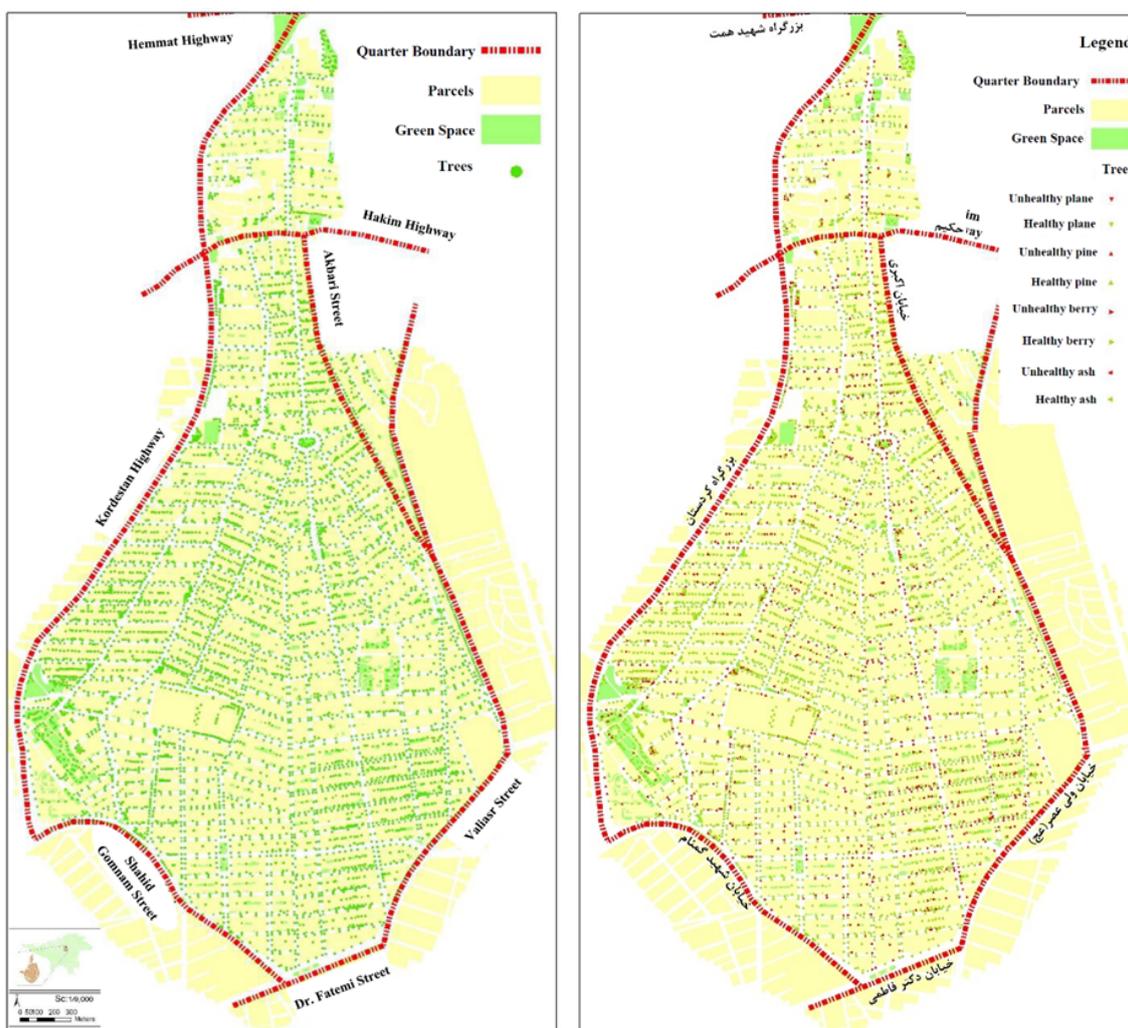


Fig. 8 Basic and analytical (qualitative) maps prepared from location of green infrastructure (left), type of plant species and their health status (right) using GIS

By examining the situation of green infrastructure in the related maps (Fig. 9), the existing plant species with their exact location, in this area, were specified. These species in some points are located in groups (masses=patches), in rows (green corridors), or individually. The analysis shows that, there is a great discontinuity (fragmentation) between them, along the Yousef Abad area. Also, by checking the health status

of plant species, it was found that some of these species are unhealthy, which could reduce their climate enhancement capabilities. These species were also investigated based on their effective climate resilience potentials: water demand, air pollution resistance and shading (Norton et al., 2015), all of which can affect the climate challenges of the city of Tehran such as air pollution, drought, lack of water resources, and increased temperature. It is important to choose plant species based on their resilience potentials for future decisions. Also, the type, number and location of plant species were documented.

Stage 4, Prioritizing and stratification of main and secondary streets and existing UGI in a certain area to enhance the existing and new UGI, was qualitatively analyzed in field surveys and the results are documented in Tab. 2. Plant species were identified along with the scientific name, health status, water demand, air pollution resistance, shading, location (in the main and secondary roads) and the number of species are displayed in Tab. 2.

Tab. 3 is also presented, to introduce the suggested plants based on their climate resilience based on Stage 05 of the framework, 'Selecting new UGI based on their existing conditions and climate potentials in the study area'. In this table, the plant species are suggested to be replaced with unhealthy plant species or with low properties to reduce the climate effects, and proper positioning is determined according to their ecological characteristics.

SPECIES	SCIENTIFIC NAME	HEALTH STATUS	WATER DEMAND	AIR POLLUTION RESISTANCE	SHADING	LOCATION IN AREA	NUMBER OF SPECIES
Plane	Platanus Spp. (Platanus orientalis)	Unhealthy	High	Resistant	Low	Main/North-South	Dominant
Mulberry	Morus Spp. (Morus alba)	Healthy (Inappropriate for footpath)	High	Non-resistant	High	Main/North-South	Dominant
Tree of heaven	Ailanthus altissima	Healthy	Low	Resistant	Low	Main/North-South	Limited
Judas tree	Cercis siliquastrum	Healthy	Low	Resistant	Low	Main/North-South	Limited
Black locust	Robinia pseudoacacia	Healthy	Low	Resistant	High	Secondary /East-West	Limited
Field Elm	Ulmus carpinifolia	Unhealthy	Low	Non-resistant	High	Secondary /East-West	Limited
Eldar Pine	Pinus eldarica	Unhealthy	Low	Resistant	High	Main/North-South	Limited
Mediterranean Cypress	Cupressus sempervirens	Healthy	Low	Resistant	Low	Main/North-South	Limited
European Ash	Fraxinus excelsior	Healthy	Low	Non-resistant	High	Main/North-South	Limited
Fig	Ficus carica	Healthy	High	Non-resistant	Low	Main/North-South	Limited
Eastern Cottonwood	Populus deltoid	Healthy	High	Non-resistant	High	Main/North-South	Very Limited

Tab. 2 Qualitative analysis of UGI status in Yousef Abad area of Tehran based on climate resilience,(Shirgir et al.,2019)*

***-About the importance of location:** Prioritization of main and secondary streets are an important factor, since they display the amount of solar radiation, the streets are exposed to during the day, and how warm it gets. The streets that are northern-southern usually get more sun and are warmer therefore they need plants with higher shadowing capacity.

-Shadowing (shading) capacity: The amount of shade, trees provide depends on their architectural form and canopy density, these can all be listed in a field survey in small areas such as neighborhoods,(Pataki et al., 2011).Thick or dense canopy trees provide good shade, meaning that broad leaf trees are generally more effective than needle-leaf trees, (Norton et al., 2015).

-Tolerance to air pollution: Some trees are more tolerant to air pollution that's why they are a proper choice for a city like Tehran with severe air pollution challenge.

-Watering need: Also, water demand is an important factor, and the trees are water stressed. Stress from low water availability during hot weather can lead to defoliation and possibly death,(Gill et al., 2007).Therefore by examining the existing plants health status, it can be cleared that some plants are not suitable for the existing climate conditions and the amount of irrigation water available in the area (Coutts & Harris, 2013).

-Plants health conditions: Vegetation health information obtained from on-ground study and GIS based maps, can be used most efficiently to enhance existing UGI. Shading capacity in trees depends on both trunk and branches, as well as, the leafy canopy. Therefore the healthier the plants are the more shading and cooling benefits they will have, (Leuzinger et al., 2010).

-The data about green species climate resilience characteristics were derived from the book by H.Sabeti in 2008, called Forests, trees and shrubs of Iran and also from the author's knowledge of the green species characteristics based on her background in the field of landscape architecture.

SPECIES	SCIENTIFIC NAME	HEALTH STATUS	WATER DEMAND	AIR POLLUTION RESISTANCE	SHADING	LOCATION IN AREA	NUMBER OF SPECIES
Plane	Platanus Spp. (Platanus orientalis)	Unhealthy	High	Resistant	Low	Main/North-South	Dominant
Mulberry	Morus Spp. (Morus alba)	Healthy (Inappropriate for footpath)	High	Non-resistant	High	Main/North-South	Dominant
Tree of heaven	Ailanthus altissima	Healthy	Low	Resistant	Low	Main/North-South	Limited
Judas tree	Cercis siliquastrum	Healthy	Low	Resistant	Low	Main/North-South	Limited
Black locust	Robinia pseudoacacia	Healthy	Low	Resistant	High	Secondary/East-West	Limited
Field Elm	Ulmus carpinifolia	Unhealthy	Low	Non-resistant	High	Secondary/East-West	Limited
Eldar Pine	Pinus eldarica	Unhealthy	Low	Resistant	High	Main/North-South	Limited
Mediterranean Cypress	Cupressus sempervirens	Healthy	Low	Resistant	Low	Main/North-South	Limited
European Ash	Fraxinus excelsior	Healthy	Low	Non-resistant	High	Main/North-South	Limited
Fig	Ficus carica	Healthy	High	Non-resistant	Low	Main/North-South	Limited
Eastern Cottonwood	Populus deltoid	Healthy	High	Non-resistant	High	Main/North-South	Very Limited

Tab. 3 Proposed plant species for Tehran Yousef Abad quarter with emphasis on increased climate resilience,(Shirgir et al.,2019)*

Shadowing (shading) capacity: The amount of shade, trees provide depends on their architectural form and canopy density, these can all be listed in a field survey in small areas such as neighborhoods,(Pataki et al., 2011).Thick or dense canopy trees provide good shade, meaning that broad leaf trees are generally more effective than needle-leaf trees, (Norton et al., 2015).

-Tolerance to air pollution: Some trees are more tolerant to air pollution that's why they are a proper choice for a city like Tehran with severe air pollution challenge.

-Watering need: Also, water demand is an important factor, and the trees are water stressed. Stress from low water availability during hot weather can lead to defoliation and possibly death,(Gill et al., 2007).Therefore by examining the existing plants health status, it can be cleared that some plants are not suitable for the existing climate conditions and the amount of irrigation water available in the area (Coutts & Harris, 2013).

-Plants health conditions: Vegetation health information obtained from on-ground study and GIS based maps, can be used most efficiently to enhance existing UGI. Shading capacity in trees depends on both trunk and branches, as well as, the leafy canopy. Therefore the healthier the plants are the more shading and cooling benefits they will have, (Leuzinger et al., 2010).

-The data about green species climate resilience characteristics were derived from the book by H. Sabeti in 2008, called Forests, trees and shrubs of Iran and also from the author's knowledge of the green species characteristics based on her background in the field of landscape architecture.

B) Based on stage 06, 'locating new UGI in the area through analyzing patches, corridors and matrix conditions', the location and size of the patches, corridors and finally the matrix were reviewed here by analyzing the available aerial images (Fig. 9). In the existing situation (on the left), the green patches are fragmented and not fully connected, the number of them are also very limited. The green corridors have been disrupted and discontinued due to new building projects during the years, which has resulted in a broken green matrix in the area. Therefore in the suggested pattern, more continued corridors and patches and a more conformed matrix were suggested (on the right).

In Fig. 9, the situation of UGI was identified using the principles derived in landscape ecology. In the present situation of the area of study in Tehran, the current situation of the green patches, corridors and matrixes in the Yousef Abad neighborhood of Tehran in the right aerial image (current situation) is presented. The results from surveying location and size of green patches includes. In this area, after the construction of successive buildings, the green patches have been discontinued. These patches are fragmented and have a very weak connection. Based on the presented theoretical framework, the more continued and the greater number of corridors and the wider and more interrelated the patches, the more continued the matrix in this neighborhood, the higher the climate resilience of the area, based on the principles, the proposed model was provided in the right side in terms of the principles of landscape ecology (patch, corridor and matrix) for the Yousef Abad neighborhood.

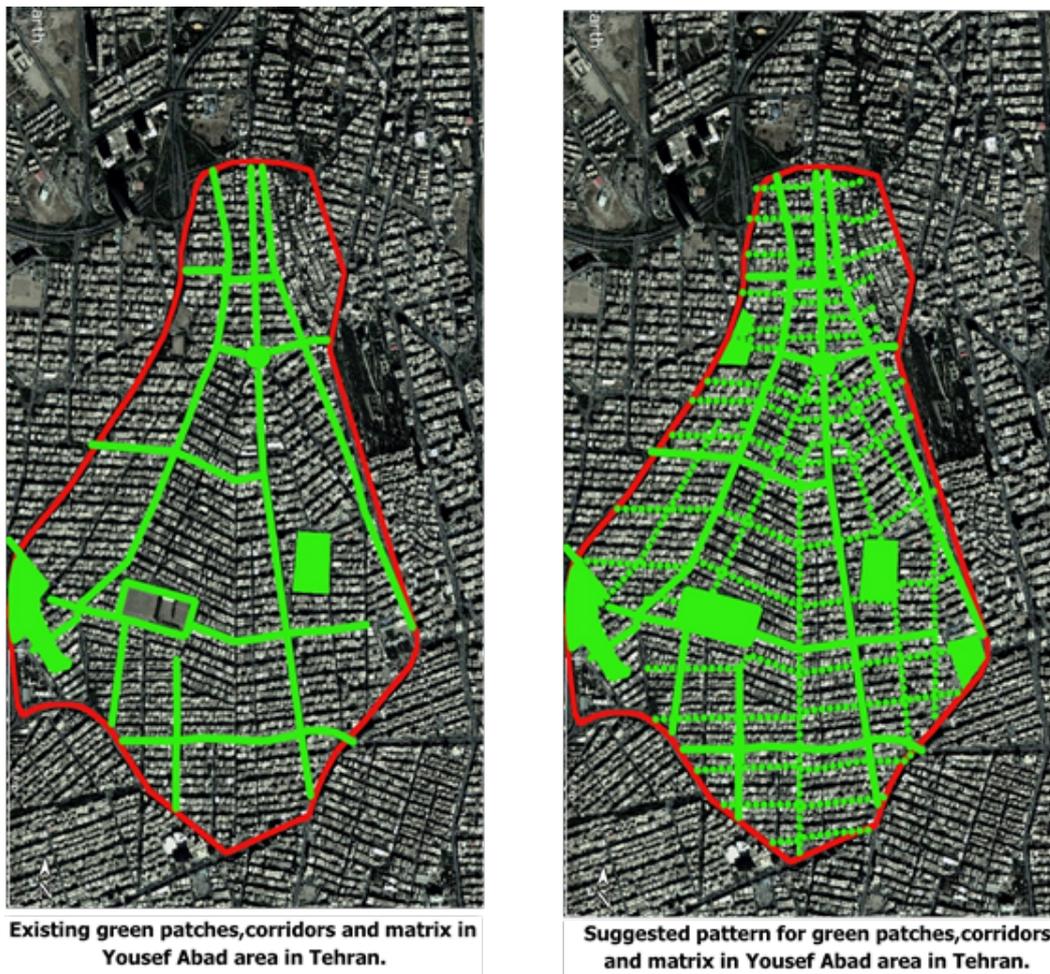


Fig. 9 Existing and suggested pattern green patches, corridors and matrix based on the science of landscape ecology (green patches, corridors & matrix) (Google n.d., 2019), (Shirgir et al., 2019)

5 DISCUSSION

In this paper, by going through the existing literature on UGI as a major climate change mitigation strategy, landscape ecology, urban climate change and urban climate resilience and on cities with dry climate facing drought, air pollution and lack of water resources etc., a major framework was produced by having combined the UGI climate change adaptation strategies with the 6 step method with landscape ecology theories, to study and analyze UGI, to manipulate UGI in cities and neighborhoods to enhance resilience to climate change and to reach a method and a pattern for a qualitative analysis.

This framework was later used as a practical method to study the existing UGI situation in a neighborhood in the city of Tehran, the capital of Iran. This method led to qualitative analysis of UGI status in Yousef Abad area of Tehran based on climate resilience and suggestion of new plant species based on their ecological characteristics and tolerance to specific climate conditions.

One of the important findings of this paper was that, climate resilience can be enhanced by introducing 'climate tolerant plants', whether drought tolerant or any kind of tolerance related to the climate challenge that a city is facing. This way climate resilience of the new or existing UGI can be ensured. This strategy can be specified to cities or neighborhoods facing drought and drier climates.

Choosing the right plant type is also very important, different plants survive in different climates and they vary in each city or region. According to the studies done for this paper, this step, which provides a list of plant species that could ensure resilience to climate conditions, has not been done officially as of today. This could be a step to further the studies done on UGI and urban resilience. It is important to say that, plant types, their location and health status of species are of great significance to reach higher resiliency.

Prioritization of main and secondary streets are an important factor, too. Since they display the amount of solar radiation the street is exposed to during the day, and how warm it gets. The streets that are northern-southern usually get more sun and are warmer, therefore they are in more need of plants that have shading capacities to cool the surfaces, that is another reason why shading capacities of plants are also surveyed on the field (Norton et al., 2015). The amount of shade, trees provide depends on their architectural form and canopy density, these can all be listed in a field survey in small areas such as neighborhoods (Pataki et al., 2011). Thick or dense canopy trees provide good shade, meaning that broad leaf trees are generally more effective than needle-leaf trees (Leuzinger et al., 2010). Also, water demand is an important factor, and trees are water stressed. Stress from low water availability during hot weather can lead to defoliation and possibly death (Gill et al., 2007). Therefore by examining the existing plants health status, it can be cleared that some plants are not suitable for the existing climate conditions and the amount of irrigation water available in the area (Coutts & Harris, 2013). Moreover, appropriate plant selection is very important (Tab. 3).

Implementing UGI is one of the easiest ways to modify street canyon microclimate other than façade awnings and overhangs to shade foot paths (Ali-Toudert & Mayer, 2007). Number of trees was qualitatively documented here, (dominant or limited), this is also to show which trees should be replaced and increased in numbers based on climate adaptation goals. It is clear that not all tree species possess the same capacities for heat and drought tolerance, a diversity of tree species can be important in moderating temperatures throughout the day, (Norton et al., 2015).

Regarding the green infrastructure in particular, it can be stated that the analysis of the situation of plant species in a region based on the type of plant species, location, covering area, number, area covered by them, health status of plant species, and comparison of these factors, can be a proper way to analyze the potential of climate resilience in the green infrastructure of an area in a city.

In principle, for the first time, in this research, a qualitative method was obtained for assessing the situation of green infrastructure based on climate resilience and changing of this green infrastructure in order to increase the climate resilience.

As displayed in Fig. 10, UGI's number, health status, type of species, location and covering area are the five important characteristics of UGI to assist with the analysis of climate resiliency. This diagram and its results can assist with 'qualitative' analysis of the above mentioned factors. More research must be done to result in more details of this analysis in a quantitative manor. For example a 'quantitative matrix' could be used to score the existing UGI in an area based on the five characteristics mentioned above, to do measurements based on quantities. In Fig. 10, to examine the qualitative characteristics of the gray infrastructure, some points are also presented which can be elaborated and completed in future studies.

6 CONCLUSION

Climate change has a negative impact on urban-scale. Climate resilience is beyond the scope of urban planning and decision-making, but adverse climatic changes lead to a reduction in environmental resilience. Instead, there are variables for controlling and intervening in the environment such as the strategies for adaptation to climate change through urban green infrastructures which can be effective on climate resilience for the reasons mentioned before.

It is clear that climate changes are hard to control since they require a wide comprehensive global network of decision making. One way to somehow control and reduce these negative impacts is by interfering in green infrastructure in the cities by analyzing their existing conditions and evaluating their resilience potentials based on the way they are located and connected on one hand and the type of species they are composed of on the other hand and to later on, make suggestions for each city based on these qualities and quantities to enhance their resilience conditions. Also these principles can also be used for new projects and for making decisions about the green spaces and their species beforehand.

It seems that studies in the areas mentioned are less oriented towards improving the situation of the neighborhoods. To take the first steps, a neighborhood was selected here as the study area. In addition, standards, indicators and components for measuring resilience in this scale have not been properly elaborated. This could also be suggested for further studies on the issue.

According to the studies conducted in this research, it seems that so far, urban green infrastructure and their role in urban design and planning have not been properly cleared.

While it is proven that the use of urban green infrastructure is one of the key strategies to reduce and adapt to climate impacts in the areas with Mediterranean, hot and arid climates, the exact strategies for the correct use of these infrastructures in the cities have not yet been provided. Here, by conducting this research on the city of Tehran, a framework was obtained for documenting and measuring the quality of urban green infrastructures in order to improve the quality and location for the adaptation to climate change. These findings can be generalized to the cities and neighborhoods according to geographic location and their similar negative impact of the particular climate change which is mostly heat waves and extreme heat. More research needs to be done to generalize this method to other cities with other climate change challenges.

Also, there is still a gap for a *quantitative method* to assess climate resilience in cities based on green and even gray infrastructure and their characteristics, which can be found in future research. However, the scale issue is also important. Finding a quantitative-qualitative method for intervening in urban green infrastructure can also be considered for future studies to promote ecological resilience to climate change.

Analysis of the current situation, quantity and quality of vegetation, the way green infrastructure is located in the neighborhood, and the standards for achieving climate resiliency through this infrastructure can be part of the existing shortcomings in this area of study. Urban neighborhoods are considered as the best scale for applying new concepts of urban design and planning. Therefore doing a study on the neighborhood scale is a suggestion for further reading. And finally, using nature and its natural capabilities, is the best way to save the planet from the issues it is facing due to human actions.

REFERENCES

Adhya A. et al. (2010). Definitions sustainable urbanism: towards a responsive urban design. Conference Paper, *Conference on Technology & Sustainability in the Built Environment*, At King Saud University, Saudi Arabia.

Ali-Toudert, F., & Mayer, H. (2007). Effects of asymmetry, galleries, overhanging facades and vegetation on thermal comfort in urban street canyons. *Solar Energy*, 81(6), 742–754. doi: <http://dx.doi.org/10.1016/j.solener.2006.10.007>

Asian Development Bank. (2014). *Urban climate change resilience: A synopsis, DB Annual report*, retrieved from <https://www.adb.org/documents/adb-annual-report-2009>.

Bartesaghi-Koc, & Osmond P, Peters A. (2019). Mapping and classifying green infrastructure typologies for climate-related studies based on remote sensing data, *Journal of Urban Forestry & Urban Greening*, 37, 154–167.

Berkes F. & Ross H. (2016). Panarchy and community resilience: Sustainability science and policy implications, *Environmental Science & Policy* 61. doi: <http://dx.doi.org/10.1016/j.envsci.2016.04.004>

Bianconi, F., Clemente, M., Filippucci, M., & Salvati, L. (2018). Re-sewing the Urban Periphery. A Green Strategy for Fontivegge District in Perugia. *Tema. Journal of Land Use, Mobility and Environment, Issue Volume* 11(1), 107-118. doi: <http://dx.doi.org/10.6092/1970-9870/5216>

Byrne J.A. et Al. (2015). Conceptualizing green infrastructure for climate change adaptation: Barriers to adaptation and drivers for uptake by spatial planners, *Journal of landscape and urban planning*, 155-163.

Childers D.L. & Cadenasso M.L. (2015). An ecology for cities: A transformational nexus of design and ecology to advance climate change resilience and urban sustainability. *Journal of Sustainability*, 7(4), 3774-3791. doi: <http://dx.doi.org/10.3390/su7043774>

Clark, W. (2010) Principles of Landscape Ecology. *Nature Education Knowledge* 3(10), 34.

Connell R. et al. (2017). *Climate change adaptation by design: a guide for sustainable communities*, London: TCPA.

Coutts A, & Harris R. (2013). Urban Heat Island Report: 'A multi-scale assessment of urban heating in Melbourne during an extreme heat event and policy approaches for adaptation, *Published by VCCCAR*, Melbourne, Australia.

Dayland A. & Brown A. (2012). From practice to theory: emerging lessons from Asia for building urban climate change resilience, *E-Journal of Environment and urbanization*, doi: <http://dx.doi.org/10.1177/0956247812456490>

Derkzen M.L. (2017). Green infrastructure for urban climate adaptation: How do residents' views on climate impacts and green infrastructure shape adaptation preferences? *Journal of Landscape and Urban Planning*, 157, 106-130. doi: <https://doi.org/10.1016/j.landurbplan.2016.05.027>

Demuzere M. et al. (2014). Mitigating and adapting to climate change: Multi-functional and multi scale assessment of green urban infrastructure. *Journal of Environmental management*, Volume 146, 107-115. doi: <https://doi.org/10.1016/j.jenvman.2014.07.025>

DucUy P. & Nakagoshi N. (2008). Application of land suitability analysis and landscape ecology to urban green space planning in Hanoi, Vietnam, *Journal of Urban Forestry & Urban Greening*, Volume 7, Issue 1, 15 February, 25-40. doi: <https://doi.org/10.1016/j.ufug.2007.09.002>

Errigo, M.F. (2018). The adapting city. Resilience through design in Rotterdam. *TeMA Journal of Land Use, Mobility and Environment*, Issue Volume 11(1), 51-64. doi: <http://dx.doi.org/10.6092/1970-9870/5402>

Fahrig, L. (1997). Relative effects of habitat loss and fragmentation on population extinction. *Journal of Wildlife Management* 61, 603–610. doi: <http://dx.doi.org/10.2307/3802168>

Folke C. (2006). Resilience: The emergence of a perspective for social–ecological systems analyses, *Journal of Global Environmental Change* 16(3) doi: <http://dx.doi.org/10.1016/j.gloenvcha.2006.04.002>

Forman R.T.T. & Gordon M. (1986). *Landscape ecology*, University of Minnesota: Wiley.

Forman R.T.T. (1995). Some general principles of landscape and regional ecology. *Landscape ecology*, 10, 133-142.

Fortin, M. J. & Dale, M. R. T. (2005). *Spatial Analysis: A Guide for Ecologists*. New York, NY: Cambridge University Press.

Foster J., Lowe A., Winkelman S. & Foster J. (2015). The value of green infrastructure for urban climate adaptation. *Center for clean air policy*. Retrieved from www.ccap.org.

Galderisi A. & Ferrara F.F. (2012). Enhancing urban resilience in face of climate change: a methodological approach *Tema. Journal of Land Use, Mobility and Environment*, 5 (2), 69-88. doi: <https://doi.org/10.6092/1970-9870/936>

Galderisi A. (2014). Climate adaptation challenges and opportunities for smart urban growth, *Tema. Journal Of Land Use, Mobility And Environment*, 1, 43-67 doi: <http://dx.doi.org/10.6092/1970-9870/2265>

Gill S.E., Handley J.F., & Ennos A.R. (2007), Adapting cities for climate change: the role of green infrastructure, *E-Journal of Built Environment*, 33 (1) 115-133, doi: <http://dx.doi.org/10.2148/benv.33.1.115>

Haddad, N. M., Bowne, D. R. et al.(2003). Corridor use by diverse taxa. *Ecology* 84, 609–615.

IPCC. (2008), *Climate change and water*, Intergovernmental Panel on Climate Change, WMO, UNEP

Leichenko R. (2011). *Climate change and urban resilience*, *Journal of Environmental Sustainability*, 3(3) 164-168. doi: <http://dx.doi.org/10.1016/j.cosust.2010.12.014>

Leuzinger S. Vogt. R. & Körner, C. (2010). Tree surface temperature in an urban environment. *Agricultural and Forest Meteorology*, 150(1), 56–62. doi: <http://dx.doi.org/10.1016/j.agrformet.2009.08.006>

McGarigal K. & Urban D. (2001). Introduction to Landscape Ecology, *Landscape Ecology course notes*, Duke University.

Miller N. Condon P.M. & Cavens D. (2009). *Urban planning tools for climate change mitigation*, MA, USA: Lincoln Institute of Land policy.

Mishra P.K. (2017). Socio-economic Impacts of Climate Change in Odisha: Issues, Challenges and Policy Options. *Journal of Climate Change*, 3 (1), 93-107, doi: <http://dx.doi.org/10.3233/JCC-170009>

Norton B.A. et al. (2015). Planning for cooler cities: A framework to priorities green infrastructure to mitigate high temperatures in urban landscapes, *E-Journal of Landscape and Urban Planning*, 134, 127–138, doi: <http://dx.doi.org/10.1016/j.landurbplan.2014.10.018>

Oliver T.H. & Morecroft D. (2014). Interactions between climate change and land use change on biodiversity: attribution problems, risks, and opportunities, *Journal of WIRES Climate change*, 5 (3), 317-335. doi: <http://dx.doi.org/10.1002/wcc.271>

Pataki D.E. (2011). Coupling biogeochemical cycles in urban environments: Ecosystem services, green solutions, and misconceptions, *E-Journal of Frontiers in Ecology and the Environment*, 9(1), 27-36: doi: <http://dx.doi.org/10.1890/090220>.

Salata, K. & Yiannakou, A. (2016). Green Infrastructure and climate change adaptation. *Tema. Journal of Land Use, Mobility and Environment*, 9 (1). doi: <http://dx.doi.org/10.6092/1970-9870/3723>

Schipper, E.L.F. (2007). Climate change adaptation and development: Exploring the linkages. *Norwich, UK: Tyndall Centre for Climate Change Research*.

Sheikhi S. & Rafeian M. (2016). Integrating climate change adaptation and mitigation with urban planning for a livable city in Tehran, PhD thesis at Tarbiat Modarres University, Tehran, Iran.

Shirgir E. Kheyroddin R. & Behzadfar M. (2019). Developing Strategic Principles of Intervention in Urban Green Infrastructure to Create and Enhance Climate Resilience in Cities—Case Study: Yousef Abad in Tehran, *Journal of Climate change*, 5(1), 61-73. doi: <http://dx.doi.org/10.3233/JCC190007>

United States Environmental Protection Agency, EPA, (2017). Evaluating Urban Resilience to Climate Change: A Multi-Sector Approach. 2017. Available online: www.epa.gov/research (accessed on 18 December 2017).

IMAGE SOURCES

Fig.1: Shirgir et al., 2019; Fig.2: Shirgir et al., 2019; Fig.3: Demuzere et al., 2014; Fig.4: Shirgir et al., 2019; Fig.5: Shirgir et al., 2019; Fig.6: Shirgir et al., 2019; Fig.7: Shirgir et al., 2019; Fig.8: Shirgir et al., 2019 & Google n.d., 2019; Fig.9: Shirgir et al., 2019.

AUTHOR'S PROFILE

Elmira Shirgir, since joining the Iran University of Science and Technology, school of architecture and Environmental design's PhD program in 2016, she has been involved with studies related to urban green infrastructures and their effects on mitigating climate change effects in cities. Environmental issues, climate change and its effects on cities has been a major concern for her many years. Before joining this program at IUST, she has had many years of experience working as a senior Landscape Architect and environmental expert, at companies in Tehran, Iran and Sydney, Australia. She received a master's degree in Environmental design engineering from the university of Tehran in Iran in the year 2005. She also got a bachelors degree in Environmental engineering from university of Tehran in 2002.

Reza Kheyroddin is an Associate Professor in Urban Planning department, faculty of Architecture and Urban Planning Iran University of Science and Technology. His research is mainly based on Quantitative and Spatial Analysis of Urban & Regional Transformation, Mega-Cities and Metropolization, Petroleum Cities. He got his PhD degree from University of Paris X-Nanterre, Paris- France in Urban Planning in 2009. He has many published papers and books on different areas of study.

Mostafa Behzadfar is a Full Professor in Urban Planning department, faculty of Architecture and Urban Planning Iran University of Science and Technology. He got his PhD in urban design (Architecture), from department of Architecture, faculty of Architecture, University of Sydney, Australia, in 1997. His research mainly focuses on: Theory and Techniques of Urban Design, truth oriented place making/urbanism, urban design education. He has many published papers and books on different areas of study.

TeMA

Journal of
Land Use, Mobility and Environment

Call for Paper

TeMA vol. 13 (2020) The city challenges and external agents. Methods, Tools and Best Practices

The Times They Are a-Changin' and cities have to face challenges which may not be further postponed. In particular, six of these challenges to modify and/or adapt cities physical shape, facilities distribution and their organization as complex systems: climate changes effects, population aging, reduction of fossil-fuel energy consumptions, immigration flows from disadvantaged regions, technological innovation and optimization of land use.

The three issues of the 13th volume will collect articles concerning the challenges that cities are going to face in the immediate future, providing readings and interpretations of these phenomena and, mostly, methods, tools, technics and innovative practices (defined as Climate proof cities, Zero consumption cities, Car Free cities, ..) oriented to gain and keep a new equilibrium between cities and new external agents.

Publishing frequency is four-monthly. For this reason, authors interested in submitting manuscripts addressing the issues may consider the following deadlines:

- First issue: 10th January 2020;
- Second issue: 10th April 2020;
- Third issue: 10th September 2020.

TeMA

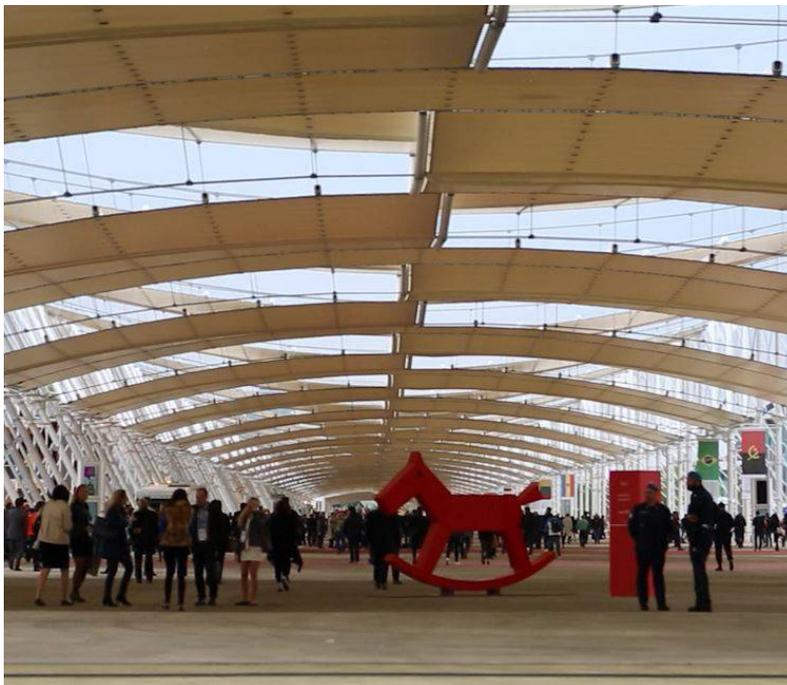
Journal of
Land Use, Mobility and Environment

TeMA 3 (2019) 249-264
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: 10.6092/1970-9870/6269

paper received 10th September 2019, accepted 2nd December 2019
Licensed under the Creative Commons Attribution - 4.0 International License
www.tema.unina.it

How to cite item in APA format:

Atun Girgin, F. & Edizel Tasci, O. (2019). Mega-event Organization Considering Safety, Security and Resilience. *Tema. Journal of Land Use, Mobility and Environment*, 12(3), 249-264. doi: <http://dx.doi.org/10.6092/1970-9870/6269>



MEGA-EVENT ORGANIZATION CONSIDERING SAFETY, SECURITY AND RESILIENCE

INSIGHTS FROM THE MILAN WORLD EXPO 2015 AND
LONDON OLYMPIC AND PARALYMPIC GAMES 2012

Funda Atun Girgin^a, Ozlem Edizel Tasci^b

^a University of Twente, Netherlands
e-mail: f.atungirgin@utwente.nl
ORCID: <https://orcid.org/0000-0003-0994-7068>

^b Boston University, United States
e-mail: ozlemedizel@gmail.com

ABSTRACT

Cities become globally significant and attract national and international interest from all over the world with the help of mega-events, such as World EXPO and the Olympic Games. Mega-events highly require the involvement of various actors working together for the same overall purpose, although these actors have the responsibility of diverse target groups and require to use different resources. In his paper, we aim to understand the role of organizations in mega-events in relation to the socio-technical systems they operate. We consider security, safety and resilience articulated in six areas: planning, construction of the site, training, collaboration, communication and legacy, in three different time slots: before, during and after the event. Results include insights to enhance multi-organizational culture-based practice. The field studies conducted in Milan in 2015 and 2016 on Milan World EXPO 2015, and in London in 2012 and 2016 on the London Olympic and Paralympic Games 2012. The research findings are based on the experience of the real actors involved in these two events. The findings suggest several courses of action for decision-makers and emergency planners to safety and security design strategies that can facilitate resilience as a legacy of a mega-event.

KEYWORDS:

Mega-event, Disaster Risk Reduction; Milan EXPO 2015; London Olympic Games 2012; Resilience; Safety; Security

TeMA

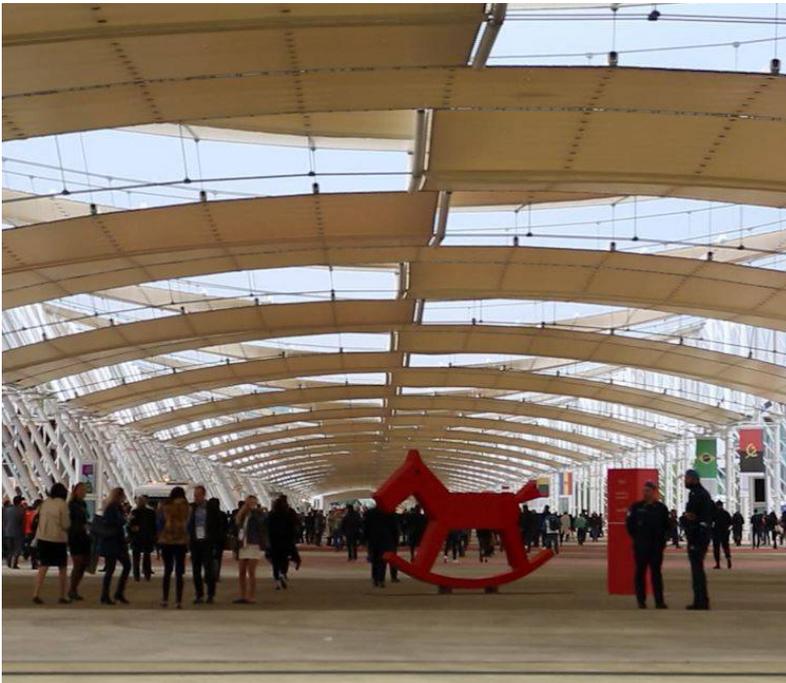
有关土地使用、交通和环境的杂志

TeMA 3 (2019) 249-264
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: 10.6092/1970-9870/6269

paper received 10th September 2019, accepted 2nd December 2019
Licensed under the Creative Commons Attribution - 4.0 International License
www.tema.unina.it

How to cite item in APA format:

Atun Girgin, F. & Edizel Tasci, O. (2019). Mega-event Organization Considering Safety, Security and Resilience. *Tema. Journal of Land Use, Mobility and Environment*, 12(3), 249-264. doi: <http://dx.doi.org/10.6092/1970-9870/6269>



考虑安全、保障和弹性度的 大型活动组织

Funda Atun Girgin^a, Ozlem Edizel Tasci^b

^a University of Twente, Netherlands
e-mail: f.atungirgin@utwente.nl
ORCID: <https://orcid.org/0000-0003-0994-7068>

^b Boston University, United States
e-mail: ozlemedizel@gmail.com

摘要

城市在世博会、奥运会等大型活动的帮助下变得全球知名，吸引来自世界各地的目光。为了实现共同的整体目标，大型活动离不开相关各方的参与，尽管这些角色承担的目标群体责任各不相同，并且需要使用不同的资源。在他的论文中，我们旨在了解组织在大型活动中与它们运作的社会技术体系相关的作用。我们认为安全、保障和弹性度体现在六个方面：规划、场地建设、培训、协作、沟通和遗产，并且分为三个不同的时间段：活动前、活动期间以及活动后。结果包括促进基于多元组织文化的实践的深入见解。2015年和2016年在米兰对2015年米兰世博会以及2012年和2016年在伦敦对2012年伦敦奥运会和残奥会都进行了实地调研。研究结果基于两次活动的真实参与者的经验。研究结果为决策者和紧急事件规划者制定安全与保障设计策略提供了一系列行动方案，从而让弹性度成为大型活动留下的遗产。

关键词：

大型活动；减少灾害风险；2015年米兰世博会；2012年伦敦奥运会；弹性度；安全；保障

1 INTRODUCTION

Due to the wide range and scope of the events, it is difficult to provide a single definition of a mega-event. The categorization and definition of a mega-event may vary according to its rationale, frequency, and location (Edizel, 2014; Mazzeo, 2008; Smith, 2012). Getz (1991) defines mega-events as events with a global reputation attracting visitors to the host city to participate in sporting, cultural, religious and political activities, while Smith (2012) simply names mega-events as those which sell over a million tickets. Overall, mega-events are "high profile spectacles held in a limited time, which change the built environment, have global significance and attract national and international interest to the city" (Edizel, 2013). According to this definition, only three events can be named as mega-events: the Olympic Games, the World Expo and the Football World Cup. In this paper, we will focus on the Milan World Expo 2015 and the London Olympic and Paralympic Games 2012 as case studies.

Mega-events have been considered as an effective economic development tool by local and national actors all over the world since the early 1990s (Edizel, 2013). Hosting mega-events increases the appeal of both the host city and country by attracting international visitors and media attention as well as contributing to the regeneration of the built environment and enhancing the strategic organizational structure of the local area. However, there are important challenges related to hosting a mega-event, such as financing the event, environmental impacts, social dimensions or under-utilized facilities and safety, and security issues. For example, significant urban intervention associated with the 1992 Barcelona Olympic Games were seen to make a very direct contribution to redevelopment through the upgrading and rehabilitation of spaces in the city (Richards & Palmer, 2010). Indirect impacts of Barcelona Games include flagship buildings of internationally renowned architects and promotion of the city's architectural heritage as well as enhancements in public transport and redevelopment of the seafront which helped economic and social regeneration of the city (Julier, 2000). Although the 1992 Barcelona Games are accepted as a success story since the city used the Olympic project as a tool for long-term urban planning and made a positive transfer of the sports and other venues to everyday, community use (Monclus, 2011); they have also experienced facility under-use problems to a certain degree, and the 1992 Games only made \$3 million from \$10 billion invested (Coaffee & Johnston, 2007; Gastaldi & Camerin, 2018).

The study of mega-events is particularly an important area in the tourism and leisure literature (Chalip & Leyns, 2002; Richards, 1996). Along with tourism studies, the growing use of events as an economic development tool has grabbed the attention of researchers and policymakers. Some of the areas researched, which form the baseline of mega-event analyses include the cost of the event to the host nation, expenditures on bidding/preparation and revenues obtained from short-term and post-event stages (Burton 2003, Gratton & Henry 2001, Roche 2000). On the other hand, there has been increasing research on the spatial impacts of mega-events which consider post-event urban development and built environment/landscapes (Essex & Chalkley, 1998; Evans, 2011; Galderisi, 2008; Hiller, 1999; Smith, 2013). Approaching mega-events as a governance issue is a current research concern. Olympic governance and legacy have been studied from different perspectives in the 2000s (Burbank et al., 2001; Cashman, 2006; Edizel, 2013; Girginov, 2012; Poynter & MacRury, 2009; Smith et al., 2011). However, the discussion of the actors' involvement in a mega-event organization regarding security, safety and resilience is still missing from the literature.

Hence, this paper will provide a new insight from the perspective of the actors involved in the safety, security and resilience of mega-events, and some clues about the legacy for the continuation of the multi-organizational structure. The overall purpose of this research is to have a clear understanding of the role of organizations in relation to the socio-technical systems they operate and the reaction of users, such as visitors, exhibitors coming from different cultures, as well as the citizens, to any kind of disruption in the system.

The objectives are:

- having a critical understanding of the multi-organizational culture that has been formed during the preparation of mega-events;
- collecting information about ways to increase the effectiveness of those who respond to emergencies during mega-events;
- providing insights that can be used in different localities even after the completion of the event.

The paper includes information from two case studies: the London Olympic Games, 2012 and Milan EXPO 2015. We adapted a mutual learning approach while conducting the research by having meetings with the related actors and desktop research on the published reports, as well as emergency plans, risk maps and development plans of the municipalities involved in the organization of the mega-event.

1.1 INTRODUCING THE MILAN EXPO 2015

Milan hosted the World EXPO 2015 starting from May 2015 until the end of October 2015 for six months. "Feeding the Planet, Energy for Life" was proposed as the theme of EXPO 2015. The proposed theme had involved issues related to food shortages, food and food solidarity education, GMO, new technologies and innovation as well. The selected location for the EXPO exhibition area was the Rho area, in in the Northern part of the Milan Municipality. The main reason for selecting this area was the presence of infrastructures (highways, high-speed rail, regional rail system, the metro line), as well as the Rho Fair area.

Milan is the second-largest city in Italy with more than 1.3 million inhabitants within the city borders of Milan and more than 3.2 million inhabitants within the Milan Province (ISTAT, 2019). Although Milan is the second largest city in Italy, the Milan Province has a central role in the Italian economy due to its economic, cultural and political influence (Please see COMPASS project).

Milan is well-connected with Lombardy region, which has a population of around 10 million inhabitants that are distributed over an area of approximately 24,000 square kilometers. During EXPO both Milan and surrounding municipalities were affected by major urban transformation processes, such as the fifth metro line in Milan (Lilla), the extension of the bicycle path from Milan to the EXPO site and extending the bicycle fleet with electric bicycles, the Via Water project, which starts from Garbagnate. The latter is a water channel connected with a pedestrian and cycle path is used as an element of a promoter of extensive territorial rehabilitation.

EXPO was a 6-month length mega-event in Milan with the involvement of 134 countries, 5 international organizations and 21.5 million visitors from different countries (EXPO S.p.A., 2015). The Milan World EXPO 2015 was coordinated by the Prefecture of Milan, and the team involved all the related actors, such as civil protection, fire brigades, police, volunteers, ambulance services, Lombardy Region, Milan Municipality, etc., the organizations were grouped into sections, according to their functions in the COM (Central Operation Room) by considering the Augustus Method¹.

1.2 INTRODUCING THE LONDON OLYMPIC GAMES 2012

The London Olympic and Paralympic Games 2012 were staged between July 27th and August 12, 2012. With its 9.1 million population, London is ranked 27th in size by the year 2019 as the most populous metropolitan area in the World in the world's cities ranking (Office for National Statistics, 2019). London has always been a

¹ In Italy, Civil Protection has carried out its activities according to the "Augustus" method since its establishment in 1997. The Augustus method involves the setting up of up to 14 (regional and national) "support functions". F1: Planning and technique; F2: Health, social and veterinary assistance; F3: Media and information; F4: Volunteers; F5: Means and materials; F6: Transportation and viability; F7: TLC; F8: Essential services; F9: Damage assessment; F10: Operative structures; F11: Local authorities; F12: Dangerous materials; F13: Assistance to the population; F14: Coordination of operational centres.

city of spectacles, and the London Olympic Games 2012 event grabbed worldwide attention, following other events in the city. The Royal Wedding in 2011 was the first of this series of events where an extra 350,000 visitors came to the UK over the month of April compared to the previous year (ONS, 2012). The Diamond Jubilee on June 2012 attracted hundreds of thousands of visitors flowing in London's hotels, restaurants, bars and shops (Parker & Rainey, 2012). Government data showed that the UK welcomed 590,000 visits for either the Olympics or Paralympics, or attendance at a ticketed event, who spent an average of £1,290 during their visit compared with £650 by other visitors (ONS, 2012). The majority of these visits were to Olympic Park, which is in the Lower Lea Valley, one of the most deprived areas in the UK. The Lea Valley was subject to a major regeneration project with the arrival of the Olympic Games coming, which fast-tracked the regeneration of the area and drew investment from public and private sources. Olympics brought a considerable amount of infrastructure to London, besides unique venues and facilities.

However, there was a dark side to the event. Right after London was awarded the 2012 Olympic Games, a suicide bomber killed fifty-six people in London, which raised security concerns and underestimated the budget of the bid. In March 2012, the Government announced the revised Olympic budget as £9.235 billion for the construction and security costs, which were £5.3 billion higher than the bid stage (Evans & Edizel, 2016), and the initial security budget increased to £1 billion from £225 million (Coaffee & Fussey, 2016). In fact, the Metropolitan Police Authority stressed that the London Olympic and Paralympic Games 2012 required the largest security operation ever held in the UK.

Therefore, London 2012 involved several actors in delivering the Games successfully. The vision for London 2012 was on hosting "an inspirational, safe and inclusive Olympic Games and Paralympic Games and leave a sustainable legacy for London and the UK" (CSL2012, 2011). London 2012 actors wanted to inspire change in many ways. They aimed to demonstrate that the London Olympic Games 2012 would be about more than sport by including culture and education programmes with wider benefits like the Cultural Olympiad and beyond London, where the benefits and excitement were felt across the UK and around the world. The events were fully accessible to everyone via tickets to watch the Olympic competitions or via watching on TV or attending other Olympic-related events (festivals, cultural events).

2 MEGA-EVENTS IN LITERATURE

There is a wide range of urban events hence different event classifications according to their rationale and location help to define mega-events. Researchers use various indicators while making a classification of mega-events such as duration, size, scale, volume of visitors and prestige. Aiming to cover all important dimensions when defining the events, Jago and Shaw (1998) identify the key attributes of mega-events by making a detailed examination of the usage of different terms in event literature and introduced a typology of special event types. On the other hand, Getz (1991) considers this classification from the tourism perspective and identify the amount of attractiveness as the only indicator to categorize mega-events. He states that the definition must focus on the proportion and number of international visitors. From a different perspective, Roche (2000) considers three events as 'mega': The Olympic Games, the World Fairs (EXPOs) and the World Football Cup. His classification is related to this cultural context, such as target attendance, type of media interest and so on and his grouping of mega-events depends on ranking the events in accordance with their scale of significance. Considering all different classifications, only three events can be named as mega-events: the Olympic Games, the World Expo and the Football World Cup. This paper will focus on two of them as case studies: Milan World Expo 2015 and London Olympic Games 2012.

Up until the 1990s, mega-events are mostly studied by tourism researchers regarding visitor numbers, iconic venues and economists regarding the cost-benefit analysis. Although it has a long history, the spatial dimension of mega-events only received attention after the 1990s. Using events to promote urban

development gained significant importance, especially after the 1992 Barcelona Games, which is accepted as a successful example, mega-events had started to be even more associated with their impact and legacy on the urban environment. It is fair to claim that the events before the 1930s did not aim to leave a permanent legacy in the built environment (Monclus, 2011) in a holistic way, but only specific urban problems are addressed through the event, such as infrastructural development and legacies; for example, the 1900 Paris EXPO and 1935 San Francisco EXPO. Public-private partnerships started to grow in the 1990s. Events were used to regenerate post-industrial cities since the main strategy of the 1990s period was reinventing cities rather than building on existing strengths. In the 2000s, events gained importance as a catalyst for urban development. While the events of the nineteenth century were more about displaying technology and trade (e.g., EXPOs), celebrating arts and culture (e.g., Garden Festivals) and establishing links between different cultures and nationalities via sport (e.g., Olympics), city authorities had started to approach these events as an opportunity to introduce their regeneration plans in recent decades.

Regenerating the host city through culture rather than the desire of putting on a good show has become the main purpose. Gold and Gold (2005, xii) also support this approach by stating "it may be an exaggeration to say that promotion of culture has become the preferred route for regenerating ailing economies, but its importance cannot be minimised". In the early 1930s, the regeneration benefits of mega-events, especially the EXPO and Olympic Games, were mostly associated with the physical infrastructure projects. However, after the 2000s, mega-events target not only interventions to the physical environment, but social, environmental and economic problems are also pointed as a part of the sustainability and legacy plans of mega-events (Fussey et al., 2011; Pitts & Liao, 2009). Therefore, Olympic-led regeneration can be a part of Getz's sustainable events since he defines sustainable events as not only the ones that can endure indefinitely but also ones "that fulfil important social, cultural, economic and environmental roles that people value" (Getz, 1997). This comprehensive approach to mega-events has become more visible after the 2000s.

Recently, hosting mega-events is claimed to bring several social benefits to the host communities. According to Ritchie (1984), mega-events offer at least two important benefits to community development; the first one being the reinforcement of the social fabric of the community through better quality of personal relationships derived from the extensive volunteer efforts frequently associated with the event, and the second one being the possibility of reinforcing activities and behaviours that can contribute to the community culture. According to anthropologists Kroeber and Kluckhohn (1952) culture involves all the materials and spirituality created by human and added to the nature. On one hand culture is a dynamic notion that can be traced by perceptions, on the other hand cultural legacy in a society determines specific norms and rules (Kroeber & Kluckhohn, 1952). As Ritchie (1984) states, mega-events can be catalysts of change both in the community culture and organizational culture.

Today, one of the biggest challenges of the world cities is to host people from different backgrounds (Sassen, 1991). Mega-events are tools to promote community cohesion with the help of the high level local involvement, such as volunteering (Smith, 2012). Roche (2000) notes that EXPOs and the Olympic Games, "together with the event movements and networks and cycles connected with them, decisively influenced and helped create a new level and form of international public culture." Therefore, mega-events are considered as a powerful method for promoting versions of citizenship, social cohesion and cultural inclusion (Misener & Mason, 2006; Mohan & Mohan, 2002; Roche, 2000; Smith, 2012). However, there is also considerable controversy about the extent that mega-events create community cohesion and inclusion.

On the other hand, another challenge is to meet resilience targets, while hosting a mega-event, due to the increased exposure of the population that involves both residents and visitors coming to the event. That increase in exposed populations that are coming from different cultures does not necessarily add new risks but concentrates the current risks in the city in one place. Hence, disaster risk reduction (DRR) that should

consider the increased exposure to enhance the resilience of the current infrastructure systems. There are also other issues, such as the new risk landscape, including terrorism, traffic jams and changing hazard conditions that increase the vulnerability of cities and the multiple interaction patterns of infrastructure systems.

Therefore, to obtain a mega-event, improving the structural condition of a city is not sufficient, it is necessary to ensure a well-maintained infrastructure system. Providing resilience against disruption to infrastructure and services is also vital to ensure the functions of the mega-event, to guarantee competitive advantage of the host city, as well as ensuring the safety and security of infrastructures.

Both Milan EXPO 2015 and London Olympic Games 2012 welcomed international attention in terms of visitors, volunteers and investors. While this diversity celebrated the multi-cultural spirit that these events target, the cities also become more vulnerable to outside threats. Both Milan and London had gone through significant infrastructure and service improvements in order to deliver the mega-events in a resilient way.

3 METHODOLOGY

Milan EXPO 2015 was a case study in EDUCEN Horizon 2020 Project to investigate the relation of organizational culture and mega-events from the perspective of safety, security and resilience. The case study was supported by the interviews with people who were actively involved in the preparation of the Milan World Expo 2015 and the London Olympic Games 2012. Both events were analysed using a qualitative approach. Interviews were targeted to discover information about safety, security and resilience notions. Questions were directed to reach the related information in previously defined sections. Semi-structured interviews were conducted face to face in the working environments of the interviewees. The primarily collected data supported by the reports and scientific literature.

In Tab. 1, we matched the objectives with methods and related activities. As a part of EDUCEN Horizon 2020 project, organizing a workshop on mega-events in Politecnico di Milano was one of the main activities in addition to interviews. On one hand, the workshop in Milan provided the opportunity to learn more about the stakeholders' experience, on the other hand, being in one location for two days let them exchange their experience and ideas.

OBJECTIVE	LAYER / PATTERN	METHOD	ACTIVITIES
Understanding the way that the multi-organizational culture has been formed	Multi-organizational pattern	Secondary data collection	Literature study on mega-events regarding
		Primary data collection in Milan	Interviews with the representatives of organizations who were actively involved in Milan EXPO 2015
		Primary data collection in London	Interviews with the representatives of organizations who were actively involved in the London Olympics
Lessons Learned - effectiveness	Multi-organizational pattern & Spatial Layer	Primary data collection and analysis	Analysis of innovative information sharing strategies
Lessons learned – gathering insights	Multi-organizational pattern & Spatial Layer	Primary data analysis	Transcription of interviews

Tab.1 Table OBJECTIVES. Source: adapted from EDUCEN Project Deliverable 7.5, 2017

For Milan World Expo 2015, we contacted with the representatives from the Lombardy Region Fire Brigade, the Municipality of Milan, and the Prefecture of Milan. To collect information on London Olympic and Paralympic Games 2012, we conducted interviews with the members of resilience team, emergency personnel, London Fire Brigade, and the Resilience team from Transport for London. Conducting interviews helped us to understand the differences between what was planned following the normative patterns, and the reality

occurred during the event. Indeed, the findings of the case study suggest several courses of action for decision-makers and emergency planners.

Interviews were conducted in London by one of the authors using open-ended questions. The purpose of the conducting interviews was to understand the differences and similarities between organizations that were involved in safety and security planning before, during and after the mega-events. In tab. 3, we listed the organizations and the role of the interviewed people. In tab. 4, there are all the open-ended questions that were asked during the interviews.

METHODOLOGY	RATIONALE
Workshop in Milan in March 2016 All presenters had 8-minute time-slot during the workshop	Participants from Milan: all the organizations which were involved in preparation and management of the Milan Expo 2015. (EXPO 2015 SPA, Milan Prefecture, State Police, Milan Municipality, Medical Emergency, Milan Firemen Department, Lombardy Region, Regional Department of Fire Brigade of Lombardy). Participants from London: one speaker for each subject (safety, security and resilience), including the Ex-Met Police Department Security Design Advisor, an expert on Safety Management involved in preparation of the Games, and Head of the Resilience Planning in Transport for London during the Games (TfL).
London Olympic and Paralympic Games 2012	We involved the London Olympic and Paralympic Games 2012 in the EDUCEN project as a good case to collect more information on the issue. We had a site visit to London on June 2016. We conducted in depth interviews with representatives from the London Resilience Team, London Fire Brigade, London Metropolitan Police, two London Boroughs and Transport for London (resilience team, London surface travel, London tube network).

Tab.2 Additional data collection activities. Source: adopted from EDUCEN Project Deliverable 7.5, 2017

ORGANIZATION	THE ROLE OF THE RESPONDENT
London Fire Brigade	Contingency Planning, Operational Resilience Group Manager
London Resilience	Exercise Unified Response Command Post Exercise Lead London Resilience Officer London Fire Brigade
London Underground	Line General Manager Piccadilly Line, London Underground
Transport for London - Resilience	Head of Resilience Planning Transport for London
Transport for London	Resilience and Business Continuity Manager, business recovery and business continuity activities
Transport for London	Resilience Training and Exercises Manager who delivers command and incident management training and desktop and seminar exercises for Surface Transport
ODA - Security	Security boss
A borough	Emergency Planner
Transport for London	Events Planning Manager, London Buses, Surface Transport

Tab. 3 The list of the organizations where the interviews were conducted in London in June 2016. Source: adapted from EDUCEN Project Deliverable 7.5, 2017

ASPECT		QUESTION
Background information	The background of the respondent	What is your role in this organization?
		What was your role during the mega-event (such as London Olympic Games or Milan EXPO)?
Planning	Planning: the first step to enhance the resilience of society against natural and man-made disasters.	What were the specific objectives?
		Do you think that considering culture in DRR is relevant in mega-events?
		How can you anticipate and identify solutions or cultural problems that may arise in the event of an emergency?
Collaboration	Mega-events are organized and governed by the several and heterogeneous organizational coalitions working at and/or responsible for different spatial or temporal scales.	With whom did you collaborate?
		According to your observation, what are the differences in the operational culture between the different institutions (such as local authorities, rescuers, etc.)?
		What is the set of procedures/configurations/institutions involved?
Communication	New crisis management tools to communication & cultural aspects in communication.	What is the best way to convey messages to people during emergencies?
		What are the impacts of cultural aspects on the effectiveness of risk communication?
		Have you ever encountered any specific problems related to specific/diverse cultural aspects?
		Which cultural factors, important insights, specific communication styles for a given cultural group should be taken into consideration during disaster situations in an urban area?
Learning		What was the worst thing that happened? How did you respond?
		How do you define the success of the mega-events?
		What did you learn?
		What were the benefits/advantages/problems which were identified?
		What would you do differently if it happens again?
Effects / Legacy		How did your planning/routines change after the mega-event?

Tab. 4 Questions asked during the interviews. Source: adapted from EDUCEN Project Deliverable 7.5, 2017

4 INSIGHTS

Although this research focused on Milan World EXPO 2015 and London Olympic and Paralympic Games 2012 as case studies, the insights could also apply to a wider level of mega-events and may help policymakers develop strategies for safe, secure and resilient events. Therefore, assessing how organizers can enhance the safety, security and resilience with the help of development principles in event-led regeneration is the main contribution of this research to knowledge.

Safety: It is about the protection of people and properties from hazards caused by incidents. According to one respondent, in such big events, however, absolute safety is not possible (interview with an officer of the fire-brigade, June 2016, London).

Security: It means the protection of people and properties from external threats and terrorist attacks, which has become a central issue while budgeting mega-events following 9/11 attacks. Security is on the concern of the organizers during the construction of the event site before the event starts. Security measures include all the issues to protect the construction site before and during the event against any kind of attack. An ex-

military officer who was responsible for the security of the Olympics in London mentioned the difficulty of the issue by saying that “you need to find the right balance between making people alert and interested in security and not alarming them” (interview with an ex-military officer, June 2016, London).

Resilience: Mega-events’ resilience means, first, being able to keep the event functioning even after potential incidents. Second, a mega-event can help to promote resilience through international programs as well. Especially a World EXPO about nutrition and sustainability shall contribute to making environmentally effective development strategies. According to one of the officials from Milan, auto-protection and accepting the inevitable phase of chaos are the keys to resilience. As it is mentioned in Norton et al. (2015) to achieve resilience it is necessary to consider the knowledge and information channels through networks as their capability to bring stakeholders together to share experiences, increase the knowledge base, and thus facilitate improved decision-making by stakeholders in policy and practice.

The notions in this research are articulated in six main groups: planning, construction of the site, training, collaboration, communication and legacy, in three different time periods; before, during and after the event (Fig. 1).

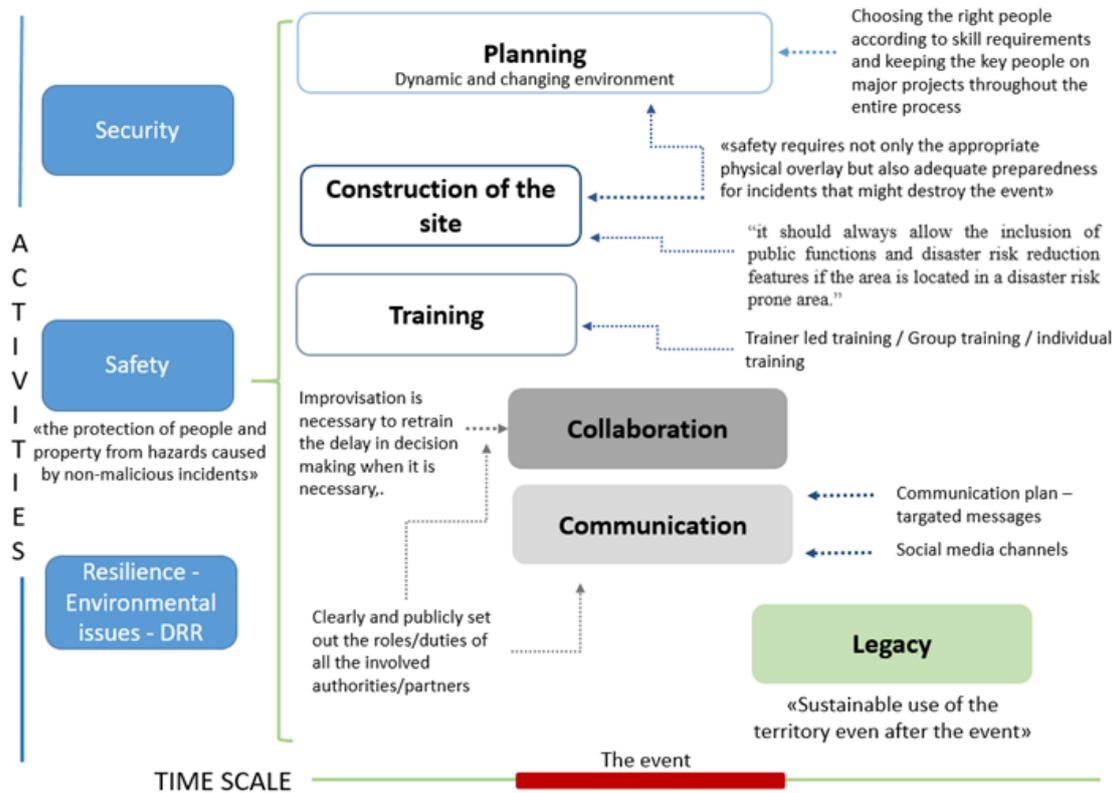


Fig. 1 The systematic schema of the activities and timing in mega-events (Source: EDUCEN Project Deliverable 7.5, 2017)

4.1 DISRUPTIONS/EMERGENCIES DURING THE EVENT

In the case of Milan World EXPO 2015, the potential flood risk maps, potential industrial accident information and emergency plans were already ready before the event. The 24h/7days surveillance-camera service in the center was in place to monitor the real-time traffic flow together with the geo-referenced vehicles. These biometric cameras were directly connected to the database. Additionally, excellent signalization of Ferrovie Nord (rail-road company) was ensured by the surveillance-camera service. During the event, the team in Milan had to deal with two big challenges. One of them occurred in August 2015. The Regional Civil Protection Authority was having a big wave of migrants (in total 1 million) in the central train station of Milan (from an interview with a regional civil protection official, February 2016, Milan). The second challenge was the blockage

of the railway system in August 2015 due to a broken train at the railway before Florence. All the trains passing through Florence returned to Milan Central Station together with their 1,500 passengers. The mobility plan helped the authorities to handle these challenges. Through the mobility plan, they alerted the central train station and all the taxis. All passengers were successfully placed in hotels at between 23:30 p.m. – 03:00 a.m. (interview with a Fire brigade officer, February 2016, Milan). In London, respondents did not report a big challenge, some incidents in the vicinity of the Olympic Stadium and an abandoned bag by journalists.

4.2 PLANNING OF THE EVENT

Definition of organizations, selection of personnel, preparation of budget and timing are the planning activities. Choosing the right people according to skill requirements and keeping the key people on major projects throughout the entire process are essentials of a successful planning. The budget estimation is a challenge in the planning of mega-events. Especially due to increasing security cost. According to one of the respondents, who is responsible from the security, the main tendency in such events is underestimating the cost of a mega-event and overestimating the funding (House of Commons, 2007). Timing is another issue that can pave the way to success or failure. In both events, respondents were agreed on the success of the definition of roles/duties of all involved authorities/personnel. However, as an official from the fire brigade in Milan mentioned that being able to improvise is necessary to be quick in decision-making for a timely response to an incident (interview with a fire brigade officer, February 2016, Milan).

4.3 NEW CONSTRUCTION

Newly constructed areas must include disaster risk reduction norms as a part of all development and infrastructure system investments to increase the resilience of the systems. The maximum building rights and any specific requirements and rules should be included in the plans for the areas of transformation. It is a must to pay more attention to requirements and rules in a disaster risk-prone area. Additionally, the newly developed areas and the increased number of people create new risk landscapes, including terrorism, traffic jams and changing hazard conditions that increase the vulnerability of the city and infrastructure systems. Other issues are cultural heritage, agricultural land and environmental and water resources. It is crucial to consider the integration and enhancement of policies in development plans to ensure coordinated actions for the development of sustainable use of the territory.

4.4 TRAINING

Technology, which has zero cost in some of the cases, might be the solution to every problem according to a respondent from Milan (interview with an emergency officer, February 2016, Milan). However, he continued saying that the main problem is the involvement of human error. To decrease the risk of human error, in Milan they conducted at least ten drills with a blind control station to test the communication system before the event. Training and drills helped them to test the system, as well as learning their role and what to do. Additionally, they knew each other and built trust between officials from different organizations during training and drills.

4.5 COLLABORATION

Activities, therefore, requires high level of collaboration. Almost all the respondents mentioned that trust is the key to flexibility during collaboration and communication activities. In addition to trust, innovative IT tools play a vital role in supporting the organization and operation activities. It is important to involve all the stakeholders, independent from their role at different temporal and spatial scales, in the meetings and during

the decision-making processes. Besides, the actors should be organized according to their target group and context.

As it is mentioned in the training section, trust building starts before the event on vertical and horizontal levels between actors. That helps to achieve an understandable, co-produced, shared knowledge, and, most importantly flexibility when a decision has to be made rapidly in an urgent situation. Another issue mentioned by respondents is that the importance of being in contact with actors from different practical backgrounds, such as academia, businesses and NGOs.

ACTIVITY	TIMING	AUDIENCE	KEY-ISSUE	GUIDELINES
Planning	Before and during the event	Prefecture Civil Protection Municipalities Public and private bodies that are involved in the planning of the event	Security and safety	<ul style="list-style-type: none"> - Selecting the right people according to their skills - Keeping the key people on major projects throughout the entire process - Inclusion of both public and private authorities in the estimation of budget - Improvising when necessary
Construction of the site	Before the event	Municipalities, planners, architects and engineers	Security	<ul style="list-style-type: none"> - Improving the safety of facilities - Making disaster risk reduction a part of all development and infrastructure related investments - Coordinated actions for development should consider sustainable use of the territory
Training and drills	Before the event	Prefecture Civil Protection Municipalities	Security and safety	<ul style="list-style-type: none"> - Learning roles and duties - Knowing each other - Building trust
Collaboration	During the event	Public and private bodies that are involved in the planning of the event	Security safety and resilience	<ul style="list-style-type: none"> - Extensive engagement of people, including the public - Involvement of all the governmental authorities - Involving communication and transportation agencies in the plan - Building synergy; having a common purpose
Communication	During the event	Public Prefecture Civil Protection Municipalities	Security and safety	<ul style="list-style-type: none"> - Flexibility - Trust building - Enhanced data grouping methods - Supporting traditional media with social media - Civil servants as volunteers communicate with public in the event area - Multi-ethnicity practice
Legacy	After the event	Public Prefecture Civil Protection Municipalities	Resilience	<ul style="list-style-type: none"> - Increased visibility in the social media, increased potential to reach a wider public even after the completion of the event - Increased use of innovative technology - Testing the current safety and security mechanisms - Regeneration and renewal of deprived areas - Enhanced tourism potential - Volunteer teams still active in the case of large events - Sustainable use of the event site - Improved supply conditions, enhanced visibility

Tab. 5 Insights. Source: adapted from EDUCEN Project Deliverable 7.5, 2017

4.6 BETTER COMMUNICATION

In the Milan World EXPO 2015, the communication plan was established before the event by considering the current one, which was a communication system between the municipality and the province. Through this system, they were able to deal with ordinary information. For emergencies, they issued a communication protocol that had to be signed and filled in by prefecture and all the other related institutions. It was updated every 1.5 and 3 hours after inserting the information into the common platform. Then, a situation report was prepared continuously according to the collected data. In communication, the key message was “filtering the data” to be able to find particular information when it is necessary. As data arrives casually, the huge amount of collected data could turn into a big challenge. The state of the emergency declaration was via SMS, and the dissemination of warnings was via megaphones. Inside the EXPO area, the organizations had their own systems to warn people. Additionally, there was a connected video and radio communication system inside and outside the EXPO area.

4.7 LEGACY ACHIEVEMENT

Increased tourism potential in the medium- and long-term, the introduction of advanced technology in certain areas, being able to test current safety and security mechanisms are some of the legacies that cities gained by hosting a mega-event. Indeed, mega-events are engines of urban developments and regeneration of deprived areas. Moreover, due to organizations’ active accounts in social media, the public have learned more about the organizations and followed them through social media channels even after the completion of the event. Besides, in both cases, the volunteer teams, which were created during the event, are still active in case of big concerts, or necessity. A well-organized mega-event is helpful for the formation of human capital. If the social inclusion strategy is adapted well during the implementation phase of a mega-event, the labor market can be adapted and allow access to those from a lower social status as well.

5 CONCLUSION

To conclude, the paper includes two different mega-events, one of them is the Olympic and Paralympic Games in which visitors are accumulated within a short period of time, less than a month. On the other hand, a World EXPO is also considered as a mega-event due to the duration of the event, which is 6 months. Both examples provide opportunities in terms of economic and spatial development in their host cities and require several institutions working together in harmony before, during, and even after the event.

The purpose of this study was threefold. First, understanding how the multi-organizational culture has been formed during mega-events; second, how to increase the effectiveness of responders to disasters with the multi-organizational interaction takes place during mega-events; third, providing insights considering different phases of a mega-event (i.e. before, during and after) on safety, security and resilience of main activities and the event itself.

Indeed, mega-events involves multi-organizational interaction that takes place among public and private organizations. These organizations behave in a casual manner and share their experience and knowledge before, during and even after the event. Therefore, a mega event helps to strengthen the multi-organizational culture due to the high level of collaboration through mutual knowledge sharing about the norms and resources of each organization. As a result of this high level of collaboration, a common terminology can be established, and several communication tools and methods can be evolved during the management of a mega-event. As we saw in London case, the constructed multi-organizational culture remains stable and continuous over time even after the mega-event as a result of the new norms and agreements that have been formed among organizations.

Although mega-events are the main concern of tourism and leisure literature as an economic tool, recently, it has also entered into disaster risk and resilience studies as a research topic.

The reason is that mega-events have been considered as a tool that is strengthening cooperation and collaboration among multi-organizations, which is an essential asset for disaster risk and resilience studies.

ACKNOWLEDGEMENT

The discussed case studies were part of the EDUCEN Project, which had received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement NO: 653874. Authors would like to thank all the participants of the research from various organizations both in Milan and London, and to project consortium, especially Jeroen Warner from Wageningen University and Scira Menoni and Giulia Pesaro from Politecnico di Milano for their guidance and research support. Additionally, the authors wish to thank two anonymous reviewers for their helpful comments on the earlier versions of this paper.

REFERENCES

- Brent Ritchie, J.R. (1984). Assessing the impact of hallmark events: Conceptual and research issues. *Journal of travel research*, 23(1), 2-11. doi: <https://doi.org/10.1177/004728758402300101>
- Burbank, M., Andranovich, G., & Heying, C.H. (2001). *Olympic dreams: The impact of mega-events on local politics*. Boulder: Lynne Rienner Publishers.
- Burton, R. (2003). Olympic Games host city marketing: An exploration of expectations and outcomes. *Sport Marketing Quarterly*, 12(1), 37-47.
- Cashman, R. (2006). *The bitter-sweet awakening: The legacy of the Sydney 2000 Olympic Games*. Basingstoke, Pan Macmillan.
- Chalip, L., & Leyns, A. (2002). Local business leveraging of a sport event: Managing an event for economic benefit. *Journal of Sport Management*, 16(2), 132-158. doi: <https://doi.org/10.1123/jsm.16.2.132>.
- Coaffee, J., & Fussey, P. (2012). Securing the Games. In: V. Girginov (Ed.), *Handbook of the London 2012 Olympic and Paralympic Games: Volume One: Making the Games*. London: Routledge.
- CSL 2012 (2011). *Game Changing? (Annual Review 2010)*. Commission for a Sustainable London 2012. London.
- Coaffee, J., & Johnston, L. (2007). Accommodating the Spectacle. In: J.R. Gold, M.M. Gold (Eds.), *Olympic Cities: Urban Planning, City Agendas and the World's Games, 1896 to the present*. 138-149. London: Routledge.
- De Steffani, A. (2011). A la carte urban policies. Mega-events: from exceptionality to construction of ordinary planning practices. A look at Italy: Case study of the 2006 Winter Olympic Games in Turin. *Science Future of Lithuania*, 3(3), 23-29. doi: <https://doi.org/10.3846/mla.2011.047>.
- Edizel, Ö. (2014). *Governance of sustainable event-led regeneration: the case of London 2012 Olympics*. Draft. Doctoral dissertation.
- Edizel, Ö. (2013). Mega-events as a place marketing strategy in entrepreneurial cities: İzmir's EXPO 2015 candidacy as a roadmap for hosting EXPO 2020. *Town Planning Review*, 84(5), 633-657. doi: <https://doi.org/10.3828/tpr.2013.33>.
- EDUCEN Project Deliverable 7.5, by Atun, F. and Menoni, S., (2017). *Mega-event (Milan-EXPO) Case Study Manuel*, EDUCEN Project: European Disasters in Urban centres: a Culture Expert Network (3C – Cities, Cultures, Catastrophes).
- Expo S.p.A. (2015). *Sustainability Report Expo Milano 2015*. Available at: <http://www.expo2015.org/cs/Expo/1398464093530/Sustainability+Report13+ENG+-+Expo2015+SpA.pdf>.
- Essex, S., & Chalkley, B. (1998). Olympic Games: catalyst of urban change. *Leisure studies*, 17(3), 187-206. doi: <https://doi.org/10.1080/026143698375123>.
- Evans, G. (2011). London 2012. In: J.R. Gold, M.M. Gold (Eds.), *Olympic Cities: City Agendas, Planning, and the World's Games, 1896 to 2012 (Planning, History and Environment)*. 2nd edition. 359-389. London: Routledge.

- Evans, G., & Edizel, Ö. (2016). London 2012. In J.R. Gold, M.M. Gold (Eds), *Olympic Cities: City Agendas, Planning, and the World's Games, 1896 to 2016 (Planning, History and Environment)*. 3rd edition. London: Routledge.
- Fussey, P. (2015). Command, control and contestation: negotiating security at the London 2012 Olympics. *The Geographical Journal*, 181(3), 212-223. doi: <https://doi.org/10.1111/geoj.12058>.
- Fussey, P., Coaffee, J., Armstrong, G., & Hobbs, D. (2011). *Securing and sustaining the Olympic city: reconfiguring London for 2012 and beyond*. Farnham: Ashgate.
- Galderisi, A. (2008). Mega events and mobility: the impacts on the quality of the urban environment. *TEMA Journal of Land Use, Mobility and Environment*, 1(2), 7-20. doi: <https://doi.org/10.6092/1970-9870/36>.
- Gastaldi, F., & Camerin, F. (2018). Transformaciones urbanas y grandes eventos en Italia y España a partir de 1992. Ciudad y Territorio. *Estudios territoriales*, 196, 201-216.
- Getz, D. (1991). *Festivals, Special Events, and Tourism*. New York: Van Nostrand Reinhold.
- Girginov, V. (2012). Governance of the London 2012 Olympic Games legacy. *International Review for the Sociology of Sport*. 47(5), 543-558. doi: <https://doi.org/10.1177/1012690211413966>.
- Gold, J.R., & Gold, M.M. (2005). *Cities of culture: staging international festivals and the urban agenda, 1851-2000*. Farnham: Ashgate Publishing.
- Gratton, C., & Henry, I.P. (2001). *Sport in the city: the role of sport in economic and social regeneration*. London: Routledge.
- Gregory, F. (2012). Chapter 11 - The European Union and the promotion of major event security within the EU area. *Routledge Online Studies on the Olympic and Paralympic Games*. 1, 208-226. doi: https://doi.org/10.4324/9780203835227_chapter_11.
- House of Commons Committee of Public Accounts (2007). *The Ninth Report of Session 2006-2007- Preparations for the Olympic and Paralympic games - risk assessment and management*. London: The Stationery Office Limited.
- Jago, L.K., & Shaw, R.N. (1998). Special events: A conceptual and definitional framework. *Festival Management and Event Tourism*. 5(1), 21-32.
- Julier, G. (2000). *The Culture of Design*, London: Sage.
- Kroeber, A.L., & Kluckhohn, C. (1952). Culture: A critical review of concepts and definitions. *Papers. Peabody Museum of Archaeology & Ethnology, Harvard University*. Cambridge (MA): Harvard University Print Office.
- Mazzeo, G. (2008). Great events: indicators for classification and their impact on the urban systems. *Tema. Journal of Land Use, Mobility and Environment*, 1(2). 77-86. doi: <https://doi.org/10.6092/1970-9870/37>.
- Misener, L., & Mason, D.S. (2006). Creating community networks: Can sporting events offer meaningful sources of social capital? *Managing Leisure*, 11(1), 39-56. doi: <https://doi.org/10.1080/13606710500445676>.
- Mohan, G., & Mohan, J. (2002). Placing social capital. *Progress in human geography*, 26(2), 191-210. doi: <https://doi.org/10.1191/0309132502ph364ra>.
- Monclus, J.F. (2011). Barcelona 1992. In: J.R. Gold, M.M. Gold (Eds.), *Olympic Cities: City Agendas, Planning and the World's Games, 1896-2012*. 2nd edition. 268-286. London: Routledge.
- Norton, J., Atun, F., & Dandoulaki, M., (2015). Exploring issues limiting the use of knowledge in disaster risk reduction. *TeMA Journal of Land Use, Mobility and Environment*, Special Issue ECCA Conference. 135-154. doi: <https://doi.org/10.6092/1970-9870/3032>.
- Office for National Statistics (2012). *Overseas Travel and Tourism*. August 2012. London: ONS.
- Parker, O., Rainey, S. (2012). How the Queen's Diamond Jubilee will affect UK tourism [WWW Document]. *The Telegraph*. URL http://www.telegraph.co.uk/news/uknews/the_queens_diamond_jubilee/9239380/How-the-Queens-Diamond-Jubilee-will-affect-UK-tourism.html (accessed 8.10.13).
- Pitts, A., & Liao, H. (2009). *Sustainable Olympic design and urban development*. London: Routledge Taylor & Francis Group.
- Poynter, G., & MacRury, I. (Eds.) (2009). *Olympic cities: 2012 and the remaking of London*. Farnham: Ashgate Publishing.

Prefettura di Milano (2015). *La prefettura al Centro Operativo Misto, 184 giorni. Viaggio dentro EXPO*. Milano: Protezione Civile, COM, Ufficio Comunicazione. Draft. In Italian.

Raine, R. (2012). *Managing the security challenge, presented at the Olympic and Paralympic Security Conference*, Royal United Services Institute, Whitehall, 25 January.

Richards, G. (1996). *Cultural tourism in Europe*. Wallingford, UK: CAB International.

Richards, G., & Palmer, R. (2010). *Eventful Cities: Cultural management and urban revitalisation*. London: Butterworth-Heinemann.

Roche, M. (2000). *Mega-events and modernity: Olympics and expos in the growth of global culture*. London: Routledge.

Sassen, S. (1991). *The Global City: New York, London, Tokyo*. Princeton: Princeton University Press.

Smith, A. (2013). "De-Risking" East London: Olympic Regeneration Planning 2000-2012. *European Planning Studies*. 22(9), 1-21. doi: 10.1080/09654313.2013.812065.

Smith, A. (2012). *Events and Urban Regeneration: The Strategic Use of Events to Revitalise Cities*. London: Routledge.

Smith, A., Stevenson, N., & Edmundson, T. (2011). *The 2012 Games: The regeneration legacy*. London: RICS.

WEB SITES

COMPASS INTERREG EU project: <http://www.compass-research.eu/>.

ISTAT 2019, data was retrieved on 15.11.2019, from <http://dati.istat.it/Index.aspx?QueryId=19101>.

Know4DRR Project, available at: www.know4drd.polimi.it.

Office for National Statistics, 2019, data was retrieved on 15.11.2019 from <https://www.ons.gov.uk/>.

Protezione Civile Italiano, available at: http://www.cittametropolitana.mi.it/protezionecivile/previsione_prevenzione/programma_previsione_prevenzione/index.html.

IMAGE

Fig. 1: EDUCEN Project Deliverable 7.5. Atun, F., Menoni, S. (2017), Mega-event (Milan-EXPO) Case Study Manuel, EDUCEN Project: European Disasters in Urban centres: a Culture Expert Network (3C – Cities, Cultures, Catastrophes).

AUTHOR'S PROFILE

Funda Atun Girgin is Assistant Professor of Strategic Spatial Planning at University of Twente. She obtained her PhD in Spatial Planning and Urban Development from Politecnico di Milano (Cum Laude). She has participated in a number of EU funded projects on environmental disaster risk management and climate change adaptation. She is currently working in the Building Resilient Urban Communities Project, funded under EU Erasmus+ Program. She is the co-founder of "The Others and Disasters" non-profit organization established in Milan in 2016.

Ozlem Edizel Tasci is Adjunct Professor at the Metropolitan College of Boston University, MA. Her specialization is particularly around mega-events, urban regeneration, urban governance, participatory planning (P-GIS) and sustainable development (climate change, water management). Over the years, she has engaged in several funded research projects in the UK and Turkey. She has been the co-organizer of RSA-Mega-Events, Regional Development and Regeneration Research Network since 2011.

TeMA

Journal of
Land Use, Mobility and Environment

TeMA 3 (2019) 265-282

print ISSN 1970-9889, e- ISSN 1970-9870

DOI: 10.6092/1970-9870/6072

paper received 18th April 2019, accepted 06th October 2019

Licensed under the Creative Commons Attribution - 4.0 International License

www.tema.unina.it

How to cite item in APA format:

Pucci, P. & Lanza, G. (2019). High speed rail and airport. Future scenarios for Marco Polo Airport in Venice. *Tema. Journal of Land Use, Mobility and Environment*, 12 (3), 265-282. doi: <http://dx.doi.org/10.6092/1970-9870/6072>



HIGH SPEED RAIL AND AIRPORT. FUTURE SCENARIOS FOR MARCO POLO AIRPORT IN VENICE

Paola Pucci^a, Giovanni Lanza

Department of Architecture and Urban Studies (DASU)

Politecnico di Milano, Italy

e-mail: {paola.pucci; giovanni.lanza}@polimi.it

^a ORCID: <https://orcid.org/0000-0003-1192-3890>

ABSTRACT

This paper introduces an analysis of the possible extension of the catchment area of the Venice Marco Polo Airport, due to the implementation of a direct rail connection and the completion of the high speed/high capacity railway between Milan and Trieste. Both interventions are expected to generate an increase in the access thresholds by rail to the airport. By constructing different scenarios based on the analysis of the evolution in mobility trends and settling patterns, retraced considering both demographic dynamics and large scale projects, this article estimates the effects generated by the new railway connections in terms of extension of the Marco Polo airport's catchment area and the possible related impacts on air traffic, in terms of potential new passengers.

KEYWORDS:

Airport; High-speed Rail; Catchment Area; Intermodal Complementarity; Scenario

TeMA

有关土地使用、交通和环境的杂志

TeMA 3 (2019) 265-282

print ISSN 1970-9889, e- ISSN 1970-9870

DOI: 10.6092/1970-9870/6072

paper received 18th April 2019, accepted 06th October 2019

Licensed under the Creative Commons Attribution - 4.0 International License

www.tema.unina.it

How to cite item in APA format:

Pucci, P. & Lanza, G. (2019). High speed rail and airport. Future scenarios for Marco Polo Airport in Venice. *Tema. Journal of Land Use, Mobility and Environment*, 12 (3), 265-282. doi: <http://dx.doi.org/10.6092/1970-9870/6072>



高铁和机场。威尼斯马可波罗机场的未来发展

Paola Pucci^a, Giovanni Lanza

Department of Architecture and Urban Studies (DASU)

Politecnico di Milano, Italy

e-mail: {paola.pucci; giovanni.lanza}@polimi.it

^a ORCID: <https://orcid.org/0000-0003-1192-3890>

摘要

威尼斯马可波罗机场开始推行直达轨道交通，加之米兰和里雅斯特之间的高铁高速/大容量铁路建成，这将让机场辐射区在未来成扩大之势。预计这两项干预措施会增加乘坐铁路去机场乘客人数。本文将对机场的这一发展前景进行分析。通过对流动性趋势和服务区模式的演变进行分析，构造不同的情境，对人口动态和大型项目进行回溯思考。本文预估了新铁路连接对马可波罗机场服务区扩展产生的影响进行了预测，从潜在新乘客的角度探讨对空中交通可能的影响。

关键词：

机场；高铁，集水区；联运互补；方案

1 INTRODUCTION: HIGH SPEED RAIL AND AIRPORT

Venice Marco Polo is one of the most relevant airports in Italy¹. There are several reasons behind this success that can be explained considering the proximity of the airport to the city of Venice (around 15 km) and the peculiarities of the North-East area, served by the airport. This territory appears as a functional polycentric system where the increasing differences in the economic structure with some important niches and a relevant diffused cultural heritage both produce a strong complementarity among cities: university, knowledge production and R&D in Padua; international culture and tourism in Venice; relevant specialization in logistics and transport-related activities in Verona and Venice; local manufacture productive systems in Vicenza and Treviso (Boschetto & Bove, 2012; Fregolent & Ventoretto, 2017).

In this context, throughout the years, the airport has known a constant process of expansion and renewal that has contributed to foster its competitiveness, in a national and global frame where an ever-growing demand of air mobility can be registered².

The Marco Polo “*Masterplan 2021*” (2014) with the aim to enhance its competitiveness and to respond to the continuous and solid growth of the civil aviation sector, has defined the main projects for developing the airport activity, identifying also some crucial challenges for the future of the Marco Polo airport. This program is congruent with respect to the strategies of the European Commission that, in the White paper “Roadmap for a single European transport area” approved in 2011, has considered as the primary transportation policy goal to promote the multi-modal integration among different transport and communication networks (airports, ports, railways and roads), in order to support the creation of new connections for passengers and goods linking urban areas, relevant economic platforms and infrastructural nodes. Based on this, the EU was expecting that by 2050, all the major European airports should be linked to the railway system with a stated preference for high-speed rail (HSR) to guarantee a more efficient integration among networks. This transport policy goal has been experienced in France since 1995 where the intermodal complementarity between HSR and air transportation has been promoted in Paris Charles de Gaulle and Lyon Satolas, furtherly supported by other national policies such as the environment program “Grenelle II” (2010), and by a policy framework aimed at facilitating the cooperation among different stakeholders and operators, to optimize the integration in different transport facilities and services (code share, single ticketing and one-stop baggage check agreements between airlines and SNCF – the French railway operator) (Mell, 2013).

In the literature, at least starting from the end of the 80s, the analysis of the effects produced by rail-air intermodality has been devoted to highlight the competition between both transport modes (Bonnafous, 1987; Vickerman, 1997). Based on ex-post evaluation of the impacts on travel demand³ determined by the intermodal integration between HSR and air transport, these studies have proved the competitiveness of HSR on medium-distance routes (Capon et al., 2003; Gao, 2009; Janic, 1993; IATA Air Transport Consultancy, 2003), allowing the acquisition of a relatively large market share, primarily over distances around 400 km (Albalade and Bel, 2012; Klein, 1997; Román et al., 2007). The most recent supply-oriented analysis on the ex-post effects of HSR on air transport (Albalade et al., 2015; Dobruszkes et al., 2014) highlighted relevant new evidence of the effects of HSR–air intermodality not only in terms of competition, but also of potential

¹ Among the Italian airports, in 2018 Marco Polo airport ranked fourth for the passenger traffic, following Rome Fiumicino, Milan Malpensa and Bergamo Orio al Serio airports and showing an increase by 33% with respect to 2013. In 2018, 11.163.736 passengers travelled to and from the airport (6% of the total transits through the Italian airport system), 86% of whom are international (7,9% of the total amount of international passenger traffic at the national level). Concerning cargo traffic, Venice airport ranked fourth at the national level in 2018, with 67.940 tons of goods handled by the airport, with a general increase by 11,8% with respect to 2017 and by 49% with respect to 2013.

² Figures show an increase, in 2018, by 5,9% nationally and 6,5% globally in passenger traffic with respect to the previous year (source: Assoaeroporti, IATA).

³ See Dobruszkes et al. (2014) for a synthetic literature review on ex-post evidence from research on the intermodal impacts induced by HSR on air services and traffic.

complementarities between the two services: the interconnection with the railway led several airports to substitute short-haul services, transferring passenger to the HSR lines, to support medium and long-haul airline services with the side effect of alleviating airport congestion by freeing up slots and generating positive outcomes, especially for the busiest airports. Moreover, it has been recognized that a railway connection contributes to the generation of an integrated *Multi Airport System*, guaranteeing the possibility to manage, in a more efficient and balanced way, landside and airside traffic volumes and the relative congestion-related issues (Xia et al., 2019). Albalade et al. (2015) have also demonstrated that the reduction in the number of flights is higher for the airports that are not served by HSR, because HSR lines allow a potential increase in the number of incoming passengers to the airport, serving as successful feeders for international air traffic as in the cases of Frankfurt Airport and Paris-Charles de Gaulle. However, this side effect, that partially contributes to compensate the decrease in the number of air travelers following the implementation of air-rail intermodality, is not expected to generate a growth in the demand for the flights that were already operated before the realization of the HSR line (Albalade et al., 2015). Furthermore, the presence of low-cost carriers in the airline market guarantees a higher protection from the competitive pressure exerted by HSR, because the emergence of low-cost air companies pushed both air and rail transport companies to reconsider their pricing strategies (Antes et al., 2004).

Once highlighted that ex-post studies carried out concerning air-rail intermodality and its impacts on travel demand and supply don't define a univocal framework, wider range evaluations bring to light different potentialities that may determine broad consequences. From an environmental perspective, air-rail integration may contribute to alleviate congestion and pollution produced by the large amount of displacements to and from the airports, offering a modal solution that is more sustainable (Givoni & Banister, 2006; Xia & Zhang, 2017), considering that a significant amount of CO₂ produced in the airport derives from the displacements of workers and travelers to reach the airport (LAirA Project, 2017). However, despite HSR does not increase neither LAP (Local air pollution) nor GHG (GreenHouse Gas emissions), D'Alfonso et al. (2016) suggest to consider that any environmental impact is closely related to the mix of energy sources from which electric power to feed the HSR network is obtained; this aspect is strongly influenced by the energy policies and mitigation strategies that are in force in every national context of analysis. Concerning an economic perspective, air rail integration produces cross-scale advantages: if the availability of a fast, frequent and reliable connection to reach the airport represents a competitive determinant in passenger's modal choices (DLR-EC, 2010), a modal integration among different networks, by extending the catchment area of the airport, generates opportunities for the local economy and the real estate development (LAirA Project, 2017). Moreover, for the airports characterized by consistent cargo activity, a dedicated railway connection opens opportunities for economic development (EC – CO-ACT Project, 2004). It should also be noted that until the 1970s the airports attracted mostly warehousing and storage activities. Only since the 1980s, in a context of decentralization of the business activities from the central urban areas and in an increased economic competitiveness that rewards multimodal accessibility, a process of polarization has been triggered around airports characterized by good multimodal accessibility, sometimes supported by national and regional policies (see for example among the earlier in Europe the *Schémas Directeurs d'Aménagement et d'Urbanisme* of the Ile de France region and Rhone Alpes region, respectively for Charles de Gaulle and Satolas airports). In these experiences the airport becomes a gateway to international cities and a new polarity in the regional development (Pucci, 1998). The HSR plays an important role in qualifying the airport as an attractive polarity and supporting its real estate developments, because, according to Varlet (1992), it offers the "trinomial of interconnection" (Air, HSR, Motorway).

Additional challenges are related to market competitiveness and to the articulated decision-making frame, involving stakeholders with different interests. Both elements, that concur in increasing the level of complexity

of the design process, can tangle the realization of the air rail integrations. The promotion of air rail intermodality strategies implies the activation of multi-level decisional processes, involving a plurality of actors and operators, some of whom may not be prone to cooperate due to the potential loss of consolidated relevance and interests that may follow this kind of interventions (LAirA Project, 2017). It is well known that the specificity of each context – the air supply and the flights offered by an airport, the geography of HSR connections, the integration between air and train timetables, the degree of commercial and technical integration between air and rail networks (Givoni & Banister, 2006) – conditions the possibility to define replicable development scenarios and specific thresholds in the number of passengers that can justify, in terms of economic efficiency, the realization of an air-rail integration.

Despite this, European development strategies still push towards the implementation of air-HSR integration for communitarian airports (UE, 2011) and at the Italian national level, the new draft of the Piano Nazionale degli Aeroporti (2019) promotes the strengthening of intermodal complementarities of HSR and air transportation, so to comply with the European standards. In Italy are currently reachable by train, with a station directly serving the terminal(s), the airports of Turin, Milan Malpensa, Trieste, Ancona, Rome Fiumicino, Cagliari, Bari and Palermo. Among them, Rome Fiumicino and Trieste are served by HSR, while Milan Malpensa and Triste are linked to Austria, Slovenia and Switzerland by direct international services. Pisa and Bologna (the latter not yet in operation) are connected to the respective cities' main railway stations by people movers. In the next future, new projects of integration are foreseen as stated in the "Contratto di programma 2017-2021" signed between RFI and Italian Ministry of Infrastructures and transport (MIT), where new rail connections to the airport of Genoa and to Marco Polo airport in Venice are outlined and financed. In this framework, the paper introduces in the Section 2 the infrastructure projects affecting Venice Marco Polo Airport, for analyzing the possible extension of the catchment area of Airport, due to the implementation of a direct rail connection and the completion of the high speed/high capacity railway between Milan and Trieste (Section 3). By constructing different scenarios based on the analysis of the evolution in mobility trends and settling patterns, Section 4 estimates the effects generated by the new railway connections in terms of extension of the Marco Polo airport's catchment area and the related impacts on air traffic, in terms of potential new passengers.

2 MARCO POLO AIRPORT AND THE HSR CONNECTION

Marco Polo airport is affected by important short-to-medium period infrastructure projects, both at the local and national scale, that may significantly contribute to extend its catchment area by rail and by sea. Currently, the airport confirms its growing importance when considering passenger traffic, a trend that has been also fostered by the implementation of several direct international routes, which have stimulated indirect flows too, resulting in more than 1 million passengers to/from North America and 500.000 passengers to/from the Far East, growing respectively by +11% and +6% in comparison to the previous year (Assoaeroporti, 2018). In 2018, the international relevance of the airport has furtherly grown, thanks to the presence of more than 50 airlines serving the airport and offering flights to more than 100 destinations, including 10 long-haul and 4 medium-haul relations⁴, that will be sided by a new service to Madrid (starting from march, 2018) providing new opportunities for the south American market. This scenario is expected to change due to the ongoing projects for the airport (Masterplan 2021 Marco Polo Domani) and the new railway connection. The frame that emerges by consulting the available planning documents and legal agreements that have been signed by

⁴ They are the flights to New York JFK, Atlanta, Philadelphia, Chicago, Montreal, Toronto, Seoul, Doha, Dubai and four medium-haul flights to Casablanca, Tunis, Tel Aviv and Shark el Sheik (starting from the winter season).

public and private stakeholders⁵, confirms the intention to expand the airport and to transform the surrounding area for creating a super-local hub fulfilled with relevant territorial-scale functions⁶. In contrast, a relevant change in the strategies of infrastructural development can be highlighted with the overcoming of the hypothesis, foreseen by territorial plans (but already excluded by *PAT Piano Assetto Territoriale*, drafted by the Venice Municipality in 2014), to implement a new HSR line between Venice and Trieste, directly serving the airport. This change has been due to the decision, taken at the national level, to upgrade the existing infrastructure that runs 5 km in the North of the airport, instead of realizing a new HSR line (Fig. 1).

The upgrading of the existing railway line into a "High Capacity Railway" (HCR) will allow to reach a maximum speed of 200 km/h (with respect to the current limit of 150 km/h, RFI), saving around 30 minutes from Venezia S.ta Lucia to Trieste Centrale. The project is expected to be completed in an over-2026 scenario. However, a new rail connection to link, by a 6km spur, the airport with a new station is confirmed. This solution, expected to be operative by 2026 (RFI), would allow HSR/HCR and local trains to directly connect the airport terminal to the city (Mestre, Venezia S.ta Lucia), to the main urban areas in Veneto region and to the most important European transportation corridors (TEN-T). This project has been featured in the contract signed in 2016 by SAVE s.p.a. and RFI and included as a relevant strategy in the Masterplan 2021 *Progetto Marco Polo domani*.

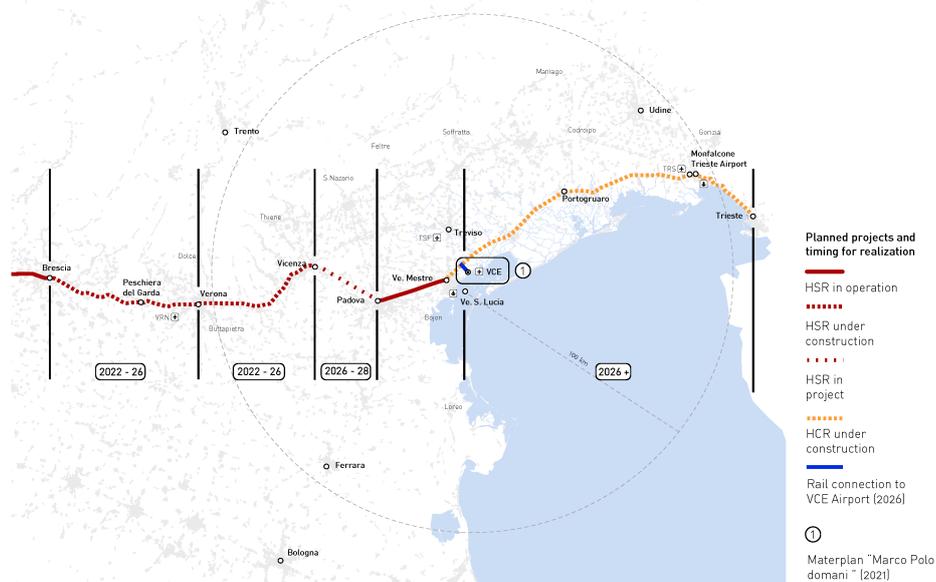


Fig. 1 Planned projects and timing for realization

This Masterplan, that has been modified several times during the years, represents the final outcome of a long and complex decision-making process that has been developed since the signing of an agreement (*Accordo Quadro per il Quadrante Tessera*) between SAVE s.p.a., ENAC and the Venice Municipality (2006-2007). In particular, the Masterplan 2021 (2014) defines a general improvement of the internal and the external infrastructural system, with an expansion of the runway, the apron and the air terminal, new parking lots, the construction of the "Moving Walkway" and "Porta d'acqua". Moving walkway (a pedestrian covered bridge

⁵ To reconstruct the future scenario for the Marco Polo airport, in a first phase, the most relevant territorial planning documents (PTRC Veneto region 2009, approved in 2013; PTCP Venice province 2010) and local urban plans (PAT Venice municipality, 2014) were consulted. In a second phase, it has been conducted an analysis on the legal agreements and contracts between the municipality of Venice and SAVE s.p.a. as well as on the infrastructural projects, relevant for the future of the airport.

⁶ On 18th October 2018, the City Council of Venice, with the deliberazione n.42, approved the declaration of public interest for the project, aimed at developing a new pole of activities close to the airport to host a new soccer stadium (18.000 – 25.000 seats), a new retail/entertainment park with commercial and food-related activities and a hotel (around 150 rooms). This decision is an important milestone in the transformation process of the area that was already defined in the previously plans and has been the object of a long and complex decision-making process.

equipped with tapis roulants) and *Porta d'acqua* (a system of connected marine piers) are conceived as an integrated system that can serve potentially relevant flows of passengers willing to reach by sea Venice and other localities of the venetian Lagoon. The interventions foreseen in the Masterplan 2021 for the airport, outline a scenario characterized by an increasing competitiveness of the airport in term of passengers (with an estimated growth of 3,2 million/ passengers by year) and air supply (11.000 new flights/years) (SAVE , 2014). These dynamics will be supported by the completion of the HSR between Venice Mestre and Milan, currently operative only between Venice Mestre and Padua and between Brescia and Milan. This infrastructure, which completion is expected by 2028, will allow to save from 20 to 35 minutes on the entire relation with respect to the current travel times.

3 HOW DOES THE CATCHMENT AREA OF MARCO POLO AIRPORT CHANGE IN THE NEAR FUTURE?

The new infrastructural connections, in particular the HSR/HCR, can produce relevant impacts on the role that Venice airport can play in the near future, which will be furtherly confirmed following the completion of the projects outlined in the Masterplan 2021. With the aim of analyzing the possible changes occurring to the role of Marco Polo Airport, due to the realization of the new rail connection to Mestre, we start our analysis defining the catchment area of the airport by train both in the current and future scenario, affecting the basin of potential users. The potential catchment area of the airport has been defined providing a simulation of the impacts that the expected development projects could determine, by considering accessibility thresholds by train and accessibility isochrones by road.

This approach simplifies the accessibility concept and related measures of which Geurs and van Wee (2004) provide an exhaustive example⁷, considering only the time component of the accessibility measures by rail and road. Because accessibility describes "the extent to which land-use and transport systems enable (groups of) individuals to reach activities or destinations by means of a (combination of) transport mode(s)" (Geurs & Wee 2004), their measures depend strongly on what accessibility you want to analyse or to promote, how (mode, speed, reliability, density) and for who.

These conditions also explain why accessibility has been receiving increasing attention from a wide range of transport planning approaches, recently concerned also with the social dimensions of mobility (Pucci & Vecchio, 2019). From the pioneer definition by Hansen (1959) in "*How accessibility shapes land use*"⁸, the accessibility measures are evolving towards multimodal approaches, finalised to analyse the range of available opportunities with respect to their distribution in space and time. In our approach we focus on *infrastructure - based accessibility measures* founded on the observed and simulated performances of the rail transport system, in terms of travel time to reach Marco Polo airport. The goal is to understand the extent of the catchment area of the airport by railway, due to the implementation of the infrastructural projects and considering a 3-hour travel time threshold⁹. By consequence, the concept of accessibility, in this research, is related to the increased number of people that may find convenient, in terms of travel time, to choose the Marco Polo airport as a departure hub for their flights. This is calculated, in a first step, considering the current and future geographical extension of the catchment area and, in a second step, for the scenario construction, by forecasting the trends in mobility habits of the inhabitants of the catchment area.

⁷ Geurs and van Wee (2004) identify four main components of accessibility affecting its meaning and measures: land use, transportation, time and individuals. These elements interact with one another in various ways, influencing themselves and contributing differently to the overall available accessibility.

⁸ According to Hansen (1959), accessibility is "the potential of opportunities for interactions".

⁹ A maximum 3 hours travel time by train from VCE Marco Polo airport was imposed. The reason for this choice is related to the geographical location of Venice: when overcoming this threshold, it is more convenient in terms of travel time by train, to reach other national airports providing a similar (or greater) level of service, such as Milan Malpensa.

The former has been calculated starting from the current railway services supply and in relation to territorial development scenarios. By consequence, current train travel times have been re-adapted to simulate the presence of the new direct connection based on the estimations provided by RFI on expected travel times from the new airport station to Mestre (Fig. 2).

By calculating train accessibility thresholds (1, 2 and 3 hours respectively) to the airport, three basins of potential users have been identified, each of which constituted by municipalities falling under one of the three isochrones and selected according to their spatial proximity (5 km) to a railway station classified considering the accessibility threshold granted to the new airport station. The analysis revealed also a fourth basin, defined as “residual”, composed of municipalities that, even if located in the study area, do not meet the previous conditions (Fig. 3).

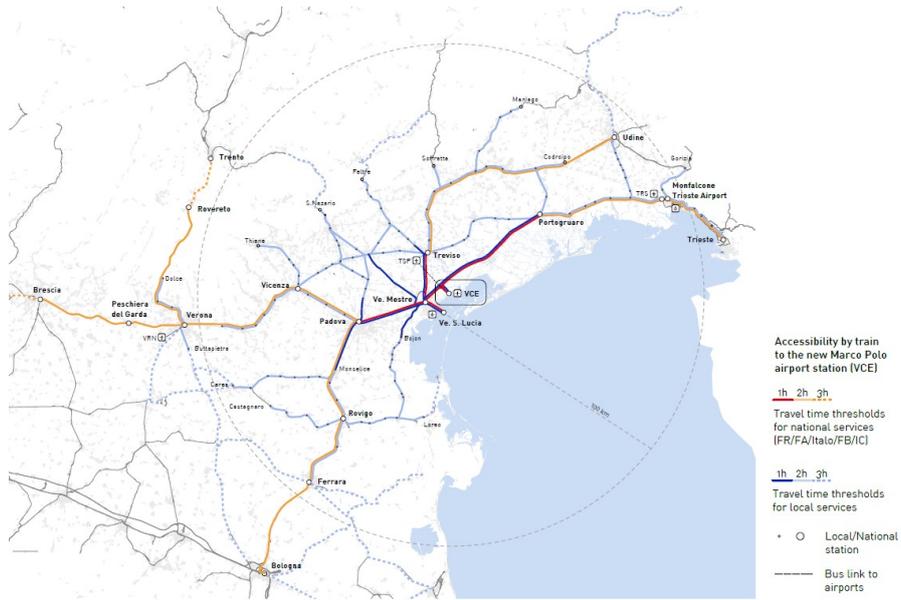


Fig. 2 Isochrones by rail to the new Marco Polo airport station

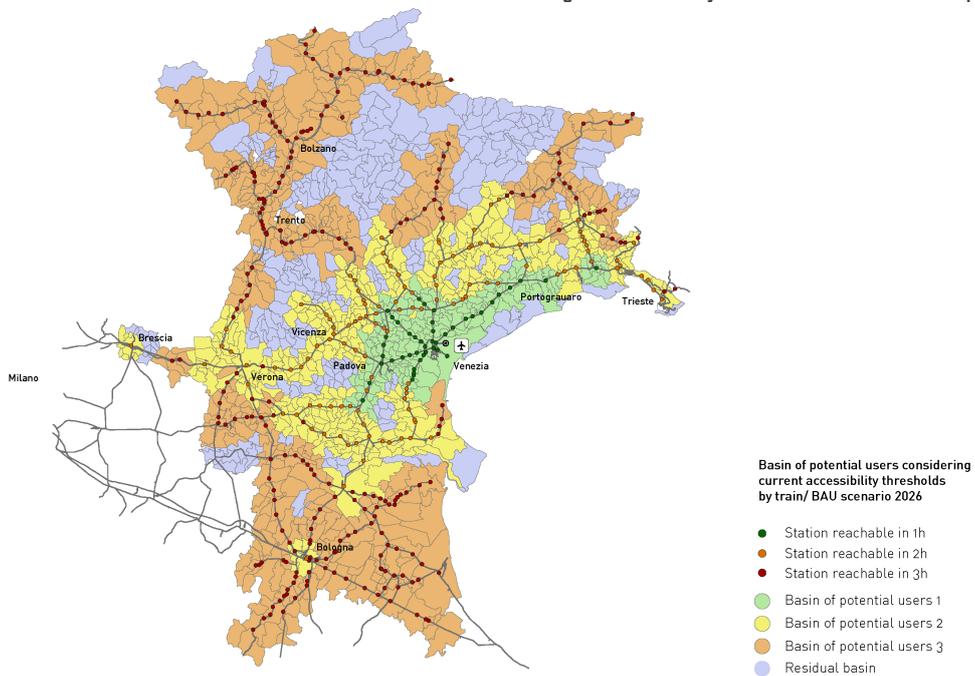


Fig. 3 Basins of potential users, considering current accessibility thresholds by train to the new airport station

To confirm the validity of the achieved results based on the railway network, an analysis on the road accessibility to the airport has been conducted. Isochrones, used in this process, represent an effective criterion to define the airport's catchment area both in the current and future scenario. Isochrones allow to define the potential airport's catchment area by road, considering travel times in a range between 15 and 60 minutes. The indicator is calculated by using a sampling function of the isochrones in which the centroid of a municipality is falling¹⁰. The outcome (Fig. 4), allowing to compare the Marco Polo airport catchment area by road with the ones of other relevant airports in the North East (Verona and Bologna), shows a widespread and balanced road accessibility in each airport; however, in terms of commercial air supply, the airport of Venice is the main hub for the international/intercontinental traffic in the North East of Italy.

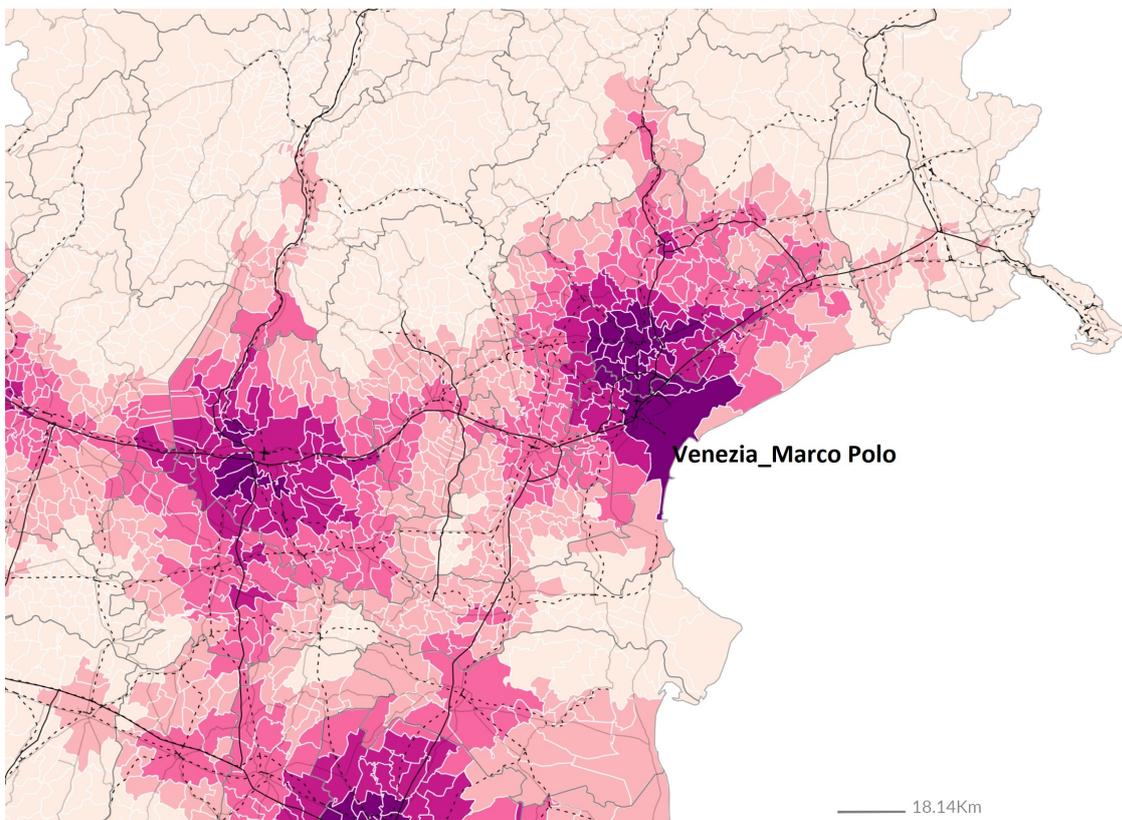


Fig. 4 Catchment area of Marco Polo airport: isochrones of accessibility by road and comparison with other relevant airports in the North East of Italy (source: Postmetropoli, Dastu, Polimi)

4 THE INTERMODAL COMPLEMENTARITIES OF RAIL AND AIR TRANSPORTATION: FUTURE SCENARIOS IN MARCO POLO AIRPORT

With the aim of providing an evaluation of the impacts of the infrastructure projects and the territorial interventions in Marco Polo airport's catchment area, the research defines two scenarios to estimate the evolution on mobility trends and the potential new users:

- a BAU (Business as usual) scenario assumes that the current socio-economic and mobility trends can be expected to continue unchanged to 2026, considering that HSR/HCR lines will not be in exercise, but the dedicated rail connection to the airport will be already operative;

¹⁰ Source: routable road network (OpenStreetMap) featuring information on average speed (data referred to 2014) and the localization of the airport. The results identify a study area at the territorial scale defined according to the following thresholds: class 1 (1-1)= average travel time between 45 and 60 minutes; class 2 (1-2)= average travel time between 30 and 45 minutes; class 3 (2-3)=average travel time between 15 and 30 minutes; class 4 (3-4)= average travel time less than 15 minutes.

- a Project scenario considers the evolutions of mobility trends to 2026, assuming the realization both of HSR/HCR lines and the dedicated rail connection to the airport.

The evolution of mobility trends has been estimated considering the current demand and its evolutions based on socio-demographic trends and to the territorial-scale projects that contribute to modify settling patterns. Data processed are commuter flows for work reasons by Istat Census data (2011), demographic census data (2011, 2017), the average income per capita (MEF 2012-2017) and mobility demand survey by Isfort (2018). The time horizon that was considered is related to the time of completion of the HSR line from Milan to Venice and to the upgrading to a HCR line between Venice and Trieste, as declared by RFI¹¹.

BAU: approach to calculate the scenario

The evolution in the demand for mobility by 2026 has been estimated considering the following hypothesis:

- population trends will remain unchanged due to the stable trend registered between 2011 and 2017 (+0.82% for the whole area of analysis and +0.9% for the Venice city catchment area);
- commuting mobility at the municipal level will increase following the average annual mobility rate¹² registered in the study area in 2018 (84.9). An additional evaluation has been provided assuming that the mobile population (composed by the employed) takes an average of 2.3 daily displacements (Isfort, 2018). By consequence, two different BAU scenarios were calculated, a first “low” scenario, based on the annual mobility rate and a second “high” scenario based on 2.3 average number of displacements per day;
- the modal split at 2026 for the displacements directed to Venice will remain stable, considering that the BAU scenario does not foresee the HSR/HCR line and the rate of car ownership shows a little increase (as observed in the whole area of analysis);
- flows directed to Venice will show the same trends as in the period 2011-2018;
- passenger traffic in the airport will increase by 4% average rate per year, according to the estimations provided by ENAC¹³ in the “Studio trasportistico aeroporto Marco Polo” (2014).

	CURRENT SITUATION (2018)		BAU SCENARIO (2026)	
	Population	Employees*	Flows**	Flows
Catchment area of Venice	5,303,020	2,323,658.92	1,970,664.8	1,987,429.239

Tab. 1 Business as usual scenario

* Employees are estimated based on the population in 2018, and according to the previous employment rate

** Flows are estimated based on the n. of employees in 2018 multiplied by the number of average daily displacements by Isfort (2018).

BAU Scenario has been calculated applying a linear function and considering for the flows estimation a constant mobility rate in line with that of the previous period (84.9). The following maps depict the trends of growth in the number of total flows by 2026 for the municipalities located into the study area considering both BAU scenarios (Figg. 5, 6) and in reference to the flows from the same municipalities to Venice (Fig. 7).

¹¹ Since 2007, HSR line between Padova and Mestre (25 km) is working, while the section between Verona and Vicenza (51.2 km) is under construction and its completion is expected by 2024; the section between Vicenza and Padua (27,6 km) has been financed at the 30% of the total cost (3.1 billion euro) and it is expected to be operative between 2026 and 2028; the section between Venice and Trieste is under upgrading to increase its speed (200 km/h) and the works are expected to be completed by 2024.

¹² Mobility rate is the percentage of employees that make at least one trip in a typical working day.

¹³ The estimation of passenger traffic is based on the scenario by ENAC (2014) that evaluates a consistent increase in the extra-Schengen movements (29% of the total in 2014) until 38% in 2021 with an annual increase rate by 7.5%; as well as a lower increase for Schengen passengers, with an average annual rate by 2.5%-3.0%.

Rail accessibility remains substantially unchanged with respect to the current condition (Fig. 3) in both scenarios, with the only difference due to the openings of the dedicated rail connection and a new station to the airport.

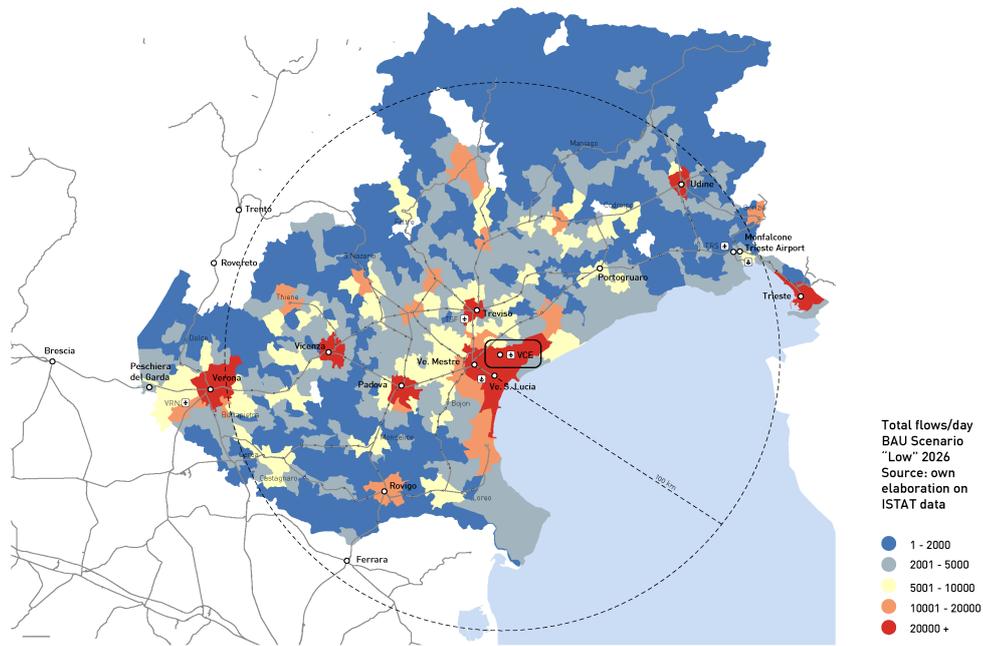


Fig. 5 Estimation of the total daily flows (inflows and outflows, all travel mode) at the municipal level – BAU scenario 2026 "low"

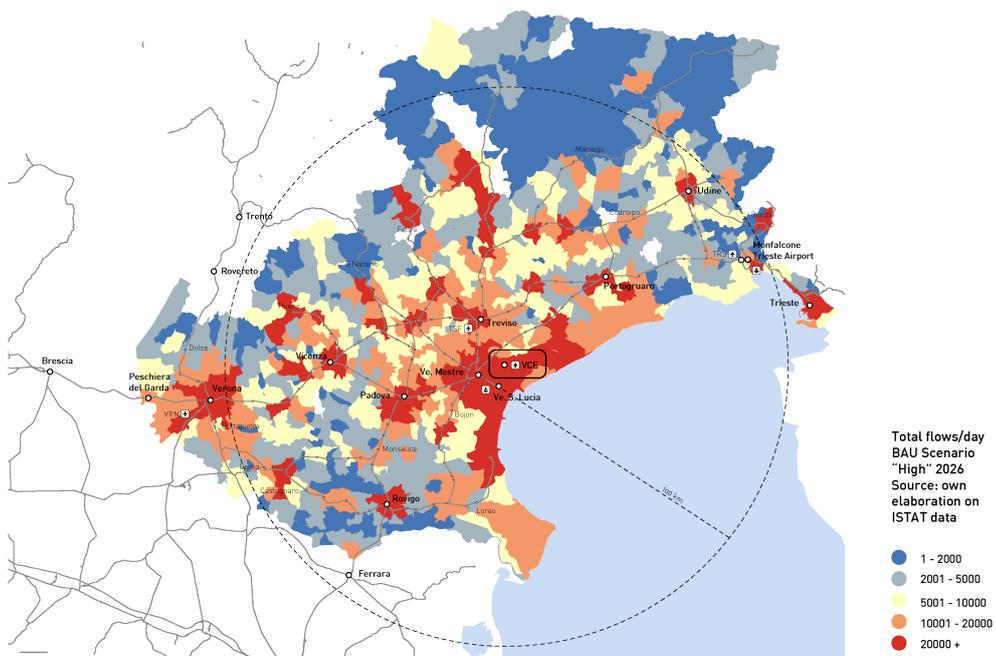


Fig. 6 Estimation of the total daily flows (inflows and outflows, all travel mode) at the municipal level – BAU scenario 2026 "high"

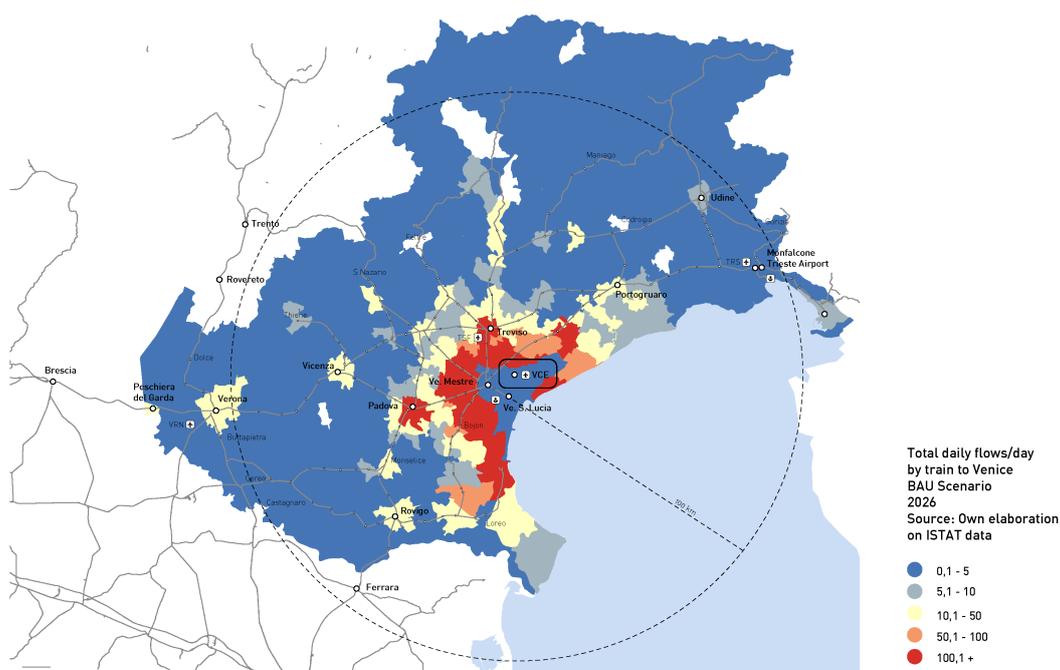


Fig. 7 Estimation of the total daily flows by train at the municipal level directed to Venice – BAU scenario 2026

Project scenario: approach to calculate the scenario

The evolution in the demand for mobility by 2026, when the HSR/HCR lines from Milan to Trieste is expected to be completed, has been estimated considering the following hypothesis:

- population trends will remain unchanged due to the stable trend registered between 2011 and 2017(+0.82% for the whole area of analysis and +0.9% for the Venice city catchment area);
- commuting mobility at the municipal level will increase according to the prevision on annual mobility average rate provided by Isfort (2018) for the North East of Italy (88.7%);
- considering the displacement directed to Venice from the municipalities hosting stations that will be served by HSR/HCR lines, the modal split for train could attest on values between 29.3% and 32.8% of the total flows directed to the airport¹⁴ (SAVE s.p.a. – Oneworks, 2014);
- the use of the local train network (SFMR) for displacements directed to the airport could reach 22.2% (SAVE s.p.a.- Oneworks, 2014);
- passenger traffic from the airport could increase by 4.5% on an average annual basis, exceeding the estimations provided by the ENAC report (*Studio Trasportistico Aeroporto Marco Polo*, 2014) due to the new dedicated connection between the HST/HCT lines and the airport;
- the new HST/HCT lines, once completed, will generate a significant reduction in travel times between Milano C.le and Trieste C.le (50/65 minutes according to RFI) determining the extension of the catchment area of the airport by rail (Fig. 8) and producing a relevant impact on long-distance relations.

Rail accessibility has been calculated considering the current supply, but a re-organization of the services could lead to a better integration with local/regional lines, strengthening the attractiveness of the inter modal air-rail solution, even for short-to-medium relations.

¹⁴ According to the available analysis (SAVE engineering – OneWorks, Studio Nodo Intermodale 2014), the following modal split has been hypothesized: taxi and bus-shuttles 9,7%; bus 11,3%; private car 32,4%; water transit 16,1%; railway 29,3%, others 1,2%. In a 2026 scenario, when the HST/HCT between Venice and Trieste will work, the following split can be hypothesized: taxi and bus-shuttles 9,7%; bus 11,3%, private cars 28,9%; water transport 16,1%; railway 32,8%, others 1,2%. These figures show a transfer of a share by 3,3% from private cars to the railway.

Project Scenario has been calculated applying a linear function and considering for the low scenario a constant mobility rate (commuter flows/employees) in line with the previous period, and for the high scenario an average, the daily displacements calculated by Isfort (2018) as a benchmark.

	CURRENT SITUATION (2018)			BAU SCENARIO (2026) - FLOWS	
	Population	Employees*	Flows**	Low	High
Catchment area of Venice	5,303,020	2,323,658.92	1,970,664.8	2,075,935.507	5,382,921.8

Tab. 2 Project scenario

* Employees are estimated based on the population in 2018, and according to the previous employment rate

** Flows are estimated based on the n. of employees in 2018 multiplied by the number of average daily displacements by Isfort (2018).

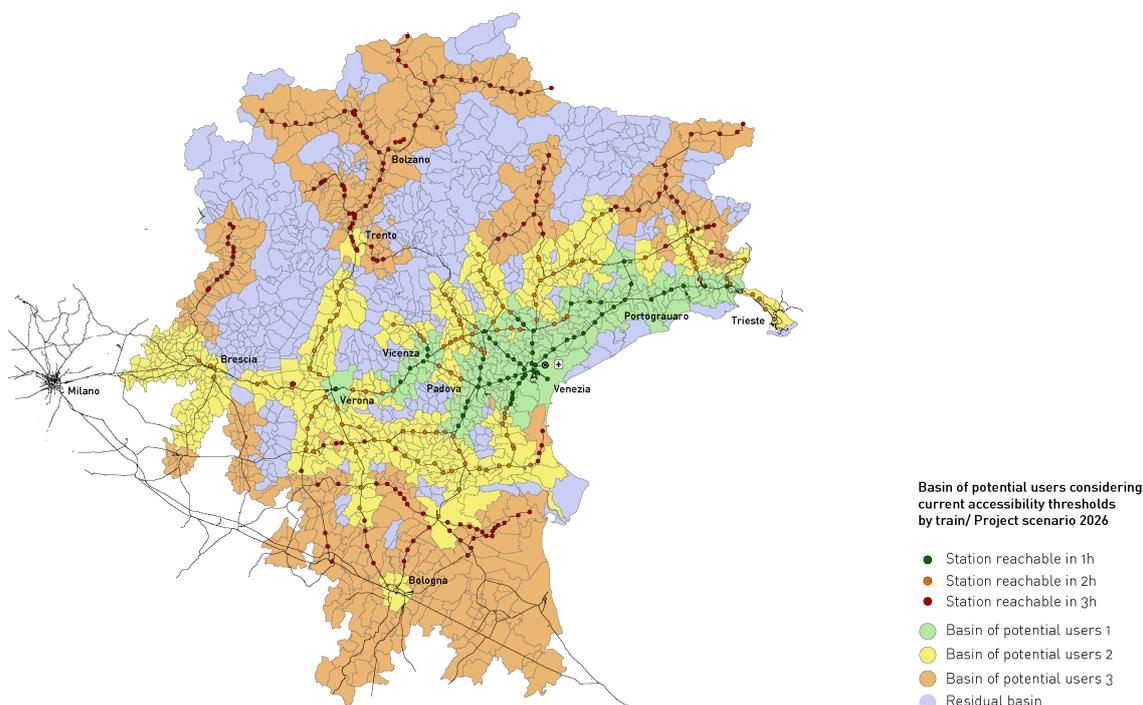


Fig. 8 Basins of potential users by train to the new airport station in the project scenario

As for the BAU scenario, two different scenarios were proposed: the first assuming that socio economic and mobility trend will remain stable (project scenario “low”) and the second project scenario considering 2.3 daily/displacements for employee (project scenario “high”). The following maps (Fig. 9, 10, 11) depict the trends of growth in the number of total flows by 2026 for the municipalities located into the study area.

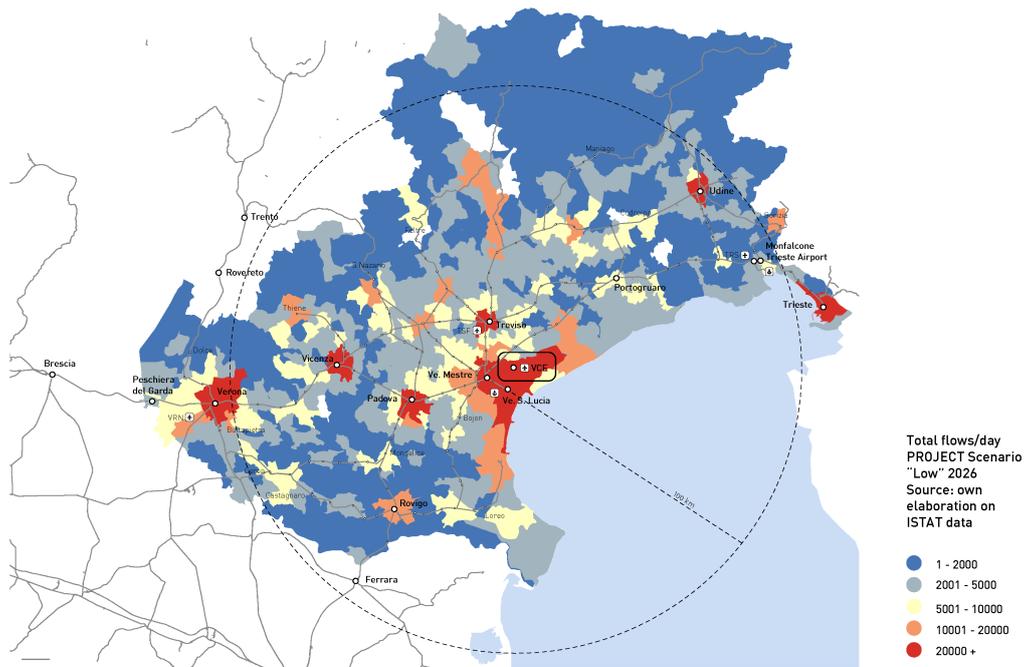


Fig. 9 Estimation of the total daily flows (inflows and outflows, all travel mode) at the municipal level – Project scenario 2026 “low”

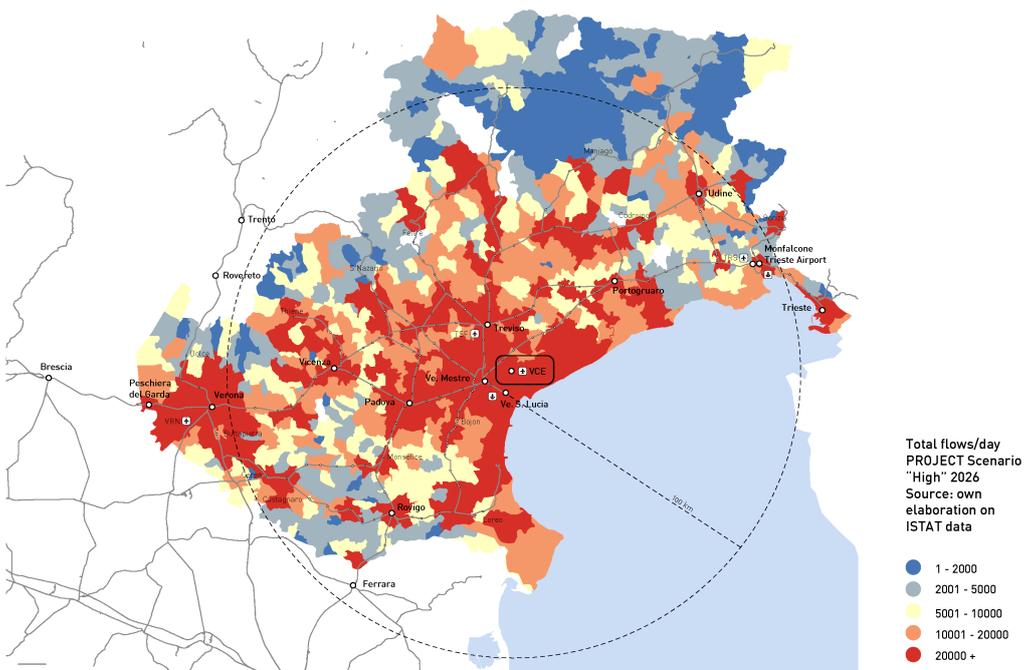


Fig. 10 Estimation of the total daily flows (inflows and outflows, all travel mode) at the municipal level - Project scenario 2026 “high”

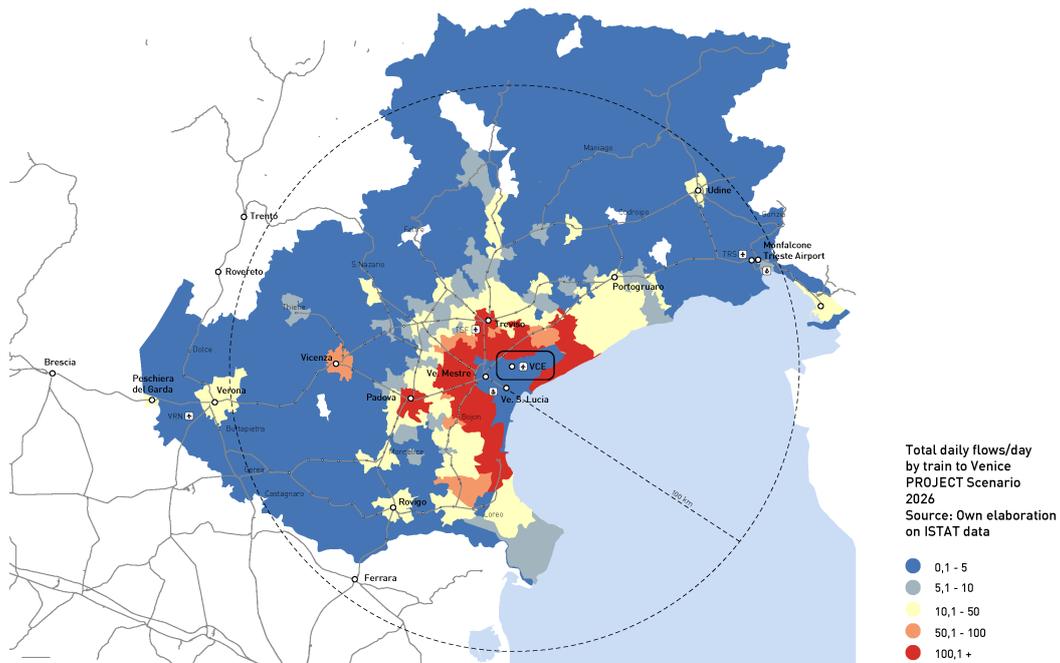


Fig. 11 Estimation of the total daily flows by train at the municipal level directed to Venice – Project scenario 2026

5 CONCLUSIONS AND DISCUSSIONS

In the next years, a further increase of the relevance of Venice Marco Polo airport into the national airport system is expected, thanks to the steady growth in passenger traffic and to the relevant infrastructure projects that will increase the airport’s efficiency. Among them, the opening of the dedicated rail connection and the completion of the HSR/HCR line between Milan and Trieste are the most relevant, due to their effects on the extension of the airport’s catchment area. This effect will be granted by a sensible reduction in travel times by train between Milan Centrale and Trieste Centrale, widening the accessibility thresholds by rail to the airport. Moreover, the dedicated rail connection will allow to directly link the airport with the local and national rail networks, determining the conditions for an efficient air-rail intermodality in accordance with European strategies and with other national and international airports that have already followed this path. This research estimates that, in a project scenario 2026, and considering an accessibility threshold by train of 3 hours, an extension of the basin of potential users of the airport could increase by 18% compared to the current condition, potentially concurring to the increase of the airport’s users.

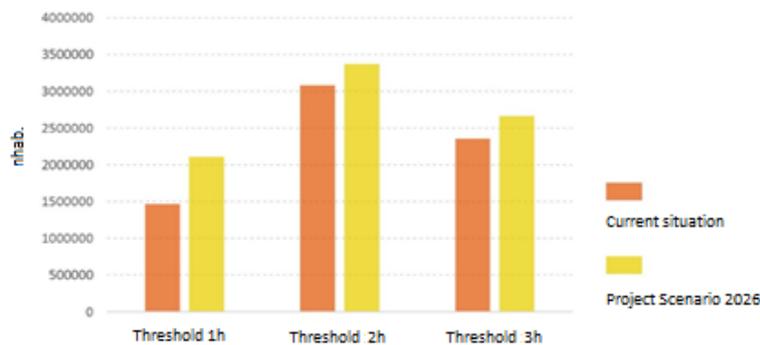


Fig.12 Variation of the inhabitants in the catchment areas of the Marco Polo airport, based on three isochrones (1h, 2h and 3 hour thresholds)

Even though the most relevant extension in the catchment area can be observed in the 1 hour threshold from the airport – namely the territory of “Veneto centrale” – it can be assumed that an increased accessibility by

train may produce significant benefits also for more remote areas such as eastern Lombardy (Brescia), Romagna and the settlements that are located along the main HSR/HCR corridors which are already characterized by a significant concentration of economic activities and business facilities and where mobility trends highlight a wider growth than the average per-capita income¹⁵. Furthermore, the new HSR long-distance connections will provide an increased competitiveness for the airport, also in comparison with the hub of Milan Malpensa, both for tourists and business travelers¹⁶. Considering Brescia as an example, the airport of Venice would be reached in around 80 minutes by train, thanks to the completion of the HSR line, while from Brescia to Malpensa airport around 100 minutes, with an intermediate reloading, are required. Considering short-to-medium distance rail connections, the project for a dedicated rail link to the airport will allow both national and local trains transit to reach the new airport station. In addition, the upgrade of the railway line to Trieste, combined with the completion of high speed rail between Venice and Milan, will lead both a decrease in travel times for the medium-long distances, and new time slots for improving the local railway supply in the historical decongested line. The contextual conditions mentioned above, relating not only to the new infrastructural supply, but also to some excellences and peculiarities of the Veneto region, contribute to enhancing the opportunities of the Marco Polo airport under some conditions that may play a significant role in fostering the positive outcomes granted by the development of the ongoing projects. These conditions are related, in particular, to the design solutions for the new dedicated rail connection and terminal rail station, to optimize the passengers transfer and ensure an efficient, integrated and livable interchange with the existing infrastructures (among them an important role is played by the Darsena).

In this framework, to facilitate the integration between rail-air services (code share, single ticketing, one-stop baggage check agreements) and new cooperation among different operators can play a relevant role to fully exploit the intermodal complementarities of HSR and air transportation in Marco Polo airport, with positive effects also for the involved territories. Final remarks refer to the approach followed in this paper and its limits. Estimating the access to the airport using only the travel times on the rail network, we assume that the reduction of these times increases the rail catchment area of the airport. This assumption does not take into account the combined effect of the different means of transport in the definition of the infrastructure accessibility to the airport that a multimodal approach to the airport accessibility should allow. However, the aim of our research focusses on the estimation not of the “new air passengers” but on the “potential users” of the airport, on the basis of a new railway supply and travel opportunities that widen the catchment area of the airport and the target populations affected. Using the definition of “potential users” of the airport, we estimate the inhabitants with a better condition for reaching the airport by train, even if we are aware that this population living in the catchment area does not involve a consequent increase in the air passengers, in particular because the new railway supply could even shift users from road transport to railways, without affecting the airport.

REFERENCES

Akhavan, M. & Vecchio, G. (2018). Mobility and Accessibility of the Ageing Society. *Tema. Journal of Land Use, Mobility and Environment*, 9-22. doi: <http://dx.doi.org/10.6092/1970-9870/5757>

¹⁵ Beside the analysis on commuter displacements (Istat 2011) and demographic trends (Istat 2011-2018), the research considered also the evolution of the average income per capita (MEF 2012-2017) to introduce the socio-economic dynamisms of our study area.

¹⁶ This scenario does not take into account the possible competition between Venice Marco Polo airport and Bergamo Orio al Serio, even if the two airports are very similar in terms of passenger traffic (Bergamo is the third airport in Italy for passenger traffic with 12.938.572 transits in 2018). This choice is due to the fact that Orio al Serio airport is not reached by the railway network and its commercial air supply is mostly oriented to the low-cost market.

Albalade, D., Bel, G., & Fageda, X. (2015). Competition and cooperation between high-speed rail and air transportation services in Europe. *Journal of Transport Geography*, 42, 166-174. doi: <https://doi.org/10.1016/j.jtrangeo.2014.07.003>

Bonnafous, A. (1987). The regional impact of the TGV. *Transportation* June, 14 (2), 127-137. doi: <https://doi.org/10.1007/BF00837589>

Boschetto, P., & Bove, A. (2012). Production facilities sprawl: the Veneto's case. *TeMA - Journal of Land Use, Mobility and Environment*, 5 (1), 79-100. doi: <https://doi.org/10.6092/1970-9870/736>

Commissione Europea (2011). Libro Bianco: Tabella di marcia verso uno spazio europeo dei trasporti. Per una politica dei trasporti competitiva e sostenibile Bruxelles.

D'Alfonso, T., Jiang, C., & Bracaglia, V. (2016). Air transport and high-speed rail competition: Environmental implications and mitigation strategies. *Transportation Research Part A: Policy and Practice*, 92, 261-276. doi: <https://doi.org/10.1016/j.tra.2016.06.009>

DLR, German Aerospace Center (2010). Topical report: Airport accessibility in Europe, European Commission, Koln, September.

Dobruszkes, F., Dehon, C., & Givoni, M. (2014). Does European high-speed rail affect the current level of air services? An EU-wide analysis. *Transportation Research Part A*, 69, 461-475. doi: <https://doi.org/10.1016/j.tra.2014.09.004>

Fregolent, L., & Vettoreto, L. (2017). Genesis of a fluid metropolitan space: urban metamorphoses in Venice and Veneto. In Balducci A. et al. (Eds.) *Post-Metropolitan Territories. Looking for a new Urbanity*, Routledge, Abingdon, 75-94. Retrieved from: <https://www.taylorfrancis.com/books/e/9781315625300/chapters/10.4324/9781315625300-5>

GARA (Global Air Rail Alliance) and SEA Aeroporti Milano (2015) Air rail Italia Ebook 2015. Retrieved from: <https://www.globalairrail.com/images/content/publications/brochures/AirRail%20Italia%20E-book-2.pdf>, Consultato in data 23 Marzo 2019

Givoni, M., & Banister, D. (2006). Airline and railway integration. *Transport Policy*, 13, 386-397. doi: <https://doi.org/10.1016/j.tranpol.2006.02.001>

Geurs and van Wee (2004). Accessibility evaluation of land-use and transport strategies: review and research directions. *Journal of Transport Geography* 12, 127-140. doi: <https://doi.org/10.1016/j.jtrangeo.2003.10.005>

Hansen, W.G. (1959). How accessibility shapes land-use. *Journal of the American Institute of Planners*, 25, 73-76. doi: <https://doi.org/10.1080/01944365908978307>

Janic, M. (1993). A model of competition between high speed rail and air transport. *Transportation planning and technology*. 17(1), 1-23. doi: <https://doi.org/10.1080/03081069308717496>

Jiménez, J.L., & Betancor, O. (2012). When trains go faster than planes: the strategic reaction of airlines in Spain. *Transport Policy*, 23, 34-41. doi: <https://doi.org/10.1016/j.tranpol.2012.06.003>

Klein, O. (1997). Le TGV-Atlantique et les évolutions de la mobilité: entre crise et concurrence. *Les Cahiers Scientifiques du Transport*, 32, 57-83. Retrieved from: <https://halshs.archives-ouvertes.fr/halshs-00140003/>

Martín, J.C., & Nombela, G. (2008). Microeconomic impacts of investments in high speed trains in Spain. *The Annals of Regional Science*, 41, 715-733. doi: <https://doi.org/10.1007/s00168-007-0116-8>

Mell, J. (2013). High speed rail stations at airports: report from France. In: Presentation at the 16th Annual Transportation and Infrastructure Summit

IATA (2018) Industry Statistics Factsheet Retrieved from: https://www.iata.org/pressroom/facts_figures/fact_sheets/Documents/fact-sheet-industry-facts.pdf, Consultato in data 24 Marzo 2019

LAirA (Landside Airport Accessibility) Interreg Project (2017) Air-rail Link Action Plan 1. Retrieved from: <https://www.interreg-central.eu/Content.Node/Action-Plan-1.pdf>, Consultato in data 23 Marzo 2019

Ouyang, J. (2012). Applications and Planning Theories of the Rail Transportation System in Airport Based on Air-Rail Intermodalism. In *Applied Mechanics and Materials*, 178, 1744-1747. Trans Tech Publications. doi: <https://doi.org/10.4028/www.scientific.net/AMM.178-181.1744>

Pucci P. (1998). Le piattaforme multimodali di trasporto: nuovi oggetti urbani. Lyon Satolas et Roissy Charles de Gaulles In: Morandi C., Pucci P. (Eds). *Prodotti notevoli, Ricerca sui fattori di successo di progetti di trasformazione urbana*, Angeli, Milano, 29-72.

Pucci, P., & Vecchio, G. (2019). Enabling mobilities. Planning Tools for People and Their Mobilities. SpringerBriefs Online ISBN 978-3-030-19581-6. doi: <https://doi.org/10.1007/978-3-030-19581-6>

Román, C., Espino, R., & Martín, J.C. (2007). Competition of high-speed train with air transport: the case of Madrid–Barcelona. *Journal of Air Transport Management*, 13, 277–284. doi: <https://doi.org/10.1016/j.jairtraman.2007.04.009>

Varlet J. (1992). Réseaux de transports rapides et interconnexions en Europe Occidentale. *L'information géographique*, 3, 101-114. ISSN 0020-0093

Vickerman, R. (1997). High-speed rail in Europe: experience and issues for future development. *The Annals of Regional Science*, 31, 21–38. doi: <https://doi.org/10.1007/s001680050037>

Xia, W., & Zhang, A. (2017). Air and high speed rail transport integration on profits and welfare: Effects of air-rail connecting time. *Journal of Air Transport Management*, 65, 181-190. doi: <https://doi.org/10.1016/j.jairtraman.2017.06.008>

Xia, W., Jiang, C., Wang, K., & Zhang, A. (2019). Air-rail revenue sharing in a multi-airport system: Effects on traffic and social welfare. *Transportation Research Part B: Methodological*, 121, 304-319. doi: <https://doi.org/10.1016/j.trb.2018.10.002>

DATA SOURCES

ACI, Annuario statistico 2018

ACI, Autoritratto, 2017

ENAC, Studio trasportistico aeroporto Marco Polo, Relazione descrittiva e metodologica, 2014

ENAC, Masterplan 2021 Aeroporto Marco Polo, Relazione illustrativa 2014

Isfort, 15° Rapporto sulla mobilità degli italiani, Roma, novembre 2018

Istat, Ambiente Urbano, 28 Giugno 2018

Istat, Forme, livelli e dinamiche dell'urbanizzazione in Italia, 2017

Istat, Mobilità urbana: domanda e offerta di trasporto pubblico locale, 12 Luglio 2017

RFI, Piano commerciale, luglio 2018

UNRAE, L'auto 2017. Sintesi Statistica

WEB SITES

www.postmetropoli.it

<http://www.assaeroporto.com/statistiche/>

www.istat.it

www.marcopolodomani.it

AUTHOR'S PROFILE

Paola Pucci is Full Professor in Urban planning and from 2013 to 2018 Research Director of the PhD course in Urban Planning Design and Policy (UPDP) at the Politecnico di Milano.

Giovanni Lanza is PhD Candidate at the Politecnico di Milano

TeMA

Journal of
Land Use, Mobility and Environment

TeMA 3 (2019) 283-294
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: 10.6092/1970-9870/6088

paper received 1st May 2019, accepted 12th September 2019
Licensed under the Creative Commons Attribution - 4.0 International License
www.tema.unina.it

How to cite item in APA format:

Reynolds Walsh, L., Xian, T., Levinson, D. & , Rayaprolu, H.S. (2019). Walking and talking. The effect of smartphone use and group conversation on pedestrian speed. *Tema. Journal of Land Use, Mobility and Environment*, 12 (3), 283-294. doi: <http://dx.doi.org/10.6092/1970-9870/6088>



WALKING AND TALKING

THE EFFECT OF SMARTPHONE USE AND GROUP CONVERSATION ON PEDESTRIAN SPEED

Lexie Reynolds Walsh^a, Tingsen (Tim) Xian, David Levinson
Hema Sharanya Rayaprolu

School of Civil Engineering, University of Sydney, Australia
e-mail: lexie.walsh@gmail.com; txia0093@uni.sydney.edu.au
david.levinson@sydney.edu.au; hema.rayaprolu@sydney.edu.au

^a ORCID: <https://orcid.org/0000-0001-6435-333X>

ABSTRACT

Distracted walking due to smartphone use is on the rise resulting in growing concern over pedestrian safety and well-being. Our study measured the walking speeds of pedestrian groups differentiated by their smartphone use in two different environments - a wide pedestrian bridge at a university, and a narrow footpath on a busy commercial street. The results show that groups of people, phone users, and often followers of phone users, walk significantly slower than solo walkers uninfluenced by phone. Especially on the narrow street, people in groups and phone users are seen to not only slow themselves down but also slow the people walking behind them.

KEYWORDS:

Walking; High-speed Rail; Catchment Area; Intermodal Complementarity; Scenario

TeMA

有关土地使用、交通和环境的杂志

TeMA 3 (2019) 283-294
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: 10.6092/1970-9870/6088

paper received 1st May 2019, accepted 12th September 2019
Licensed under the Creative Commons Attribution - 4.0 International License
www.tema.unina.it

How to cite item in APA format:

Reynolds Walsh, L., Xian, T., Levinson, D. & , Rayaprolu, H.S. (2019). Walking and talking. The effect of smartphone use and group conversation on pedestrian speed. *Tema. Journal of Land Use, Mobility and Environment*, 12 (3), 283-294. doi: <http://dx.doi.org/10.6092/1970-9870/6088>



行与说：智能手机使用和群聊对行人走路速度的影响

Lexie Reynolds Walsh^a, Tingsen (Tim) Xian, David Levinson
Hema Sharanya Rayaprolu

School of Civil Engineering, University of Sydney, Australia
e-mail: lexie.walsh@gmail.com; txia0093@uni.sydney.edu.au
david.levinson@sydney.edu.au; hema.rayaprolu@sydney.edu.au

^a ORCID: <https://orcid.org/0000-0001-6435-333X>

摘要

使用智能手机让越来越多的人在走路的时候分心，也让行人安全和福祉问题日益受到关注。我们的研究通过两个不同的环境：大学里的宽阔人行天桥，狭窄的繁忙商业街人行道。研究不同的智能手机使用方式对行人群体步行速度的影响。结果表明，人群、电话用户以及频繁关注电话用户的行走速度，明显慢于没有电话影响的独行者。尤其是在狭窄的街道上，人群中使用电话的用户不仅放慢了自己的脚步，也让其身后的人群步伐变慢。

关键词：

步行；高速铁路；集水区；多式联运的互补性；情境

1 INTRODUCTION

Growing environmental and health concerns have directed a multitude of research into walking, pedestrian behaviour and safety (Papa, 2008; Rahaman & Lourenco, 2010; Shbeeb & Awad, 2013; Soltani et al., 2018). Our study examines the impact of smartphone use on pedestrian movement. While walking is a multi-dimensional activity serving various purposes like mobility, leisure, exercise, social interaction, etc., this study focuses mainly on the transport aspect of walking, especially walking speed. Walking speed has been measured in a variety of contexts ranging from pace of life studies to human factors and behavioural to transportation studies (Chandra & Bharti, 2013, Clark-Carter et al., 1986; Finnis & Walton, 2008; Fitzpatrick et al., 2006; Franek, 2013; Levine & Norenzayan, 1999; Moussa et al., 2010; Tanaboriboon, 1986; Tarawneh, 2001; Walmsley & Lewis, 1989). But as smartphones have come to be almost ubiquitous across the world, the issue of smartphone use while walking arises. With increasing phone-related injuries and incidents among pedestrians (Nasar & Troyer, 2013; Smith et al., 2013), the behavior of distracted pedestrians has been widely investigated. The majority of the studies are however experimental (Mwakalongo et al., 2015) and report diverse findings. While (Haga et al., 2015; Nasar et al., 2008) and (Schwebel et al., 2012) find distracted pedestrians to exhibit unsafe behaviour, (Lopresti-Goodman et al., 2012) find them to act with more caution, and (Stavrinou et al., 2011) and (Timmis et al., 2017) find their behaviour to be unaffected by distractions. Nevertheless, when pedestrians were observed in their natural environments, those that were distracted with activities using phones were found to walk slower and display less caution (Nasar et al., 2008; Bungum et al., 2005; Hyman et al., 2010; Thompson et al., 2012). Bungum et al., (2005) assessed the relationship between distracted walking and routine cautionary behaviours of pedestrians crossing a street. Trained observers recorded the distractions (wearing headphones, talking on a mobile-phone, eating, drinking, smoking, or talking with another pedestrian) and cautionary behavior (looking left and right before crossing, entering the crosswalk only during the 'walk' phase) of 866 pedestrians. Using regression analysis, they found that distraction was negatively but weakly correlated with displaying caution.

In one of their studies, (Nasar et al., 2008) observed the behaviour of 127 pedestrians at three cross walks to estimate their safety. They found that mobile phone users crossed more unsafely than those using iPods or none of the devices. (Hyman et al., 2010) observed 317 pedestrians crossing a square at Western Washington University and investigated the effects of divided attention during walking. They observed that mobile phone-users walked slower, changed directions more frequently, and were less likely to acknowledge people and notice unusual activities in the surroundings in comparison to the others. They did not find any significant differences in behaviour across genders, in contrast to (Ortiz et al., 2017) who found females and the young to be more prone to distraction by phone use or talking to others in their observation of pedestrian and driver interactions. In another study, (Thompson, 2013) observed 1102 pedestrians at 20 high-risk intersections in Seattle, Washington to investigate the impact of technological and social distraction on pedestrian cautionary behaviours and crossing times.

They found mobile phone use and talking with a companion to increase crossing times. In an examination of the association between distracted behaviours and optimal crossing behaviour, they found text messaging while crossing to be associated with the highest risk. While many studies show smartphone use reduces the walking speed of the distracted pedestrian, the impact of the smartphone using pedestrians on the walking speed of those following them and the pedestrian traffic in general has been unexplored.

Our study addresses this gap. We investigate the impact of smartphone using pedestrians on others and the overall walking speed in different pedestrian environments in Sydney, Australia, by recording and examining video footage. Our hypothesis is that smartphone using pedestrians become obstacles for the non-smartphone users, who thus slow their walking speed.

The alternative hypothesis I that pedestrians not using smartphones adapt their behaviour to accommodate the smartphone users by perhaps weaving around them and increase their walking speed to overtake.

In this scenario, the use of smartphones would primarily affect the walking speeds of individual pedestrians using the devices but would not actually have any effect on the average speed of other travelers. In addition, the behaviour of pedestrians in groups is studied and posited to have similar effects.

2 METHODOLOGY

We examined pedestrian movements at two sites:

- on a university pedestrian bridge - City Road Bridge;
- on a busy commercial street - Bay Street.

At each of the sites, we recorded the pedestrian activity and measured walking speeds based on the collected footage. From the videos, we carefully logged the distance covered in the frame, and the time taken for each pedestrian to pass through the frame to extract their walking speed. Speed was calculated by dividing the distance walked by the time taken to walk. Each pedestrian was time stamped, and their direction of travel was noted. Other characteristics recorded include gender, whether they walked alone or in a group, and whether or not they were using their phone while walking.

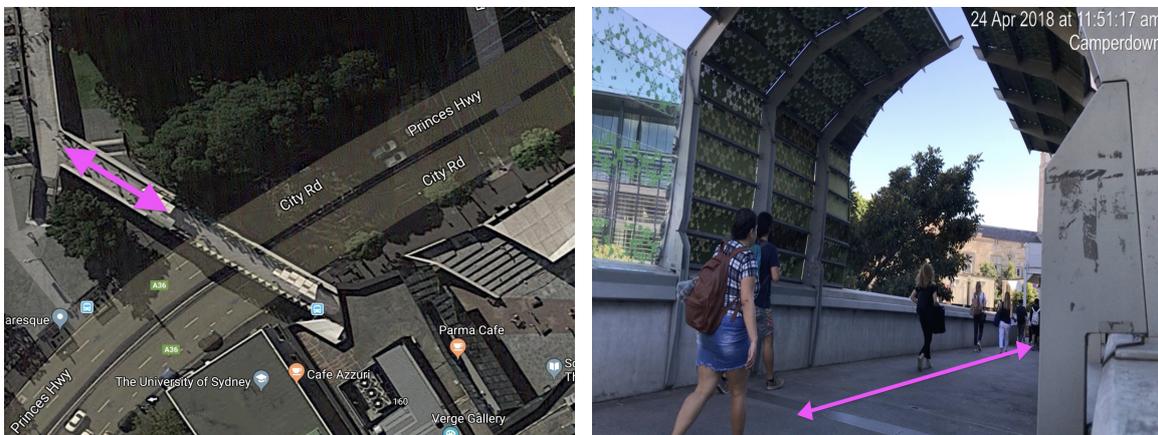


Fig. 1 Site 1: City Road Bridge. (a-left) Camera Layout (b-right) Measuring Zone: 24 m on the west (far) side of the Bridge, 18 m on the east (near)

The datasets for sites 1 and 2 have 180 and 477 reference items respectively, each one corresponding to a pedestrian, and include the relevant information on that pedestrian as outlined above. The data were broken down for analysis based on gender, walking in groups, and smartphone usage: the walking speeds of the pedestrians in various categories were then evaluated.

Further, to explore the impact that phone users had, the walking speeds of pedestrians following phone users with a headway less than 5 seconds were also evaluated. Finally, the results were tested for statistical using z-tests. Details of each of the sites are discussed in turn.

3 SITE 1: CITY ROAD BRIDGE

Site 1 (Fig. 1) consists of a pedestrian bridge over City Road on the University of Sydney campus. Video footage was recorded during a school day, April 24, 2018 between 11:24am and 12:34pm, just prior to lunchtime to ensure maximum pedestrian traffic. During the recording period, the conditions were clear, with light breeze and approximately 23°C. Pedestrian movements in the first ten minutes of the video were logged for speed measurement.

The logged data were then analyzed in conjunction with a more general observation of the rest of the footage. The general observation of the footage offered insights into trends that the logged data did not pick up. For example, the most obvious trend seen in the video observation is that pedestrians who were texting while walking were careful to keep to the left in their direction of travel (in Australia, pedestrians generally walk on the left). In this people walking in groups.

Based on this observation, further information was logged from the videos: the number of times that pedestrians overtook one another and whether the pedestrians overtaken were using smartphones or not.

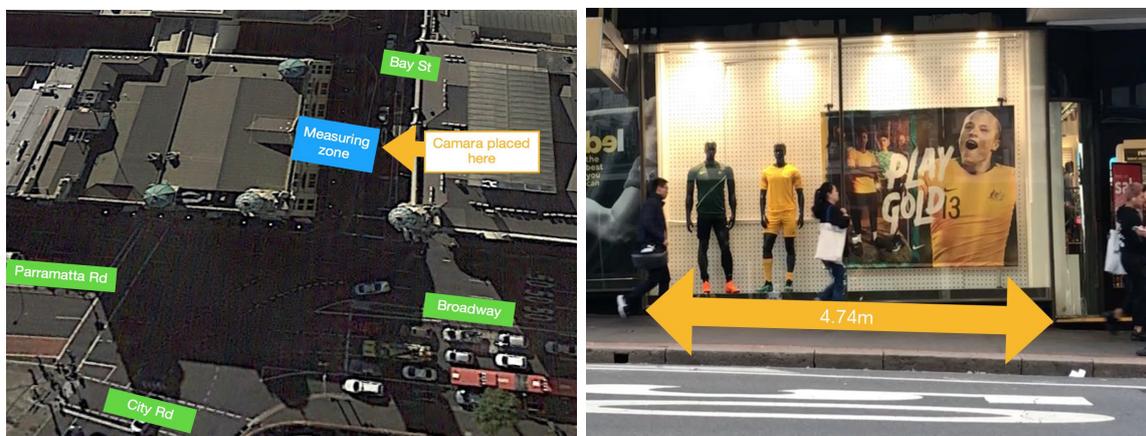


Fig. 2 Site 2: Bay Street. (a-left) Camera layout Bay St (b-right) Measuring zone Bay St

4 SITE 2: BAY STREET

Three videos were collected at Bay St, Ultimo, NSW, a busy street in a commercial district. They had been collected from 4:42 pm to 4:55pm on a Tuesday, 1 May, 2018, and from 11:11 am to 11:28am and from 4:22 pm to 4:38 pm on a Wednesday, 13 June, 2018.

The camera was located about halfway on the east sidewalk facing west between Grose St and Broadway (refer to Fig 2(a) and (c)). The camera was facing West and was placed on the other side of the road in order not to narrow the walkway under observation. The segment observed is shorter than in site 1 to avoid distractions in movements caused by shop entrances and exits. We expect this to aid the comparability of the results.

5 RESULTS AND DISCUSSION

5.1 CHARACTERISTICS OF PEDESTRIANS

The characteristics of pedestrians observed at sites 1 and 2 are shown in Tab. 1. Pedestrians at site 1 were mainly university students, which explains the similar share of female and male pedestrians. The greater number of female pedestrians at site 2 could be due to its location in a commercial shopping district, as shopping remains gendered (Roy Dholakia, 1999; Taylor et al., 2015).

Interestingly, an equal share of female and male students used their phones while walking, while male pedestrians on Bay Street were seen to use phones more than their female counterparts, an observation that contrasts the findings of studies where female pedestrians were observed to be equally or more likely to be distracted (Hyman et al., 2010; Ortiz et al., 2017; Smith et al., 2013).

Phone usage was nevertheless observed to be higher among students than pedestrians in the commercial district, as one would expect. Gender was significant in another dimension: women were more likely to walk in groups than men at both sites, and the likeliness was significant at site 1. Pedestrians following phone users with a headway less than 5 seconds were sporadic at both sites.

	SITE 1			SITE 2		
	Total	Male	Female	Total	Male	Female
Number of Pedestrians	180	92	88	477	207	270
Using phones	17%	17%	17%	12%	14%	11%
Not using phones	83%	83%	83%	88%	86%	89%
Phone user followers	7%	6%	1%	12%	5%	7%
Walking alone	72%	82%	61%	67%	71%	64%
Walking in a group	28%	18%	39%	33%	29%	36%

Tab. 1 Descriptive statistics

5.2 WALKING SPEED ANALYSIS

Walking speeds of pedestrians observed at both sites differentiated by gender, phone use, and walking companions are shown in Tab. 2. As one would expect, the average walking speed on the busy Bay Street (site 2) was higher than that on the wide, dedicated pedestrian bridge on campus (site 1).

As expected, pedestrians using phones had lower walking speeds than those not using phones and the general walking speeds, but the difference was not significant enough to fall outside the standard deviation of the general walking speed at both sites. The results for phone use followers do not align with our initial hypothesis that pedestrians using phones would slow down the other pedestrians around them.

Pedestrians using phones had no discernible effect on the walking speed of the pedestrians following them. While the walking speeds of phone user followers at site 2.

	SITE 1			SITE 2		
	All	Male	Female	All	Male	Female
All	1.21 (0.32)	1.24 (0.32)	1.17 (0.31)	1.31 (0.25)	1.34 (0.25)	1.29 (0.25)
Using phones	1.16 (0.30)	1.09 (0.33)	1.22 (0.24)	1.20 (0.20)	1.25 (0.24)	1.15 (0.16)
Not using phones	1.22 (0.32)	1.28 (0.31)	1.16 (0.33)	1.33 (0.25)	1.36 (0.25)	1.30 (0.26)
Phone user followers	1.34 (0.29)	1.33 (0.28)	1.38 (0.47)	1.25 (0.24)	1.30 (0.15)	1.22 (0.29)
Walking alone	1.31 (0.26)	1.32 (0.26)	1.28 (0.26)	1.36 (0.24)	1.40 (0.21)	1.32 (0.25)
Walking in a group	0.97 (0.32)	0.90 (0.34)	1.00 (0.31)	1.22 (0.26)	1.21 (0.29)	1.23 (0.24)

Tab. 2 Walking speed (m/s) of all pedestrians, phone-users, groups, and pedestrians following phone-users and groups (The values in brackets correspond to the standard deviation)

were comparable to the speeds of phone users, at site 1, pedestrians following phone users had speeds higher than the average. This is perhaps because phone using pedestrians were overtaken by the surrounding pedestrians who increased their walking speed temporarily during the overtaking, thereby producing no net effect on the general pedestrian speed.

To investigate this hypothesis, further analysis on overtaking patterns was undertaken at site 1 - discussed in the subsequent section.

The general walking speed of male pedestrians was slightly higher than that of the female pedestrians at both sites. This difference was fairly consistent across the categories except for male phone users at site 1, however the difference fell within the standard deviation.

The average walking speeds of male phone user followers at site 1, and male pedestrians walking in groups at both sites are almost negligibly lower than that of their female counterparts. Pedestrians walking in groups had lower walking speeds than those walking alone and the general population at both sites.

Although a clear slowing in the tempo of pedestrians walking in groups as compared to those walking alone was evident at site 1, the difference was not large enough to fall outside the standard deviation of the general walking speed. The difference was even smaller at site 2.

	MALE	FEMALE	OVERALL
People overtaken	13	20	33
Texting	2	3	5
Calling	0	0	0
Holding phone only	1	5	6
In a group	3	13	16
Alone with no phone	7	2	9
People that overtook others	13	9	22
Texting	0	1	1
Calling	0	0	0
Holding phone only	1	0	1
In a group	1	1	2
Alone	12	8	20
Not using phone	13	8	21

Tab. 3 Data on the Overtaken: Site 1

5.3 OVERTAKING PATTERNS AT SITE 1

Tab. 3 details characteristics of the overtaken and the overtaking pedestrians. For the analysis of overtaking patterns, we differentiated phone using pedestrians by what they appeared to be doing on their phones - texting, calling or just holding their phones while walking to identify patterns at a greater detail. Among all the observed pedestrians, only 33 (18%) were overtaken.

The data show that female pedestrians were more likely to be overtaken than male pedestrians. This is likely because most female pedestrians who were overtaken were walking in groups, and of the people who were overtaken, 48% were walking in groups. It may be that women are more likely to be overtaken simply because they are more likely to walk in groups, as seen in Tab.1, or there could be another unknown reason for this that has not been captured by this investigation. Male pedestrians were more likely to overtake than female pedestrians, perhaps because they tend to walk faster as seen in 1.

Overtaking pedestrians were likely to be walking alone (91%), and not using their phones (95%). A group of two people, one male and one female, was the only group to overtake in the footage. One male pedestrian held his phone as he overtook, and one female pedestrian managed to overtake while texting - in fact, she overtook two people. The analysis on overtaking patterns was undertaken with the expectation that most pedestrians who were using phones would be overtaken.

However, results show that the vast majority of people who were using phones were not overtaken.

The following additional points were noted during observation of the footage:

- texters kept to the left (Australia is a drive/walk on the left country) in their direction of travel - they tended to hug the wall as they passed over the bridge, and most looked up periodically;
- people in groups appeared to be less aware of their surroundings and took up more space than texters;
- no collisions or near misses were noted;
- pedestrians more easily overtook people using smartphones than people walking in groups;

- A slightly higher number of women (5%) than men carried their phones without using them: this could be explained by the fact that women's clothing has less functional pockets than men's clothing. If a female pedestrian was between texts, she may be less likely to put her phone away in her bag where she would be unlikely to hear or feel notifications, whereas a male pedestrian may be more likely to slip his phone back in his pocket while waiting for a reply. In addition, some women may keep their phone in their hand while listening to music for a similar reason. Without examining all the female pedestrians' pockets or asking them why they were holding their phones without using them, it is hard to make a definitive statement on this.

Overall, the results from the data collected on the City Road Bridge indicate that smartphone usage among pedestrians has little effect on overall pedestrian speed. However, this seems counter-intuitive given that people using smartphones have been shown to walk more slowly than without a smartphone, and walk with a reduced ability to follow a set pathway correctly (Bugum et al., 2005; Haga et al., 2015; Hyman et al., 2010; Lopresti-Goodman, 2012; Nasar et al., 2008; Thompson et al., 2010). Increases in injury rates have also been documented (Nasar & Troyer, 2013; Smith et al., 2013). It is thought that the effect of smartphone use would be more significant in areas with heavier pedestrian traffic, at different times of day, and perhaps with a slightly different demographic.

Most of the pedestrians seen in the video footage were almost certainly university students, around 18-35 years. At around 11:30 am, these students would not yet be late for a 12pm class, and so would not likely be rushing. Further, just before 12pm is about the time friends may meet for lunch, and therefore be more likely to be walking in groups than using their phones. Another location and time of day may yield different results. At 8am in Sydney CBD for example, a high volume of pedestrians aged 18 years and up would more likely to be walking alone on their way to work.

It is possible that under this scenario, smartphone use is more prolific and the effect on general pedestrian speed would be more significant and obvious. Further, a higher number of people walking past one another may mean that smartphone usage among some pedestrians does slow the walking speeds of other people. The barricades on the sides of the pedestrian bridge may also be affecting pedestrian behaviour. It is noted that most texters kept to the left and stayed very close to the barricade as they walked.

However, if the edge of the footpath met a busy road this may not be the case: people using smartphones may be more likely to walk close to the centre of the footpath where they would be more difficult to overtake.

6 SIGNIFICANCE OF RESULTS

To test the observed results for validity, we performed a series of Z-tests and found that the Z-test generally corroborate the observations, as shown in Tab.4.

The differences in walking speeds between most groups are significant beyond an 80% level. This is also true for the comparisons between sites. The results can hence be validated to be significant.

7 CONCLUSION

Observation of walking behaviour reveals or confirms the following: Males walk faster than females, females are more likely to walk in groups, females are more likely to carry articles in their hands than males. The results of the investigation from site 1, a wide university bridge, show that pedestrians using smartphones did not have a significant impact on overall pedestrian speed on the pedestrian bridge. Average walking speeds of pedestrians walking near smartphone users were not significantly different from the average speed. Overtaking pattern analysis showed that most people using smartphones were not overtaken either. It was found that people walking in groups were most likely to be overtaken by other pedestrians. In contrast, site

REFERENCES

- Bouterse L. & Wall-Scheffler C. (2018). Children are not like other loads: a cross-cultural perspective on the influence of burdens and companionship on human walking. *PeerJ*. 6:e5547. doi: <https://doi.org/10.7717/peerj.5547>
- Bungum T.J., Day C., & Henry L.J. (2005). The association of distraction and caution displayed by pedestrians at a lighted crosswalk. *Journal of Community Health*. 30(4):269–279. doi: <https://doi.org/10.1007/s10900-005-3705-4>
- Chandra S. & Bharti A.K. (2010). Speed distribution curves for pedestrians during walking and crossing. *Procedia-Social and Behavioral Sciences*. 104:660–667. doi: <https://doi.org/10.1016/j.sbspro.2013.11.160>
- Clark-Carter D., Heyes A., & Howarth C. (1986). The efficiency and walking speed of visually impaired people. *Ergonomics*. 29(6):779–789. doi: <https://doi.org/10.1080/00140138608968314>
- Finnis K.K. & Walton D. (2008). Field observations to determine the influence of population size, location and individual factors on pedestrian walking speeds. *Ergonomics*. 51(6):827–842. doi: <https://doi.org/10.1080/00140130701812147>
- Fitzpatrick K., Brewer M., & Turner S. (2006). Another look at pedestrian walking speed. *Transportation Research Record: Journal of the Transportation Research Board*. (1982):21–29. doi: <https://doi.org/10.1177/0361198106198200104>
- Franěk M. (2013). Environmental Factors. Influencing Pedestrian Walking Speed. Perceptual and Motor Skills. 116(3):992–1019. doi: <https://doi.org/10.2466/06.50.PMS.116.3.992-1019>
- Haga S., Sano A., Sekine Y., Sato H., Yamaguchi S., & Masuda K. (2015). Effects of using a smart phone on pedestrians' attention and walking. *Procedia Manufacturing*. 3:2574–2580. doi: <https://doi.org/10.1016/j.promfg.2015.07.564>
- Helbing D., Molnár P., Farkas I.J., & Bolay K. (2001). Self-organizing pedestrian movement. *Environment and Planning B: Planning and Design*. 28(3):361–383. doi: <https://doi.org/10.1068/b2697>
- Hyman Jr I.E., Boss S.M., Wise B.M., McKenzie K.E., & Caggiano J.M. (2010). Did you see the unicycling clown? Inattentive blindness while walking and talking on a cell phone. *Applied Cognitive Psychology*. 24(5):597–607. doi: <https://doi.org/10.1002/acp.1638>
- Levine R.V. & Norenzayan A. (1999). The Pace of Life in 31 Countries. *Journal of Cross-Cultural Psychology*. 30(2):178–205. doi: <https://doi.org/10.1177/0022022199030002003>
- Lopresti-Goodman S.M., Rivera A., & Dressel C. (2012). Practicing safe text: the impact of texting on walking behavior. *Applied Cognitive Psychology*. 26(4):644–648. doi: <https://doi.org/10.1002/acp.2846>
- Moussaïd M., Perozo N., Garnier S., Helbing D., & Theraulaz G. (2010). The walking behaviour of pedestrian social groups and its impact on crowd dynamics. *PloS one*. 5(4). doi: <https://doi.org/10.1371/journal.pone.0010047>
- Mwakalonge J., Siuhi S., & White J. (2015). Distracted walking: Examining the extent to pedestrian safety problems. *Journal of Traffic and Transportation Engineering (English Edition)*. 2(5):327–337. doi: <https://doi.org/10.1016/j.jtte.2015.08.004>
- Nasar J., Hecht P., & Wener R. (2008). Mobile telephones, distracted attention, and pedestrian safety. *Accident Analysis and Prevention*. 40(1):69–75. doi: <https://doi.org/10.1016/j.aap.2007.04.005>
- Nasar J.L. & Troyer D. (2013). Pedestrian injuries due to mobile phone use in public places. *Accident Analysis and Prevention*. 57:91–95. doi: <https://doi.org/10.1016/j.aap.2013.03.021>
- Ortiz N.C., Ramnarayan M., & Mizenko K. (2017). Distraction and road user behavior: an observational pilot study across intersections in Washington, DC. *Journal of Transport & Health*. 7:13–22. doi: <https://doi.org/10.1016/j.jth.2017.05.362>
- Papa E. (2008). Subway & Skyway System: Sustainable Infrastructure for Walking? *TeMA. Journal of Land Use, Mobility and Environment*. 1(3). doi: <https://doi.org/10.6092/1970-9870/186>
- Rahaman K.R., & Lourenço J. (2010). Pedestrian Planning in City Centers: a Study of Guimarães and Braga. *TeMA Journal of Land Use, Mobility and Environment*. doi: <https://doi.org/10.6092/1970-9870/134>
- Roy Dholakia R. (1999). Going shopping: key determinants of shopping behaviors and motivations. *International Journal of Retail & Distribution Management*. 27(4):154–165. doi: <https://doi.org/10.1108/09590559910268499>

Stavrinos D., Byington K.W., & Schwebel D.C. (2011). Distracted walking: Cell phones increase injury risk for college pedestrians. *Journal of Safety Research*. 42(2):101–107. doi: <https://doi.org/10.1016/j.jsr.2011.01.004>

Schwebel D.C., Stavrinos D., Byington K.W., Davis T., O'Neal E.E., & De Jong D. (2012). Distraction and pedestrian safety: How talking on the phone, texting, and listening to music impact crossing the street. *Accident Analysis and Prevention*. 45:266–271. doi: <https://doi.org/10.1016/j.aap.2011.07.011>

Shbeeb L., & Awad W. (2013). Walkability of School Surroundings and its Impact on Pedestrian Behaviour. *Tema Journal of Land Use, Mobility and Environment*. pp.171–188. doi: <https://doi.org/10.6092/1970-9870/1608>

Smith D.C., Schreiber K.M., Saltos A., Lichenstein S.B., & Lichenstein R. (2013). Ambulatory cell phone injuries in the United States: an emerging national concern. *Journal of Safety Research*. 47, 19–23. doi: <https://doi.org/10.1016/j.jsr.2013.08.003>

Soltani A., Pour M.H., Sholeh M., & Zare P. (2018). The Development of a Walkability Audit. Based on Iranian Cities Pedestrian Environment. *TeMA. Journal of Land Use, Mobility and Environment*. 95–108. doi: <https://doi.org/10.6092/1970-9870/5468>

Tanaboriboon Y., Hwa S.S., & Chor CH. (1986). Pedestrian characteristics study in Singapore. *Journal of transportation engineering*. 112(3), 229–235. doi: [https://doi.org/10.1061/\(ASCE\)0733-947X\(1986\)112:3\(229\)](https://doi.org/10.1061/(ASCE)0733-947X(1986)112:3(229))

Taylor B.D., Ralph K., & Smart M. (2015). What explains the gender gap in schlepping? Testing various explanations for gender differences in household-serving travel. *Social Science Quarterly*. 96(5), 1493–1510. doi: <https://doi.org/10.1111/ssqu.12203>

Tarawneh M.S. (2001). Evaluation of pedestrian speed in Jordan with investigation of some contributing factors. *Journal of Safety Research*. 32(2), 229–236. doi: [https://doi.org/10.1016/S0022-4375\(01\)00046-9](https://doi.org/10.1016/S0022-4375(01)00046-9)

Thompson L.L., Rivara F.P., Ayyagari R.C., & Ebel B.E. (2013) Impact of social and technological distraction on pedestrian crossing behaviour: An observational study. *Injury Prevention*. 19(4), 232–237. doi: <https://doi.org/10.1136/injuryprev-2012-040601>

Timmis, M. A., Bijl, H., Turner, K., Basevitch, I., Taylor, M. J., & van Paridon, K. N. (2017). The impact of mobile phone use on where we look and how we walk when negotiating floor based obstacles. *PLoS one*, 12(6). doi: <https://doi.org/10.1371/journal.pone.0179802>

Walmsley D.J. & Lewis G.J.(1989) The Pace of Pedestrian Flows in Cities. *Environment and Behavior*. 21(2):123–150. doi: <https://doi.org/10.1177/0013916589212001>

AUTHOR'S PROFILE

Lexie Reynolds-Walsh has a Bachelor of Arts (Social Anthropology and History) and a Bachelor of Engineering (Civil) both completed at the University of Sydney. She is currently a Project Engineer with Roads and Maritime Services NSW working in Regional Maintenance Division at Wagga Wagga.

Tingsen (Tim) Xian is a current Transport Engineering student at the University of Sydney. He started research in Pedestrian Behaviour in 2017. He is a founding member of the Institute of Transportation Engineers the University of Sydney chapter.

David Levinson joined the School of Civil Engineering at the University of Sydney in 2017 as Foundation Professor in Transport Engineering. He was a Professor at the Department of Civil, Environmental, and Geo- Engineering at the University of Minnesota, from 1999 to 2016. He conducts research on Accessibility, Transport Economics, Transport Network Evolution, and Transport and Land Use Interaction. He is the Founding Editor of *Transport Findings* and the *Journal of Transport and Land Use*. He is the author of several books including: *The Transportation Experience*, *Planning for Place and Plexus*, *A Political Economy of Access*, *Elements of Access*, and *The End of Traffic and the Future of Access*. He blogs at <http://transportist.org>.

Hema Rayaprolu is currently a PhD candidate at the University of Sydney. She has a Master of Science degree in Transportation Systems from the Technical University of Munich. Her research interests include Transport Network Evolution, Travel Demand Modelling, Transport and Land Use Interaction, and Planning for Walking and Cycling.

TeMA

Journal of
Land Use, Mobility and Environment

Call for Paper

TeMA vol. 13 (2020) The city challenges and external agents. Methods, Tools and Best Practices

The Times They Are a-Changin' and cities have to face challenges which may not be further postponed. In particular, six of these challenges to modify and/or adapt cities physical shape, facilities distribution and their organization as complex systems: climate changes effects, population aging, reduction of fossil-fuel energy consumptions, immigration flows from disadvantaged regions, technological innovation and optimization of land use.

The three issues of the 13th volume will collect articles concerning the challenges that cities are going to face in the immediate future, providing readings and interpretations of these phenomena and, mostly, methods, tools, technics and innovative practices (defined as Climate proof cities, Zero consumption cities, Car Free cities, ..) oriented to gain and keep a new equilibrium between cities and new external agents.

Publishing frequency is four-monthly. For this reason, authors interested in submitting manuscripts addressing the issues may consider the following deadlines:

- First issue: 10th January 2020;
- Second issue: 10th April 2020;
- Third issue: 10th September 2020.

TeMA

Journal of
Land Use, Mobility and Environment

TeMA 3 (2019) 295-312
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: 10.6092/1970-9870/6272

paper received 11th Septmeber 2019, accepted 16th December 2019
Licensed under the Creative Commons Attribution - 4.0 International License
www.tema.unina.it

How to cite item in APA format:

Gaglione, F., Gargiulo, C. & Zucaro, F. (2019). Elders' quality of life. A method to optimize pedestrian accessibility to urban services. *Tema. Journal of Land Use, Mobility and Environment*, 12 (3), 295-312. doi: <http://dx.doi.org/10.6092/1970-9870/6272>



ELDERS' QUALITY OF LIFE

A METHOD TO OPTIMIZE PEDESTRIAN ACCESSIBILITY TO URBAN SERVICES

Federica Gaglione^a, Carmela Gargiulo, Floriana Zucaro

Department of Civil, Architectural and Environmental Engineering (DICEA)
University of Naples Federico II, Italy
e-mail: {federica.gaglione; gargiulo; floriana.zucaro}@unina.it
URL: www.dicea.unina.it

^a ORCID: <https://orcid.org/0000-0002-7067-7784>

ABSTRACT

The progressive ageing of population requires rethinking the spatial planning of the urban spaces and activities to guarantee the best accessibility and usability to urban services of interest for the elderly segment of the population. In this perspective, the paper provides a methodology oriented to reorganize the urban services to better satisfy the renewed needs of over 65, by classifying the areas of a city according to (i) the levels of urban accessibility and (ii) the Functional Accessibility Soft zones (FASzones). In fact, the FASzones are the parts of the city where elderly can easily reach their services of interest due to the presence of "optimal" pedestrian routes fitting their behaviours. The results provide local decision-makers with useful suggestions for deciding where and how to in on the distribution and location of services, in order to increase urban accessibility for the over 65 by improving their quality of life.

This methodological aim represents a first step in the broader MOBILAGE research work aimed at defining strategies, tools and actions to improve the pedestrian accessibility to urban services and places for elderly users.

KEYWORDS:

Spatial planning; Urban accessibility; Elderly; GIS; Walkability

TeMA

有关土地使用、交通和环境的杂志

TeMA 3 (2019) 295-312
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: 10.6092/1970-9870/6272

paper received 11th Septmeber 2019, accepted 16th December 2019
Licensed under the Creative Commons Attribution - 4.0 International License
www.tema.unina.it

How to cite item in APA format:

Gaglione, F., Gargiulo, C. & Zucaro, F. (2019). Elders' quality of life.A method to optimize pedestrian accessibility to urban services. *Tema. Journal of Land Use, Mobility and Environment*, 12 (3), 295-312. doi: <http://dx.doi.org/10.6092/1970-9870/6272>



老年人生活质量与城市可达性：空间规划的方法建议

Federica Gaglione^a, Carmela Gargiulo, Floriana Zucaro

Department of Civil, Architectural and Environmental Engineering (DICEA)
University of Naples Federico II, Italy
e-mail: {federica.gaglione; gargiulo; floriana.zucaro}@unina.it
URL: www.dicea.unina.it

ORCID: <https://orcid.org/0000-0002-7067-7784>

摘要

人口逐渐老龄化是每个城市如今在满足相关的新承诺时必须应对的挑战。回应老年人的需求意味着要重新考虑城市空间的整治与规划，以确保老年人群对感兴趣的都市服务享有最佳的可达性和可用性。从这个角度来看，本文提供了一种根据 65 岁以上人口的流动性和城市服务水平对城市区域进行分类的方法。该方法学的目标代表了一项更广泛的研究工作的第一步，后者的目的在于确定策略、工具和行动，以便提高老年人在城市中获得服务和前往各种场所的机会。

关键词：
老年人；空间规划；空间规；城市可达性

1 INTRODUCTION

Over the last twenty years, improvements in quality of life and scientific and technological advances have led to an increase in life expectancy.

In some countries, such as Italy, the rise in life expectancy combined with the low birth rate has completely altered the age structure of the population. Taking into account the life expectancy statistics of the last four decades, it can be observed that the age for males increased from 69.6 in 1976 to 80.6 in 2016 and for females from 76.1 to 85.1; the percentage of people over 65 rose from 15% in 1991 (it was 8.2% in 1951) to 22.3% as of 1 January 2017, and in parallel also the percentage of the "older old" (90 plus) went from 0.06% in 1951 and 0.4% in 1991 to the current percentage of 1.2% of the total Italian residents (723000 people) (ISTAT, 2015). This new demographic trend requires many changes: (i) a social change, which could enable older people to "exercise their skills and maintain or establish solidarity relationships" (Ombuen, 2017), recognizing them as a resource and no longer as a burden for a cohesive development of society; (ii) an economic change, because the rise in life expectancy and the increasingly unfavorable relationship between the active and non-active population will also led to an increase in the health and social security expenses mainly for the elderly, causing the so-called longevity shock, recently underlined by the International Monetary Fund; (iii) an urban change, since a better organization of the spaces, channels and activities will increase the possibility of movement of the elderly. In this perspective, to make local decision-makers aware of the needs of this segment of the population, in 2006 the WHO addressed the problem of population aging (through the "Global Age-friendly Cities" project) by identifying the basis for developing age-friendly cities and communities.

In this study, urban accessibility depends not only on the physical characteristics (places) and functional features (activities) of a city, but also on people's behaviours (lifestyles). In this logic, the paper tries to integrate and overcome the more traditional studies referring to place-accessibility and activity-based approaches, by introducing the variable of "needs" linked to the behavior of specific population segments. Therefore, in addition to the common consideration of urban places and activities, accessibility levels are defined by a system of relationships referring to spaces, activities and needs of the people who use them, according to the abilities of individuals and not only to their expectations.

The scientific community addresses the issue of improving the accessibility of the elderly by intervening mainly on the transport networks. In fact, scholars have focused extensively on how to increase the supply of local public transport and on identifying some geomorphological factors influencing the decision of people over 65 to get around the city, (such as the slope of the territory) (Arentze et al., 2008; Frochen et al., 2019; Padeiro, 2018). Few studies have focused on identifying the physical and functional features of the city that influence the pedestrian accessibility (walkability) of the elderly (Elsawahli et al., 2014).

To this end, the MOBILAGE project is aimed at defining a decision support tool for public administrations to improve elders' pedestrian accessibility to services, thus contributing to enhance their quality of life. This paper, which represents a step of the research project, has a twofold objectives: the first concerns the classification of urban areas, after defining physical and functional accessibility levels; the second refers to the definition of the Functional Accessibility Soft zones (FASZones) that identify the urban portions where services can be reached by suitable pedestrian routes for elderly (Cottrill et al., 2020). This work allow to support local decision makers in defining interventions oriented to improve the urban accessibility of the over 65. Against the scientific literature that provides a plethora of interpretations of accessibility, because of its interdisciplinary nature (e.g. Cheng et al., 2007; Litman, 2017; Sola et al., 2018), this study refers to the "urban accessibility" concept according to the holistic-systemic approach of the governance of urban transformations. Urban accessibility can be meant as the possibility of a person with any ability to reach and make use of places and activities of interest without barriers. In other words, the defining elements of urban accessibility are the services reachable on the urban level (functional component of urban accessibility) and the set of pedestrian

networks (physical component of urban accessibility), in close proximity to houses, all of them related to the behaviour of the older users.

Improving both the distribution of urban places and services and the usability of the paths to reach all of them results in contributing to increase the quality of life of the elderly by intervening on urban accessibility.

The paper is articulated as follows: the first section proposes a review of the scientific literature on the issue of accessibility for the elderly population; the second section presents a methodology to define the different levels of urban accessibility; the third section outlines the application of this method in the GIS environment to the Fifth Municipality (Vomero and Arenella districts) of the city of Naples; the fourth section describes the results obtained.

2 POPULATION AGING AND URBAN ACCESSIBILITY

Even though the influence of built environment on people habits, behaviors, expectations and aspirations has been debated by several authors for decades (see, e.g. Edwards et al, 1998; Grzeskowiak et al., 2003; Steinfeld and Maisel, 2012), just in the last years this discussion has been focusing on the "late life" segment of the population by connecting it with the spatial and urban accessibility field (Boudiny, 2012; Bricocoli et al., 2018; Henkin and Zapf, 2006; Pinto and Sufineyestani, 2018; Yuen, 2018).

The duality in the relation between the habits of the elderly (demand) and the organization of the urban system (supply) has prompted scientific debate on how to improve both the accessibility to urban places and services and the pedestrian network, given that soft mobility is the preferred transport mode among elder people: elders aged 60-74 years walk and cycle (64% of trips) more frequently than they drive within urban areas and for short distances (EC, 2012; Eurostat, 2017; Rosenbloom, 2004;). However, few studies have dealt with integrating the above matters, due to the complex spatial relationships between activities and mobility. In particular, Guagliardo (2004), Mao and Nekorchuk (2013) Wang (2012; 2015) and Zhu et al. (2019) have simultaneously focused on the two issues with the aim of measuring the "spatial accessibility to public services, especially healthcare services" (Tao and Cheng, 2018) and mainly by private transport. Such studies use a new accessibility indicator which, by measuring some characteristics (such as the travel distance to reach a specific activity and the related journey time), allows identifying those areas characterized by a lack of services. The possibility of reaching places and services, as well as the use of local public transport and the pedestrian network represent important steps towards improving overall urban accessibility and reducing social exclusion (Gargiulo, 2014; Khosravi et al, 2015; Zali et al., 2016). In this regard, there is an extensive body of scientific literature concerning the increase of the local public transport supply. Some of the studies developed (Broome et al., 2012; Fobker and Grotz, 2006; Kotval, 2017; Morency et al., 2011; Wong et al., 2017) have deepened the issues of the most frequent and preferred transport mode for the elderly (mainly the bus) and the quality of public transport offered. These studies were based on surveys conducted through questionnaires that provide information on the lifestyles of the elderly population, on the use of multivariate statistical techniques for assigning weights and the correlated identification of significant variables, and on the application of accessibility models, in order to understand how the elderly can reach a specific transport service. For example, the extensive scientific literature aimed at understanding the key factors influencing travel decisions among people aged 65 and older – which relate to the spatio-temporal constraints in achieving a given service of interest (Hildebrand, 2003; Szeto et al., 2017; Witten et al., 2003;) - makes wide use of this type of statistical methods. Even the most recent research segment concerning the reorganization of outdoor spaces (not specifically aimed at encouraging "active aging"), adopts multivariate statistical techniques to determine the impact of the built environment on the accessibility to places. In fact, the scientific community has dedicated particular attention to identifying, on a neighborhood scale, the physical and environmental characteristics that influence the participation and social aggregation of the elderly (Curvers et al., 2018;

Hawkesworth et al., 2018; Siu, 2019). Other studies have highlighted the physical and environmental characteristics of the built environment to detect which factors influence the “walkability” of the elderly (Feng et al., 2018; Meshur, 2016; Tseng and Wu, 2018; Van Cauwenberg et al 2011; Wang and Cao, 2017; Zang et al., 2018), so as to provide useful information for improving the pedestrian accessibility of the road network. Within the scientific framework of reference, very few studies link the needs and habits of the elderly (demand) to the matter of accessibility to urban places and services. Starting from this gap, this work intends to define the levels of urban accessibility, according to its physical and functional features, comparing them with the elderly density distribution and with the FASZones in order to identify the different demand-supply ratio degrees.

3 METHODOLOGY AND STUDY AREA

In order to classify the portions of a city according to their physical and functional accessibility levels of the older population at the neighborhood scale, a four-stage methodology was developed.

It is worth noting that this study goes a step further than a previous work (Gargiulo et al., 2018) and use a set of 13 variables classified according to the four main urban subsystems (Table 1). These 13 variables are the most significant ones due to their statistical weight, according to literature.

By referring to the performance approach (Gargiulo, 2009), the variables within the functional, physical and environmental subsystems define the supply of urban accessibility, while the variables within the socio-economic subsystem define the demand of urban accessibility of the elderly segment of the population.

The numerous services of interest for the elderly (functional subsystem) have been also geolocated in accordance with the following types of services:

- health services: hospitals, pharmacies, diagnostic centers and ASL;
- cultural and leisure services: cinema, theater and libraries, green areas;
- economic-financial services: banks and post offices;
- commercial services: supermarkets and shopping fronts.

This further classification has been introduced to cluster the numerous kind of services, as well as for facilitating the reading and the interpretations of the results obtained.

ID	VARIABLE	WEIGHT	MEASURE	SOURCE
SOCIO-ECONOMIC SUBSYSTEM				
1	Population over 60 divided into age groups (60-70,70-80,> 80)	p=-0.25 p<0.001 p=0.37 p=- 0.55	Inhabitant (Inhab.)	Istat-Municipality
2	<i>Old index</i>		(%)	
ENVIRONMENTAL SUBSYSTEM				
3	<i>Orography (elevation)</i>		<i>m</i>	GIS
PHYSICAL SUBSYSTEM				
4	Metro stations	p=0.7 p=0.5 p=0.3	R.i.= 500m	Geographic information system
5	Bus and tram stops	p=0.94 p=0.80 p=0.50	R.i.= 500m	GIS_Open street map
6	Network of protected paths	p=0.02 p=0.005 p=0.86	Km	GIS

FUNCTIONAL SUBSYSTEM (services of local interest)		
7	<i>ASL</i>	<i>Radius of influence (R.i.)= 500m</i>
8	<i>Pharmacies</i>	<i>R.i.= 500 m</i>
9	<i>Poly-diagnostic center</i>	<i>R.i.= 560 m</i>
10	<i>Local market</i>	<i>R.i.= 600 m</i>
11	<i>Social center</i>	<i>R.i.= 200 m</i>
12	<i>Churches</i>	<i>R.i.= 400 m</i>
13	<i>Cinema</i>	<i>R.i.= 515 m</i>
14	<i>Theater</i>	<i>R.i.= 1000 m</i>
15	<i>Green areas</i>	<i>p=0.67 p=0.50 R.i.= 100 m</i>
16	<i>Municipal library</i>	<i>R.i.= 600 m</i>
17	<i>Sports center</i>	<i>R.i.= 1000 m</i>
18	<i>Post office</i>	<i>R.i.= 500 m</i>
19	<i>Bank</i>	<i>R.i.= 500 m</i>
20	<i>Police and Carabinieri</i>	<i>R.i.= 500 m</i>
21	<i>Supermarket</i>	<i>R.i.= 500 m</i>
FUNCTIONAL SUBSYSTEM (services of general interest)		
22	<i>Hospital</i>	<i>R.i.= 1100 m</i>
23	<i>Private Clinic</i>	<i>R.i.= 1100 m</i>
24	<i>Urban park</i>	<i>R.i.= 1000 m</i>
25	<i>Museums</i>	<i>R.i.= 1100 m</i>
26	<i>Cemetery</i>	<i>R.i.= 1100 m</i>
27	<i>Stadium</i>	<i>R.i.= 1100 m</i>

Geographic information system
GIS_Open street map

Geographic information system
GIS_Open street map

Tab. 1. Classification and parameterization of the variable set. The variables in italic are the ones that have been introduced by authors, as they are significant for the aim of the work

The 13 variables, as well as the methodology, have been applied to the municipality of Vomero and Arenella, in the central area of the city of Naples (Figure 1). The choice of this area of study is linked to two main aspects: on the one hand; the morphological, settlement and functional characteristics, whose diversification makes these districts a significant test area for the whole MOBILAGE project. For example, the hilly orographical conformation of the area (from 150 to 375 m above sea level) influences the choices of mobility and the use of spaces and services of interest for the elderly, thus representing an important element in the definition of strategies and policies aimed at improving urban accessibility. On the other hand; the municipality of Vomero and Arenella are both characterized by an older demographic structure, which percentage of the population over 60 is higher than any other municipality of Naples, equal to 34.3% (City of Naples, 2016). The ageing index, which is the synthetic indicator of the degree of population ageing (the ratio of the population aged 65 and over and the number of people younger than 15), is above 100. In particular, in 2010, this indicator amounted to 188.8% and the value rose up to 210.2% in 2016, with a growth of 21.4%, the latter percentage being higher than any other municipality of Naples (City of Naples, 2016).

The selected variables were parameterized and geolocated, in order to measure the main urban features seen as significant both in literature and in the urban planning tools to foster ageing friendly

environments/communities. This operation made use of quantitative data, compared to previous studies that used mostly qualitative ones (Gargiulo et al., 2018).

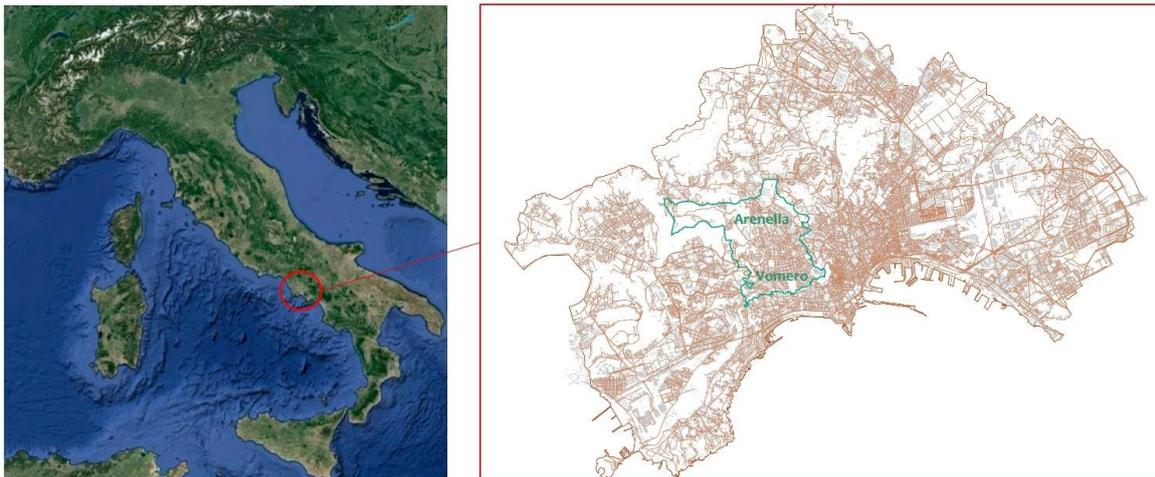
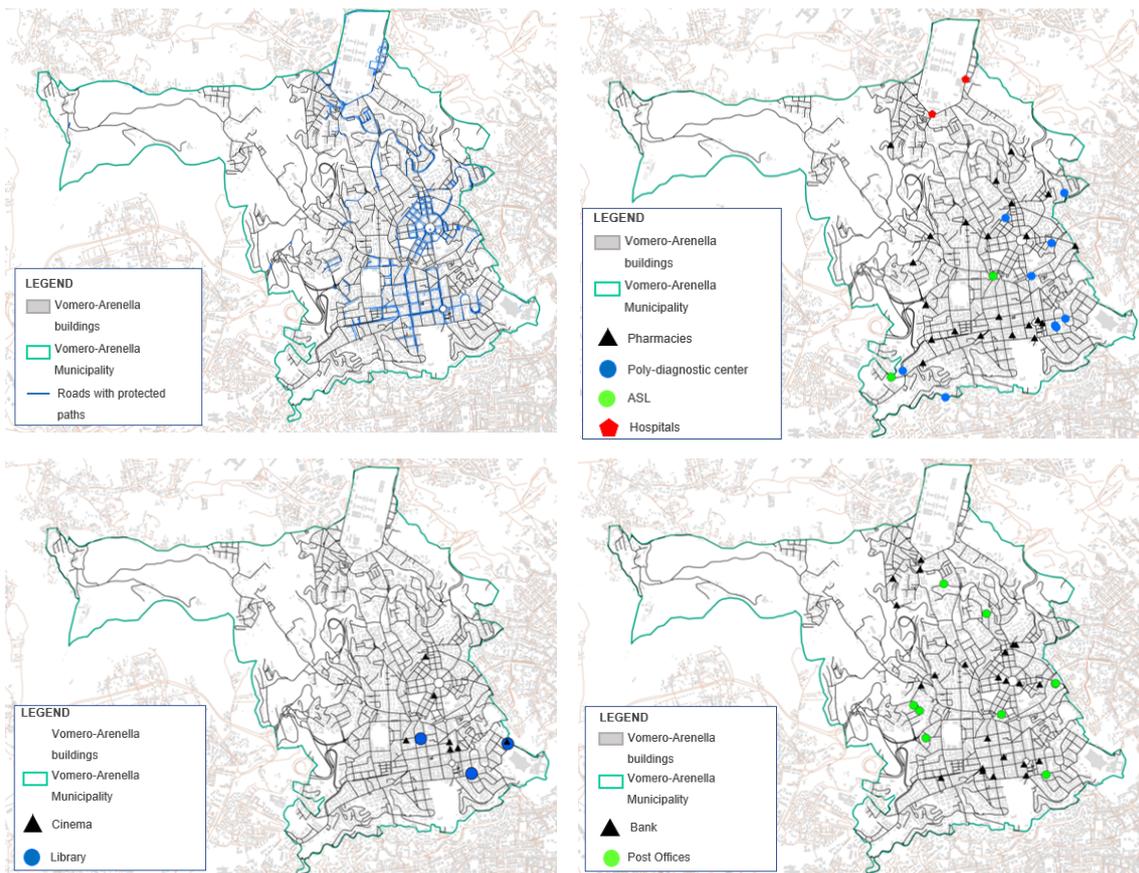


Fig. 1. The Municipality of Naples and the two districts studied

With the exception of the socio-economic subsystem - for which data are available only by consulting the databases of the National Institute of Statistics (ISTAT) - for the environmental, physical and functional subsystems quantitative data are obtained through spatial analysis in the GIS environment (Figure 2). Furthermore, all the data belong to the Open Data category, that are information collected in the form of databases by providing relevant opportunities to better design, interpret and manage the urban systems (Batty, 2012; Sui, 2014).



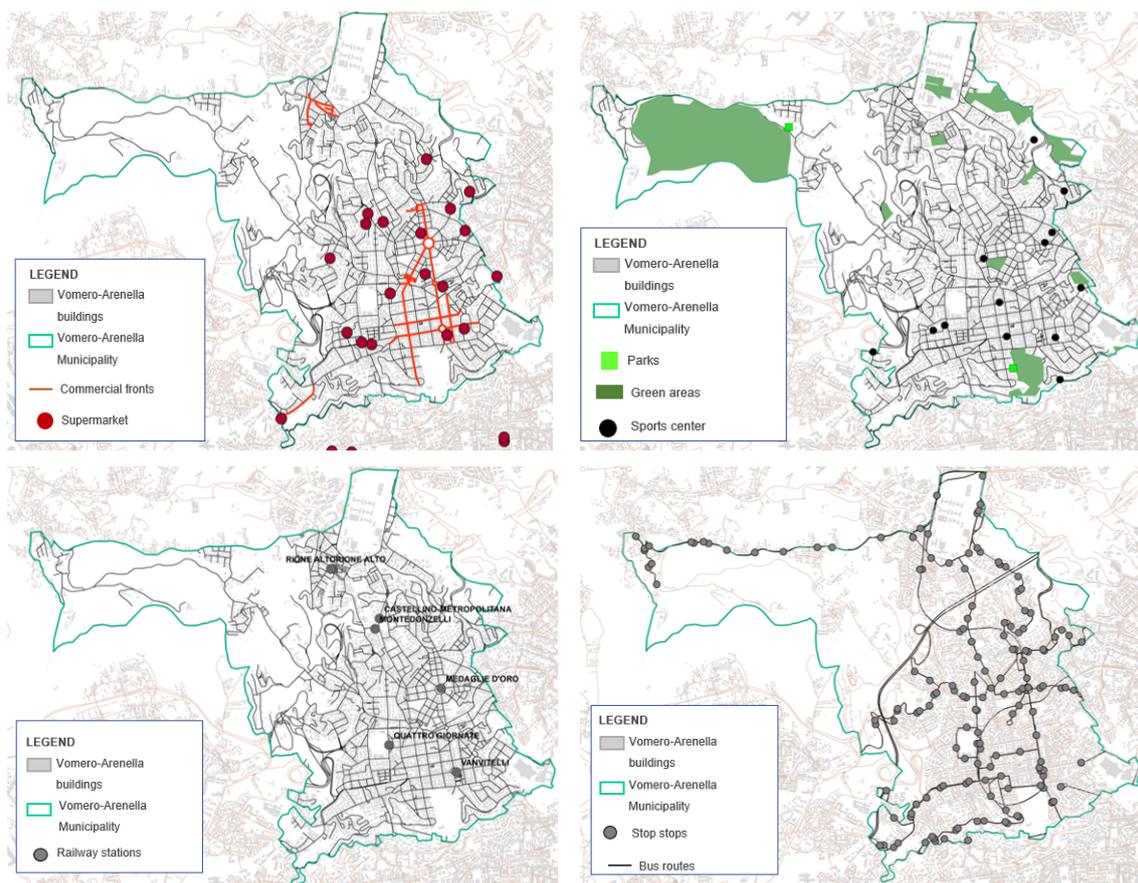


Fig. 2. Geolocalization of services of interest for the elderly and LPT supply

With regard to the physical subsystem, the variables related to the road and rail networks were geolocated by referring to the Open Data of the City of Naples, thus identifying 156 bus stops, 116 km of bus network, 6 railway stops and 1 railway line. The protected routes here are intended as the roads provided with wide sidewalks along which all the weak users can walk in safe conditions and without obstacles.

The geolocation phase of the variables of all 4 subsystems was followed by the definition of the local public transport (LPT) bus supply (Figure 2). The bus stops were classified on the basis of the service frequency of the lines which serve the study area, in order to consider the different mobility capital for the elderly.

The data of the LPT road lines were found by consulting the database of the Open Data of the City of Naples, with the respective departure and arrival times of the buses in the time slot 7:00 am - 2:00 pm. This time interval is supposedly the one in which most of the daily activities are carried out by the elderly; moreover, having a bus stop within easy walking distance favors their choice to use this mode of travel (e.g. Horgas et al., 1998; Morris et al., 2017).

The alphanumeric data collected were then associated with the related geometric elements in the GIS environment and the ones of interest were extrapolated through query operations. In particular, the following three frequency bands of the LPT bus service were determined: high frequency: < 15 minutes; medium frequency: 16-30 minutes; low frequency: > 30 minutes.

In the next step of the methodology, the service area (identifying the area where the users of that service actually reside) of each service has been defined according to the following elements: (i) the radius of influence derived from the scientific reference framework, that is the maximum pedestrian distance that a user is willing to walk to reach a specific service (Table 1), (ii) the slope of the road network determined by processing a Digital Elevation Model in the GIS environment, as this feature can contribute to reducing the distance that

elderly can walk; (iii) the walking speed that is an average value derived from the reference studies (e.g. Studenski et al., 2011; Weber, 2016) and equal to 0.7 m/s for the over 65 population.

The overlap of the "service areas" together with the concentration and distribution of each type of the services led to graduate the study area based on whether the physical and functional accessibility.

In fact, the systemization of the service areas of the LPT bus stops, classified according to the service frequency bands, and of the protected pedestrian paths led to define the following three classes of physical accessibility:

- high accessibility: when the service area of high frequency buses overlaps with the ones of the railway stations and protected routes are present in this overlay;
- medium accessibility: when the service area of medium frequency buses overlaps with the protected routes;
- low accessibility: when there are only medium/low frequency bus service areas.

An equivalent categorization led to the definition of the three classes of functional accessibility, according to the supply of each category of services considered:

- high accessibility: when at least two services are overlapped;
- medium accessibility: when there is only one service;
- low accessibility: when no service is present.

To achieve the second research objective, the research work was divided into three main phases.

In the first one, the "service areas" were deepened according to the maximum distances that the elderly can reach by walking (service distances), and to the different pedestrian speeds of the three main segments of the elderly population (65-69; 70-74; > 75) that have been identified according to studies such as Weber (2016). Thereby the functional component (services) is related to the behaviors related to each segment of the elderly population (Gargiulo et al., 2019). In the second one, the "service areas" have been redefined due to the presence of pedestrian paths with characteristics suitable for the elderly. In particular, the characteristics of pedestrian routes have been grouped into three main categories: physical characteristics, urban context characteristics and safety characteristics (Table 2).

ID	VARIABLE	MEASURE	SOURCE
PHYSICAL CHARACTERISTICS			
1	Slope of the links of the road network	>5%=0 o <5%=1	GIS
2	Sidewalk width	<1,5 m=0 >1,5m=1	Google Maps
3	State of pavement of the sidewalk	0=poor good=1	Google Maps
CHARACTERISTICS RELETED TO THE SENSE OF SECURITY			
4	Lighting density	<0,056=0 >0,056=1	GIS
5	Presence of escalators and elevators	No=0 Yes=1	Google Maps
6	Presence of parking areas	No=0 Yes =1	Google Maps
URBAN CONTEXT CHARACTERISTICS			
7	Presence of green areas	No=0 Yes =1	Google Maps
8	Presence of panoramic points	No=0 Yes =1	Google Maps
9	No-main roads	No=0 Yes =1	Google Maps

Tab. 2. The three categories of characteristics used to define the optimal pedestrian network for elderly

In the third phase, we have identified the areas that, due to the presence of useful services for the elderly, to the physical characteristics of the routes, and to the geomorphological characteristics, are compatible with lifestyles, needs and behavior of elderly people, according to their walking willingness. These areas, defined as FASZones, are, in other words, the urban partitions where the elderly are facilitated to reach the services of interest, based on their abilities (behavior) and the characteristics of usability and attractiveness of optimal pedestrian routes.

4 TESTING AND RESULTS

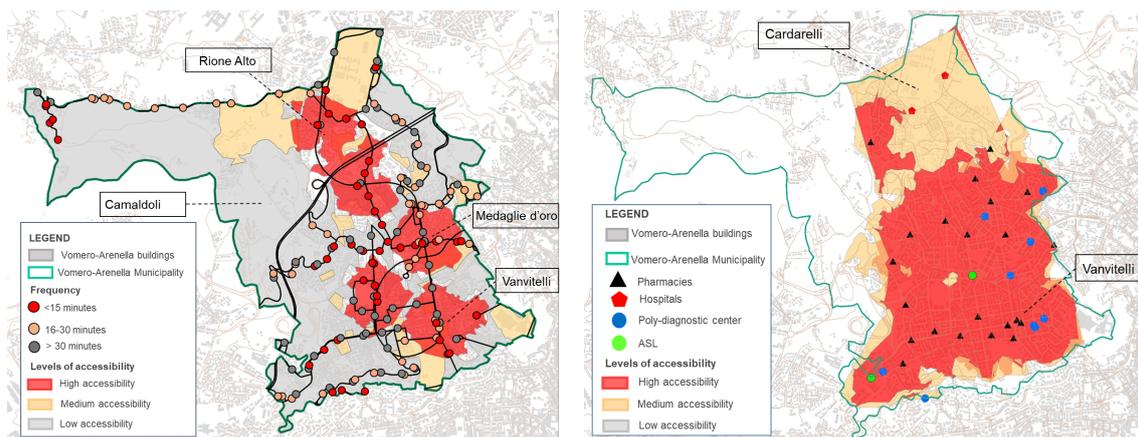
The description of the results is articulated according to the two main objectives of the work: identifying (i) the levels of urban accessibility and (ii) the Functional Accessibility Soft zones (FASZones).

With regard to the first goal, the overlay of the LPT supply and of the protected pedestrian paths (physical subsystem), on the one hand, the "service areas" and the concentration and distribution of each service of interest for the elderly (functional subsystem) on the other, led to classify the Fifth Municipality of Naples (Figure 3).

In Figure 3, it is possible to identify some macro-areas characterized by a high accessibility to LPT and protected path network in both the districts of the Fifth Municipality examined: the Arenella district, the eastern area of Camaldoli which includes the zone of Rione Alto and the contiguous areas, respectively, Domenico Fontana road and Medaglie d'Oro square, and the Vomero district, the area of Vanvitelli square and Francesco Gemito road. In all these zones, there are at least 5 high-frequency service bus stops and in particular the areas of Medaglie d'Oro and Vanvitelli squares facilitate elderly walkability thanks to the protected paths. This built environment convenience for walking is due to the urban fabric planned in the second half of the nineteenth century, with its regular road mesh and wide sidewalks.

The areas lying between Domenico Fontana and Bernardo Cavallino roads (Arenella district) and between Simone Martini and Francesco Cilea roads (Vomero district) is characterized by medium accessibility with a frequency of transport service between 16-30 minutes. In these two portions of the urban area, the improvement of the road LPT supply would allow for a more efficient connection with the nearby hospital, in the first case, and with a residential area (the one near Pigna road) located in the Vomero district, in the second case.

The remaining areas of the entire territory of the Fifth Municipality, which mostly concern the Camaldoli area near Rione Alto, the area located to the right of the hospital center and the southern area of Vomero bordering the Chiaia district, are neither served by bus frequency consistent with elderly needs, nor covered by protected paths.



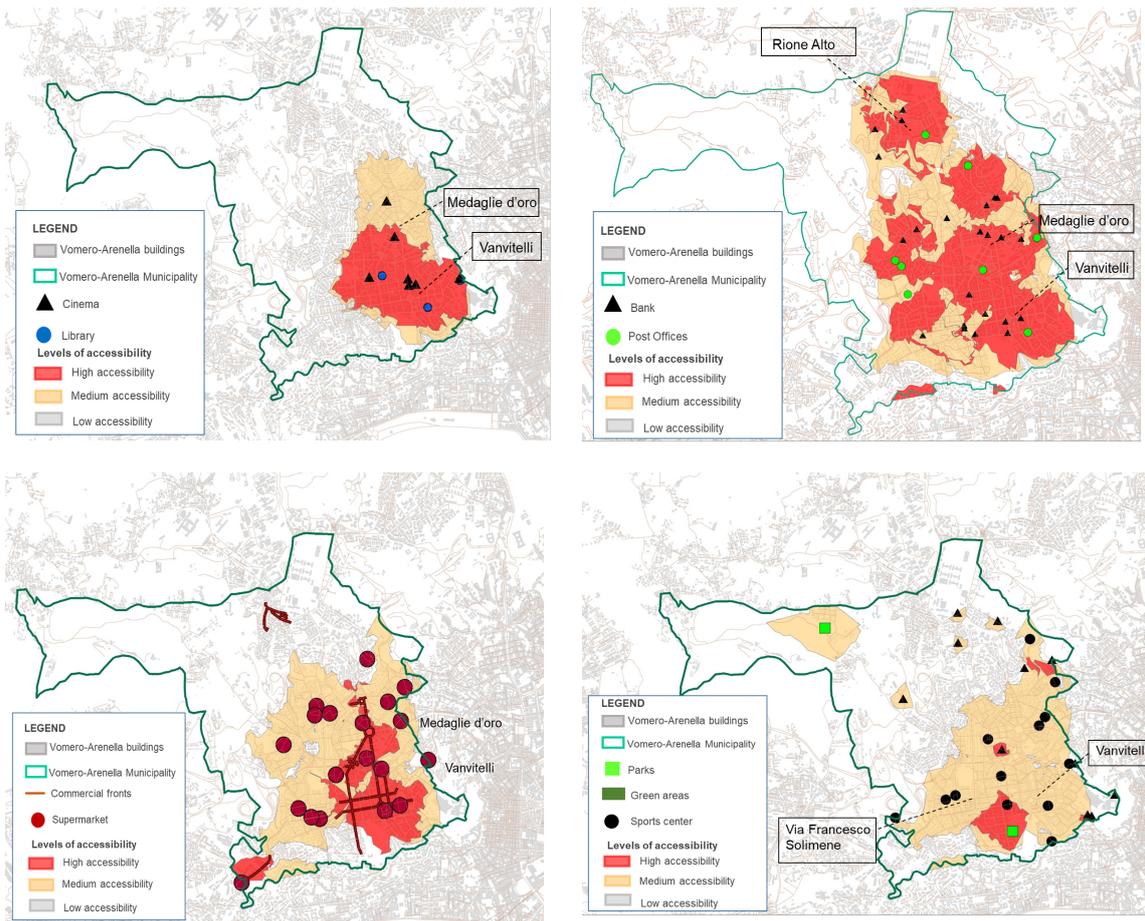


Fig. 3. Classification of the accessibility levels in Arenella and Vomero districts

With reference to the different types of services of interest for the elderly, the localization and distribution of health care services (hospitals, pharmacies, diagnostic centers and ASL) is homogeneous in those portions of urban fabric characterized by a unitary and planned design, as in the area close to the Pascale hospital center (Arenella district), the area bordering the Vomero district and almost all of the latter. Medium and low accessibility, instead, characterizes the service area of the contiguous area of the Cardarelli hospital center and the Camaldoli area.

Similar considerations apply also for financial services: their functional supply appears to satisfy the demand of most of the elderly who reside in the Fifth Municipality.

These results show that if the study area is generally characterized by a medium-high accessibility to the health and financial services, the accessibility is lacking in the commercial, cultural and recreational services. The service area of these three types of services is, in fact, almost exclusively concentrated in the area lying between Medaglie D'Oro and Vanvitelli squares, with the exception of the recreational facilities in the area between Aniello Falcone and Luca Giordano roads, where the urban park of Villa Floridiana is located. It is also worth noting that a medium accessibility also characterizes commercial and recreational services (urban park, green areas and sports facilities) in the Vomero district and in the area of the Arenella district lying between Pietro Castellino and Domenico Fontana roads, while the supply of commercial services (like supermarkets) is limited to the contiguous area between the two districts.

Taking an overall look at the six maps obtained, some "hotspots" of physical and functional accessibility characterizing the study area seem to come up: the portion of consolidated urban fabric between Medaglie d'oro and Vanvitelli squares, and the more recent areas of Francesco Solimena road and Rione Alto. In order

to investigate the demand-supply ratio in these areas characterized by high accessibility, they were compared with the distribution of the elderly population density residing in the Fifth Municipality. In practical terms, we tried to investigate the main reasons why elderly chose these areas to live, according to urban accessibility levels. As this choice depends on numerous factors relating also the desired quality of life, the comparison of density population distribution (Figure 4) with urban accessibility maps (Figure 3) have been made by setting up demographical (population density distribution), settlement (different kinds of urban textures) and real estate value aspects, in order to provide an integrated interpretation of the overall structure, highlighting its characteristic relationships.

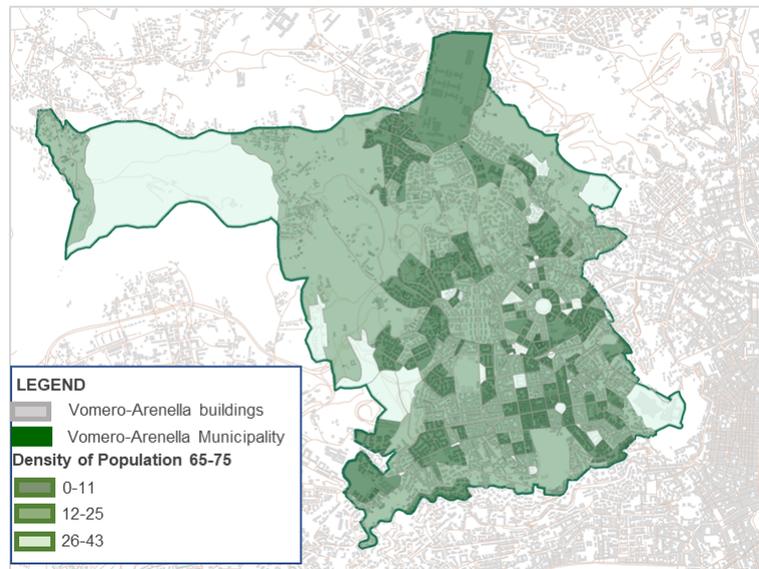


Fig. 4 Population density in Arenella and Vomero districts

The map shows that the highest population density values (about 25%) characterize the consolidated and planned portions of the urban fabric in both the Vomero and Arenella districts (Vanvitelli square, Medaglie d'Oro square, Scarlatti road). This concentration can be linked to aspects related to urban planning, as these areas are the result of an urban project aimed at improving urban quality also through the presence of services and functions compatible with residency. In fact, a diversified functional supply entails benefits in terms of accessibility (presence of several services accessible through footpaths) and also an increase in property values (as in the case of the two districts examined) because the more options there are for residents that share similar socio-economic characteristics, behaviours and lifestyles, the more they spend (Battarra et al., 2018a; Waldfogel, 2003).

The concentration of the elderly in the western part of the Arenella district (near Francesco Altamura road) can be attributed to the presence of gated communities (developed in the post-war period as unplanned building constructions) which would provide an increased sense of security and protection for this segment of the population to the detriment of low levels of accessibility both to local public transport and to cultural, recreational and commercial services.

Lastly, high density of the elderly population characterizes the area of Rione Alto, where the building process - started as a consequence of urban saturation of the "historical" areas of Vomero and Arenella - has led to a "non-uniform" improvement of the accessibility to road and railway public transport connected to the presence of the Cardarelli hospital center and also to good accessibility and financial services.

With regard to the second objective, by taking into account the results of the previous phase, the urban portions classified on the basis of physical and functional accessibility levels were compared with the FASZones. As defined in the previous sections, the FASZones have been identified within the "service areas" and are also

equipped with pedestrian paths suitable for the elderly. For this reason, the latter first ones are to be considered the areas of greatest accessibility within the "service areas", thus providing first suggestions to the public administration about the improvements to implement in the various areas. As an example, FASzones of one of the segments of the elderly population, the over 75, and for commercial and economic financial services are described.

By comparing Fig. 3 and Fig. 5, it can be seen that the "service areas" of the commercial services with high functional accessibility (in red, Fig. 3) are lack in pedestrian paths suitable for elderly. In fact, the optimal footpaths characterize only some parts of the surrounding areas of Vanvitelli square. The disparity between the functional and the physical components of urban accessibility characterizes also the economic-financial services for the area between Vanvitelli square and San Martino. From the comparison between Fig. 3 and Fig. 6, it is clear that, despite the fact that the services supply for the elderly is satisfactory, the pedestrian accessibility is lacking in a large part of the area.

Instead, for the areas of Camaldoli and Rione Alto, the comparison between Fig. 5 and Fig. 6 shows the overall significant lack of accessibility both in terms of services and pedestrian routes.

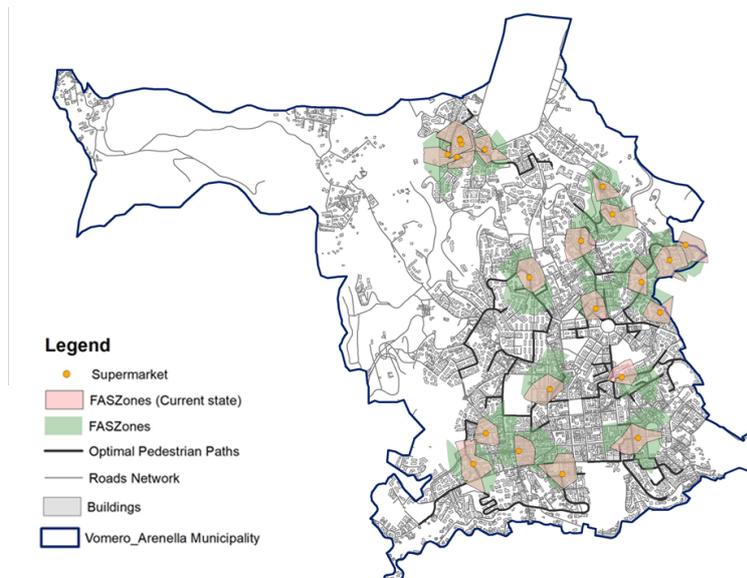


Fig. 5 FASZones of commercial services for over 75

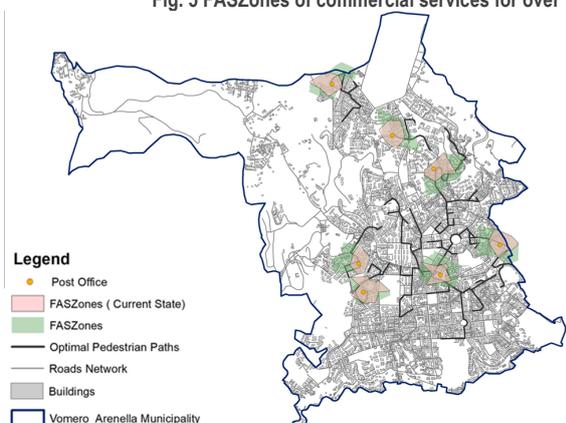
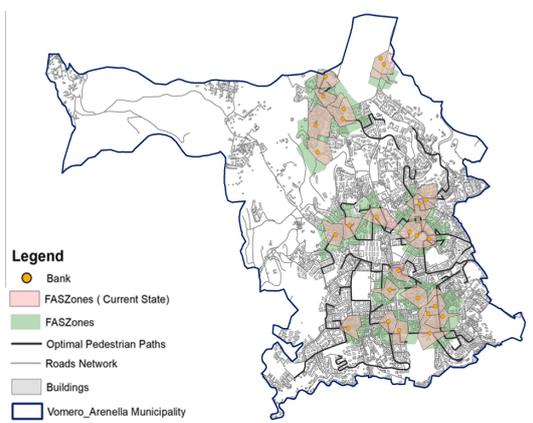


Fig. 6 FASZones of economic-financial services for over 75

5 CONCLUSIONS

This research work is a first result for the development of a decision support tool to improve urban accessibility to services of the elderly. The methodological results allowed to innovate the traditional urban planning "trade tools" by defining the "service areas" and the FASZones of services of interest for elderly. The FASZones relate the supply of main urban services to the behaviour of the older users through the suitable pedestrian network for them, according to the principles of Universal Design and the most recent theories on accessibility (Deboosere et al., 2018; Jansen et al., 2018).

The operating findings obtained show the urban portions with a supply-demand equilibrium, as well as those where it is necessary to intervene to fill this gap for elderly. For instance, the urban portions characterized by a high lack of accessibility to urban services require both areal and linear interventions, aimed respectively at increasing the supply services and improving the use of pedestrian network.

Therefore, integrated actions should be taken both on the functional and physical subsystems, in order to improve urban accessibility and guarantee social inclusion for the elderly by enabling them to actively participate in 'urban life' (Chun et al., 2018; Garin et al., 2014; Peacock-McLaughlin et al; 2018). According to Loo et al. (2017) and Wiles et al. (2009) the organization of urban spaces and services in the immediate surrounding areas near elderly's homes represent a significant element in "constituting their local activity space". In fact, a good connectivity and distribution among recreational services and 'necessary' services makes them more livable, also by promoting the sustainability of the related trips.

In this framework, if we systematize the physical and functional supply with the demand of the elderly, we can tackle the issue of urban accessibility with the systemic and performance-based approach that characterizes the governance of urban and territorial systems (Battarra et al., 2018b; Gargiulo et al., 2012).

The comparison between the urban accessibility obtained through the determination of the service areas in the GIS environment and the distribution of the elderly population density within the Fifth Municipality of the city of Naples, allows for identification of many ideas to be further investigated: (i) a more quantitative definition of accessibility levels by using indicators to be parameterized in the GIS environment; (ii) the definition of a set of punctual, linear and areal interventions to improve the distribution of urban places and services and the quality of pedestrian paths to get to them; (iii) a more detailed comparison between the real estates of the areas where the over 65 population density is high and the FASzones.

ACKNOWLEDGEMENTS

This work has been supported by Fondazione Cariplo (Grant n° 2017-0942). The authors acknowledge the financial support from the Fondazione Cariplo.

AUTHOR CONTRIBUTIONS

Although this paper should be considered a result of the common work of the authors, F. Gaglione took primary responsibility for the section 4, C. Gargiulo for the section 3, and F. Zucaro for the sections 1, 2 and 5.

REFERENCES

- Arentze, T., Timmermans, H., Jorritsma, P., Kalter, M. J. O., & Schoemakers, A. (2008). More gray hair—but for whom? Scenario-based simulations of elderly activity travel patterns in 2020. *Transportation*, 35 (5), 613-627. doi:10.1007/s11116-008-9170-z
- Battarra, R., Gargiulo, C., Tremitterra, M. R., & Zucaro, F. (2018a). Smart Mobility in Italian Metropolitan Cities: A comparative analysis through indicators and actions. *Sustainable Cities and Society*, 41, 556-567. doi: 10.1016/j.scs.2018.06.006
- Battarra, R., Zucaro, F. and Tremitterra, M.R. (2018b). Smart Mobility and Elderly People. Can ICT Make City More Accessible for Everybody? *Tema. Journal of Land Use, Mobility and Environment*, 23-42. doi:10.6092/1970-9870/5768

- Batty, M. (2012). Smart cities, big data. *Environment and Planning – Part B*, 39 (2), 191. doi: 10.1068/b3902ed
- Boudiny, K., (2012). Active ageing: from empty rhetoric to effective policy tool. *Ageing and Society*. 1–22. doi: <https://doi.org/10.1017/S0144686X1200030X>
- Bricocoli, M., Brouwer, A. E., & Gargiulo, C. (2018). Editorial Preface: Elderly Mobility. *TeMA - Journal of Land Use, Mobility and Environment*, 3-8. <https://doi.org/10.6092/1970-9870/5868>
- Broome K., Worrall L., Fleming J. & Boldy, D. (2012). Evaluation of flexible route bus transport for older people. *Transport Policy*, 21, 85-91. doi:10.1016/j.tranpol.2012.02.005
- Cheng, J., Bertolini, L., & le Clercq, F. (2007). Measuring sustainable accessibility. *Transportation research record*, (1), 16-25. doi: 10.3141/2017-03
- Chen, S., Fan, Y., Cao, Y., & Khattak, A. (2019). Assessing the relative importance of factors influencing travel happiness. *Travel Behaviour and Society*, 16, 185-191. doi: 10.1016/j.tbs.2019.01.002
- City of Naples (2016). Città al censimento 2011. Accessed 28 October 2018. Available at: <http://www.comune.napoli.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/21423>
- Chun, C., Yong, C., Li, Y., & Wei, Z. (2018). Planning for a Healthy City: The Influence of Built Environment on Elderly's Body Mass Index. *China City Planning Review*, 27 (1). ISSN: 1002-8447
- Cottrill, C., Gargiulo, C., Gaglione, F. & Zucaro, F. (2020). Defining the characteristics of walking paths to promote an active ageing. In *Pedestrians, urban spaces and health: Proceedings of the XXIV International Conference on Living and Walking in Cities (LWC 2019)*, September 12-13, 2019, Brescia, Italy. CRC Press. In press.
- Curvers, N., Pavlova, M., Hajema, K., Groot, W., & Angeli, F. (2018). Social participation among older adults (55+): Results of a survey in the region of South Limburg in the Netherlands. *Health & Social Care in the Community*, 26 (1), e85–e93. doi: 10.1111/hsc.12480
- Deboosere, R., El-Geneidy, A. M., & Levinson, D. (2018). Accessibility-oriented development. *Journal of Transport Geography*, 70, 11-20. doi: 10.1016/j.jtrangeo.2018.05.015
- EC – European Commission (2012). The 2012 Ageing Report: Economic and budgetary projections for the 27 EU Member States (2010–2060). European Commission. European Economy 2|2012. Accessed 15 December 2018. Available at: http://ec.europa.eu/economy_finance/publications/european_economy/2012/pdf/ee-2012-2_en.pdf
- Edwards, J. R., Caplan, R. D. & Harrison, R. V. (1998). Person-environment fit theory: Conceptual foundations, empirical evidence, and directions for future research, in Cooper, C.L. (Ed.), *Theories of organizational stress*, Oxford University Press, Oxford, 28-67.
- Elsawahli, H., Ahmad, F. & Shah Ali, A. (2014). *Urban Design International*, 19 249. doi: 10.1057/udi.2013.22
- EUROSTAT (2017). People in the EU - statistics on an ageing society. Accessed 18 December 2018. Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php/People_in_the_EU_-_statistics_on_an_ageing_society
- Feng, J., Tang, S., & Chuai, X. (2018). The impact of neighbourhood environments on quality of life of elderly people: Evidence from Nanjing, China. *Urban Studies*, 55 (9), 2020-2039. doi: 10.1177/0042098017702827
- Fobker, S., and Grotz, R. (2006). Everyday mobility of elderly people in different urban settings: The example of the city of Bonn, Germany. *Urban Studies*, 43(1), 99-118. doi: 10.1080/00420980500409292
- Frochen, S., Ailshire, J. & Rodnyansky, S. (2019). Residential Care in Los Angeles: evaluating the spatial distribution of facilities and neighbourhood access to care among older adults. *Local Environment*, 24 (3), 274-288, doi: 10.1080/13549839.2018.1564254
- Gargiulo, C. (2009). Sistema urbano e paradigma prestazionale. In Papa R. (ed.) *Il governo delle trasformazioni urbane e territoriali. Metodi, tecniche e strumenti*. Franco Angeli, Napoli. ISBN: 9788856811476
- Gargiulo, C. (2014). *Integrazione trasporti-territorio. Strumenti, interventi e best practices verso la Smart City*. Napoli: CLEAN Edizioni
- Gargiulo, C., Pinto, V., & Zucaro, F. (2012). City and mobility: towards an integrated approach to resolve energy problems. *TeMA - Journal of Land Use, Mobility and Environment*, 5(2), 23-54. <https://doi.org/10.6092/1970-9870/920>

Gargiulo, C., Zucaro, F., & Gaglione, F. (2018). A Set of Variables for the Elderly Accessibility in Urban Areas. *TeMA - Journal of Land Use, Mobility and Environment*, 53-66. <https://doi.org/10.6092/1970-9870/5738>

Gargiulo, C., Zucaro F. & Gaglione, F. (2019). Improving accessibility to urban services for over 65: a GIS- supported method. In C. Gargiulo & C. Zoppi (Eds.), *Planning, nature and ecosystem services* (pp. 839-850). Naples: FedOAPress. ISBN: 978-88-6887-054-6, doi: 10.6093/978-88-6887-054-6

Garin, N., Olaya, B., Miret, M., Ayuso-Mateos, J. L., Power, M., Bucciarelli, P., & Haro, J. M. (2014). Built environment and elderly population health: a comprehensive literature review. *Clinical practice and epidemiology in mental health: CP and EMH*, 10 (103). doi: 10.2174/1745017901410010103

Grzeskowiak, S., Sirgy, M. & Widgery, R. (2003). Residents' Satisfaction with Community Services: Predictors and Outcomes. *The Journal of Regional Analysis and Policy* 33(2): 1–36. doi: 10.22004/ag.econ.132251

Guagliardo, M.F. (2004). Spatial accessibility of primary care: concepts, methods and challenges. *International Journal of Health Geographics*, 3. doi: 10.1186/1476-072X-3-3

Hawkesworth, S., Silverwood, R. J., Armstrong, B., Pliakas, T., Nanchalal, K., Jefferis, B. J., ... & Casas, J. P. (2018). Investigating associations between the built environment and physical activity among older people in 20 UK towns. *J Epidemiol Community Health*, 72 (2), 121-131. doi: 10.1136/jech-2017-209440.

Henkin, N., and Zapf, J. (2006). How communities can promote civic engagement of people age 50-plus. *Generations*, 30(4), 72–77.

Hildebrand, E.D. (2003). Dimensions in elderly travel behaviour: A simplified activity-based model using lifestyle clusters, *Transportation*, 30, 285. doi: 10.1023/A:1023949330747

Horgas, A. L., Wilms, H. U., & Baltes, M. M. (1998). Daily life in very old age: Everyday activities as expression of successful living. *The Gerontologist*, 38 (5), 556-568. doi: 10.1093/geront/38.5.556

Jansen, E., Pijpers, R. & de Kam, G. (2018). Expanding Capabilities in Integrated Service Areas (ISAs) As Communities of Care: A Study of Dutch Older Adults' Narratives on the Life They Have Reason to Value, *Journal of Human Development and Capabilities*, 19 (2), 232-248, doi: 10.1080/19452829.2017.1411895

ISTAT - National Institute of Statistics. 2015. Diseguaglianze nella speranza di vita. Accessed 05 November 2018. Available at: <https://www.istat.it/it/archivio/speranza+di+vita>

Kotval, K. Z. (2017). Transit accessibility for older adults in the Greater Lansing, Michigan region, *Quality in Ageing and Older Adults*, 18(3), 175-187. doi:10.1108/QAOA-08-2016-0032

Khosravi, H., Gharai, F., & Taghavi, S. (2015). The impact of local built environment attributes on the elderly sociability. *دانشگاه علم و صنعت ایران*, 25 (1), 21-30.

Littman, T. (2017). Transit Oriented Development: Using Public Transit to Create More Accessible and Livable Neighborhoods. In TDM Encyclopedia; Victoria Transport Policy Institute: Victoria, BC, USA.

Loo B. P., Mahendran R., Katagiri K., and Lam, W. W. (2017). Walking, neighbourhood environment and quality of life among older people. *Current Opinion in Environmental Sustainability*, 25, 8-13. doi: 10.1016/j.cosust.2017.02.005

Mao, L. and Nekorchuk, D. (2013). Measuring spatial accessibility to healthcare for populations with multiple transportation modes. *Health and Place*, 24, 115-122. doi: 10.1016/j.healthplace.2013.08.008

Meshur, H. F. A. (2016). Evaluation of Urban Spaces from the Perspective of Universal Design Principles: The Case of Konya/Turkey. *Tema. Journal of Land Use, Mobility and Environment*, 9 (2), 191-208. doi: 10.6092/1970-9870/3786

Morency, C., Paez, A., Roorda, M. J., Mercado, R., & Farber, S. (2011). Distance traveled in three Canadian cities: Spatial analysis from the perspective of vulnerable population segments. *Journal of Transport Geography*, 19 (1), 39-50 doi: 10.1016/j.jtrangeo.2009.09.013.

Morris, A., Barnes, J. and Fildes, B., (2017). Challenges of using the bus as an older person. Proceedings of 23rd International Conference on Urban Transport and the Environment (ICUTE); Sept., 5-7th, Rome.

Ombuen, S. (2017). Mobilità e accessibilità: una città per tutti. *AeA Informa*, 1, 13-15. Accessed 02 November 2018. Available at: http://www.abitareanziani.it/wp-content/uploads/2017/03/AeA_Magazine_02.pdf

- Padeiro, M. (2018). Geographical accessibility to community pharmacies by the elderly in metropolitan Lisbon. *Research in social and administrative pharmacy*, 14(7), 653-662. doi: 10.1016/j.sapharm.2017.07.014
- Peacock-McLaughlin, C., Largo-Wight, E., Wlyudka, P. S., Johnson, T. M. & Merten, J. W. (2018). The built environment, transportation policy, and population health: a comparison of two cities, *Urban Research & Practice*, 11(3), 193-199, doi: 10.1080/17535069.2017.1322134
- Pinto, F., & Sufineyestani, M. (2018). Key Characteristics of an Age Friendly Neighbourhood. *TeMA - Journal of Land Use, Mobility and Environment*, 117-132. <https://doi.org/10.6092/1970-9870/5754>
- Rosenbloom, S. (2004). Mobility of the elderly: Good news and bad news. Proceedings of 27th Transportation in an Aging Society: A Decade of Experience; 3-21 March, Washington DC..
- Siu, B. W. (2019). Designing a Better Environment Through Analysing the Built Environment. In *Service-Learning for Youth Leadership* (pp. 227-247). Springer, Singapore.
- Solá, A. G., Vilhelmsen, B., & Larsson, A. (2018). Understanding sustainable accessibility in urban planning: Themes of consensus, themes of tension. *Journal of transport geography*, 70, 1-10. doi: 10.1016/j.jtrangeo.2018.05.010
- Steinfeld, E., and Maisel, J. (2012). *Universal Design: Creating Inclusive Environments*. Hoboken, NJ: John Wiley and Sons.
- Studenski, S., Perera, S., Patel, K., Rosano, C., Faulkner, K., Inzitari, M., ... & Nevitt, M. (2011). Gait speed and survival in older adults. *Jama*, 305 (1), 50-58. doi:110.1001/jama.2010.1923
- Sui, D. (2014.) Opportunities and impediments for open GIS, *Transactions in GIS*, 18, 1-24. doi: 10.1111/tgis.12075
- Szeto, W. Y., Yang, L., Wong, R. C. P., Li, Y. C., & Wong, S. C. (2017). Spatio-temporal travel characteristics of the elderly in an ageing society. *Travel Behaviour and Society*, 9, 10-20 doi: 10.1016/j.tbs.2017.07.005.
- Tao, Z., and Cheng, Y. (2018). Modelling the spatial accessibility of the elderly to healthcare services in Beijing, China. *Environment and Planning B:Urban Analytics and City Science*. doi:10.1177/2399808318755145
- Tseng, M. H. and Wu, H. C. (2018). The geographic accessibility and inequality of community-based elderly learning resources: a remodeling assessment, 2009–2017, *Educational Gerontology*, 44 (4), 226-246, doi: 10.1080/03601277.2018.1452704
- Van Cauwenberg, J., De Bourdeaudhuij, I., De Meester, F., Van Dyck, D., Salmon, J., Clarys, P., & Deforche, B. (2011). Relationship between the physical environment and physical activity in older adults: a systematic review. *Health & place*, 17(2), 458-469. doi: 10.1016/j.healthplace.2010.11.010
- Waldfogel, J. (2003). Preference Externalities: An Empirical Study of Who Benefits Whom in Differentiated-Product Markets. *The RAND Journal of Economics*, 34 (3), 557-568. doi: 10.2307/1593746
- Wang, F. (2012). Measurement, optimization and impact of healthcare accessibility: A methodological review. *Annals of the Association of American Geographers* 102, 1104–1112. doi: 10.1080/00045608.2012.657146
- Wang, F. (2015). *Quantitative Methods and Socio-Economic Applications in GIS*, 2nd ed. Boca Raton, FL: CRC Press
- Wang J., & Cao.X. (2017). Exploring built environment correlates of walking distance of transit egress in the Twin Cities. *Journal of Transport Geography*, 64, 132-138. doi: 10.1016/j.jtrangeo.2017.08.013
- Weber, D. (2016). Differences in physical aging measured by walking speed: evidence from the English Longitudinal Study of Ageing. *BMC geriatrics*, 16(1), 31. doi: 10.1186/s12877-016-0201-x
- Wiles, J. L., Allen, R. E., Palmer, A. J., Hayman, K. J., Keeling, S., & Kerse, N. (2009). Older people and their social spaces: A study of well-being and attachment to place in Aotearoa New Zealand. *Social Science & Medicine*, 68 (4), 664-671. doi: 10.1016/j.socscimed.2008.11.030
- Witten, K., Exeter, D., & Field, A., (2003). The quality of urban environments: mapping variation in access to community resources. *Urban Studies*, 40, 161–177. doi: 10.1080/00420980220080221
- Wong, R. C. P., Szeto, W. Y., Yang, L., Li, Y. C., & Wong, S. C. (2017). Elderly users' level of satisfaction with public transport services in a high-density and transit-oriented city. *Journal of Transport & Health*, 7, 209-217 doi: 10.1016/j.jth.2017.10.004.

Yuen, B. (2018). Moving towards age-inclusive public housing in Singapore, *Urban Research & Practice*, doi: 10.1080/17535069.2018.1451556

Zali, N., Rahimpour, M., Saed Benab, S., Molavi, M., & Mohammadpour, S. (2016). The distribution of public services from the perspective of sustainable spatial equality in the Tabriz Metropolitan in Iran. *TeMA - Journal of Land Use, Mobility and Environment*, 9 (3), 287-304. <https://doi.org/10.6092/1970-9870/3976>

Zhu, L., Zhong, S., Tu, W., Zheng, J., He, S., Bao, J., & Huang, C. (2019). Assessing Spatial Accessibility to Medical Resources at the Community Level in Shenzhen, China. *International journal of environmental research and public health*, 16 (2), 242. doi: 10.3390/ijerph16020242

Zang, P., Xue, C.Q.L., Lu, Y. et al. (2018). Neighbourhood adaptability for Hong Kong's ageing population. *Urban Design International*, 24 (3), 187-205. doi: 10.1057/s41289-018-0074-z

IMAGE SOURCES

Image of cover page retrieved from <https://www.gazetamonitor.com/shetitja-ne-park-ul-tensionin-e-gjakut-dhe-na-ben-me-te-lumtur/>

Fig. 1: is an elaboration of the authors

Fig. 2: is an elaboration of the authors

Fig. 3: is an elaboration of the authors

Fig. 4: is an elaboration of the authors

Fig. 5: is an elaboration of the authors

Fig. 6: is an elaboration of the authors

AUTHOR'S PROFILE

Federica Gaglione is an engineer, Ph.D. in Civil Systems Engineering at University of Naples Federico II. Her research topic concerns the urban accessibility. The aim is to develop a decision support tool that, on an urban scale, allows to choose the most effective actions to improve urban accessibility for vulnerable users, by contributing to improve their quality of life.

Carmela Gargiulo is full professor of Urban Planning Techniques at the University of Naples Federico II. Since 1987 she has been involved in studies on the management of urban and territorial transformations. Since 2004, she has been Member of the Researcher Doctorate in Hydraulic, Transport and Territorial Systems Engineering of the University of Naples "Federico II". She is Member of the Committee of the Civil, Architectural and Environmental Engineering Department of the University of Naples "Federico II". Her research interests focus on the processes of urban requalification, on relationships between urban transformations and mobility, and on the estate exploitation produced by urban transformations. On these subjects she has co-ordinated research teams within National Project such as Progetto Finalizzato Edilizia - Sottoprogetto "Processi e procedure" (Targeted Project on Building – Subproject "Processes and procedures), from 1992 to 1994; Progetto Strategico Aree Metropolitane e Ambiente, (Strategic Project Metropolitan Areas and Environment) from 1994 to 1995; PRIN project on the "Impacts of mobility policies on urban transformability, environment and property market" from 2011 to 2013. Principal investigator of the Project Smart Energy Master for the energy management of territory financed by PON 04A2_00120 R&C Axis II, from 2012 to 2015. Scientific Responsible Unit Dicea Project by Fondazione Cariplo "MOBILAGE. Mobility and aging: daily life and welfare supportive networks at the neighborhood level" 2018-2020. Scientific Responsible Unit TeMALab Dicea ERASMUS+ Key Action2: Project "Development of a Master Programme in the Management of Industrial Entrepreneurship for Transition Countries" (MIETC), partners: University of Santiago de Compostela (leading organization), University of Ljubljana, Academy of Science of Turkmenistan, Karaganda Economic University of Kazpotrebsouz. Author of more than 140 publications. Since 2008 Associate Editor of TeMA Journal of Land Use, Mobility and Environment.

Floriana Zucaro is an engineer, she received a M.Sc. in Environmental and Territorial Engineering at the University of Naples Federico II with a specialization in management of urban and territorial transformations. In April 2015 she holds a PhD in Hydraulic, Transport and Territorial Systems Engineering at the Department of Civil, Building and Environmental Engineering – University of Naples Federico II. In 2014 she was a scholarship holder within the Project Smart Energy Master for the energy management of territory financed by PON 04A2_00120 R&C Axis II, from 2012 to 2015. Her research activity was focused on the integration of land use planning and energy saving policies in urban contexts. Since 2018 she has been a research fellow on the "MOBILAGE - Mobility and aging: daily life and welfare supportive networks at the neighborhood level" project financed by Fondazione Cariplo (Grant n° 2017-0942). As part of this research, she worked on defining methods and techniques to improve urban accessibility for vulnerable users.

TeMA

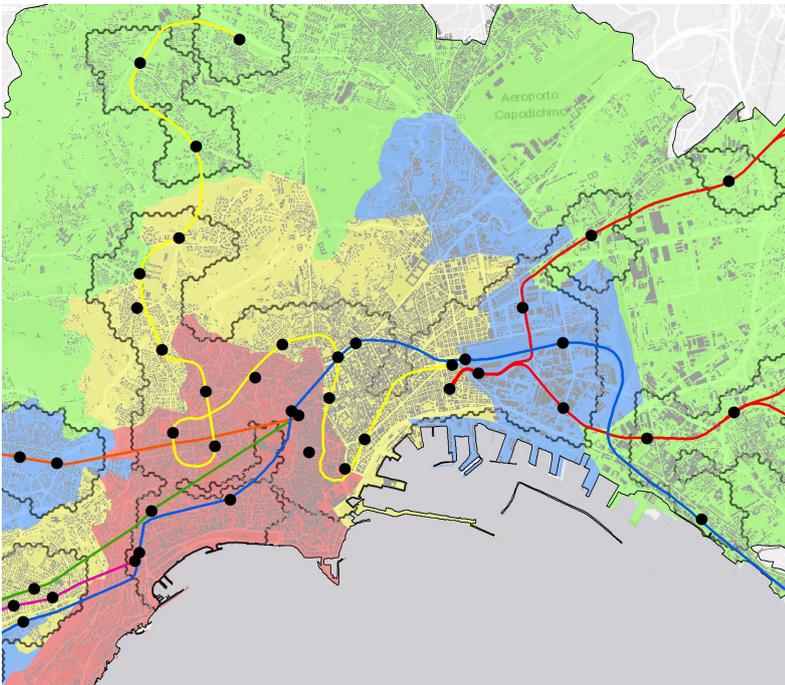
Journal of
Land Use, Mobility and Environment

TeMA 3 (2019) 313-330
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: 10.6092/1970-9870/6273

paper received 16th September 2019, accepted 19th December 2019
Licensed under the Creative Commons Attribution - 4.0 International License
www.tema.unina.it

How to cite item in APA format:

Carpentieri, G., Guida, C. & Chorus, P. (2019). Land-Use and Transport integration policies and real estate values. *Tema. Journal of Land Use, Mobility and Environment*, 12(3), 313-330. doi: <http://dx.doi.org/10.6092/1970-9870/6273>



LAND-USE AND TRANSPORT INTEGRATION POLICES AND REAL ESTATE VALUES

THE DEVELOPMENT OF A GIS METHODOLOGY AND THE
APPLICATION TO NAPLES (ITALY)

Gerardo Carpentieri^a, Carmen Guida, Paul Chorus^b

^a Department of Civil, Architectural and Environmental Engineering (DICEA)
University of Naples Federico II, Italy

^b Province Noord Holland

e-mail: {gerardo.carpentieri; carmen.guida}@unina.it; chorusp@noord-holland.nl

^a ORCID: <https://orcid.org/0000-0002-2111-650X>

ABSTRACT

The interactions between the Transport and the Land-Use Systems are complex and not widely analysed, causing uncertainties in decision-making processes. New governance tools are needed to support territorial transformations oriented to more sustainable use of soil resources, the transition towards more environmentally friendly transport modes and to greater accessibility equity to transport services. Moreover, these tools have to consider the interactions of external phenomena on the urban system, such as economic crisis and political issues. In this perspective, the research aims at developing a GIS-based methodology able to assess the impacts of interventions on the railway network and nodes on the urban environments, in terms of real estate values, as a proxy of urban requalification. The methodology consists of an ex-post spatial analysis procedure, applied to the city of Naples (Italy), where local and regional planning strategies, during the last decades, have been oriented towards an integrated approach between Transport and Land-Use Systems. The results show that in some catchment areas and concerning some types of properties, the effects of the world economic crisis on the real estate had less effect in terms of fall in prices. Moreover, the results show that the methodology is useful to quantitatively assess ex-post the main impacts of actions aimed at the integration between the Transport and Land-Use Systems, but its application could be extended to support the implementation of these strategies in different territorial context, on the basis of well-known best practices and their economic impacts on urban environment.

KEYWORDS:

Catchment Areas; Real Estate; GIS

TeMA

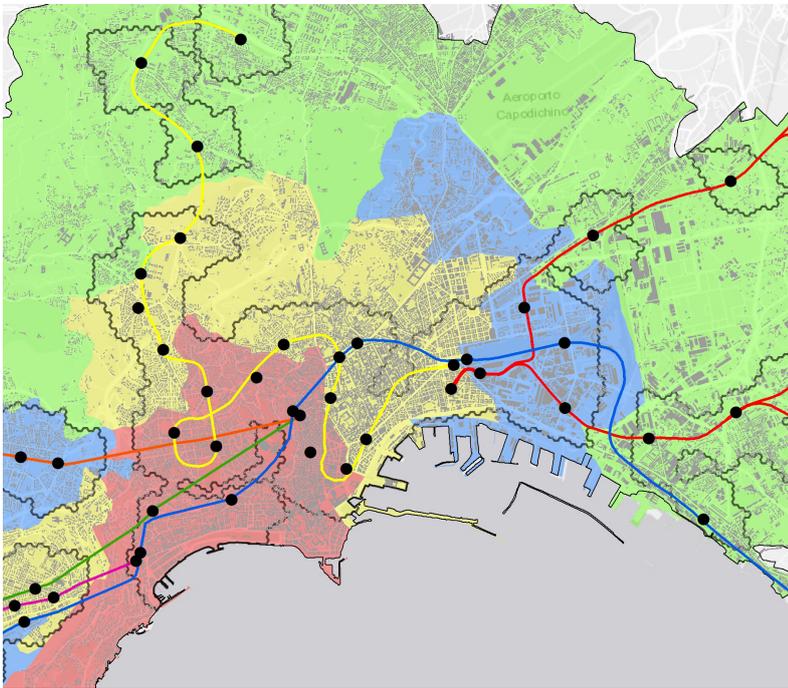
有关土地使用、交通和环境的杂志

TeMA 3 (2019) 313-330
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: 10.6092/1970-9870/6273

paper received 16th September 2019, accepted 19th December 2019
Licensed under the Creative Commons Attribution - 4.0 International License
www.tema.unina.it

How to cite item in APA format:

Carpentieri, G., Guida, C. & Chorus, P. (2019). Land-Use and Transport integration policies and real estate values. *Tema. Journal of Land Use, Mobility and Environment*, 12(3), 313-330. doi: <http://dx.doi.org/10.6092/1970-9870/6273>



老年人生活质量与城市可达性： 空间规划的方法建议

Gerardo Carpentieri^a, Carmen Guida, Paul Chorus^b

^a Department of Civil, Architectural and Environmental Engineering (DICEA)
University of Naples Federico II, Italy

^b Province Noord Holland

e-mail: {gerardo.carpentieri; carmen.guida}@unina.it; chorusp@noord-holland.nl

^a ORCID: <https://orcid.org/0000-0002-2111-650X>

摘要

人口逐渐老龄化是每个城市如今在满足相关的新承诺时必须应对的挑战。回应老年人的需求意味着要重新考虑城市空间的整治与规划，以确保老年人群对感兴趣的都市服务享有最佳的可达性和可用性。从这个角度来看，本文提供了一种根据 65 岁以上人口的流动性和城市服务水平对城市区域进行分类的方法。该方法学的目标代表了一项更广泛的研究工作的第一步，后者的目的在于确定策略、工具和行动，以便提高老年人在城市中获得服务和前往各种场所的机会。

关键词：
老年人；空间规划；市可达；城市可达性

1 INTRODUCTION

The research is part of the scientific panorama related to the Integration of Land-Use and Transport System in decision-making processes focused on the sustainability of urban areas. The relationships between spatial organization of urban systems and transport systems are complex and not widely analysed (Deboosere et al., 2018; E. Papa & Bertolini, 2015; van Wee, 2002; Wegener & Fürst, 2004). Considering the main influences between the two subsystems, many topics need further insights, such as the sustainable use of soil resource, the effects of the transition towards more environmentally friendly transport modes, the economic crisis and issues related to a greater accessibility equity to transport services (Beyazit, 2015; Coppola & Nuzzolo, 2011; Te Brömmelstroet & Bertolini, 2010).

Even though decision-makers are now aware of the imperative to implement policies able to integrate land-use and transport planning policies, in practice it is difficult to define roles and their individual contribution as well as their nonlinear interactions, considering urban planning, transport engineering, mobility planning, etc. In view of the above, it is clear how urgent the development of new approaches and tools is, in order to quantitatively analyse the interactions between mobility and land-use domains.

The aim of this study is to develop an ex-post spatial analysis procedure, GIS-based, able to quantify, in terms of real estate values, the impacts in station areas, at micro and macro level, that have been recorded as results of the redevelopment and opening of new urban railway lines and stations, as well as of the development of urban requalification and transformation actions. This result will provide decision-makers and technicians an appropriate knowledge of the evolutive dynamics, to facilitate the decision-processes about the choice of right localization for investments, according to the interest of public authorities (improve the urban spaces and infrastructures) and to attract private investors. Moreover, a second objective is to apply the methodology to the Naples case study, in order to assess its effectiveness. The choice of this context has been prompted not only by its high urban and social complexity, but also by local and regional planning strategies (Piano delle 100 stazioni) which, during the last decades, have oriented their territorial policies towards an integrated approach between Transport and Land-Use (Cascetta et al., 2013; E. Papa, Carpentieri, & Angiello, 2018; E. Papa & Pagliara, 2006).

After this introduction, the rest of the paper is organised as follows. Section 2 outlines evidence from scientific literature of the land-use and economic impacts of urban rail investments. Section 3 describes Naples as a study case, with a focus on the GIS-based methodology that was implemented. Section 4 summarises the findings and highlights some further perspectives.

2 THE LITERATURE REVIEW

During the last decades, the growth of the number of people within urban areas resulted in an increased demand of new adapted spaces. In order to satisfy this increasing settlement request, areas characterized by a low residential density, marked mono-functionality and lack of services and infrastructures have been urbanized (Brueckner, 2000). The spread of this settlement has been promoted also by the wider use of private transport modes, that allowed a greater individual mobility freedom, causing several negative impacts on community and environment (Johnson, 2001; R. Papa & Mazzeo, 2014).

Demographic, economic and location dynamics have influenced the evolution of physical and morphological structures of urban areas, with negative impacts also for actors dwelling in this kind of contexts: (i) the unsustainable use of soil and of other unrenovable resources, the input of huge quantities of pollutants which generated negative consequences, locally and globally (Travisi et al., 2010); (ii) social exclusion phenomena linked to the lack of accessibility to services and opportunities, especially for more disadvantaged walks of life (Lucas, 2012).

In order to reduce these negative effects, decision-makers, researchers and technicians are working to guide future choices related to the urban and regional framework towards new solutions, capable to ensure a greater economic, social and environmental sustainability through practices which promote the integration of land use and transport. As highlighted by the scientific literature, practices focused on an integrated development appear to be key elements to guarantee a greater equity and sustainability to urban development actions (Duncan, 2010b; E. Papa & Pagliara, 2006; Ratner & Goetz, 2013). Examples of these actions are the realization of new urban transit lines and the physical and functional upgrading of existing ones, the improvement of accessibility levels and quality of the architectural environment and the implementation of measures to optimize the use of soil (Bonotti et al., 2015; Coppola & Nuzzolo, 2011; E. Papa & Coppola, 2012). The quantitative evaluation of socio-economic impacts related to the opening or improvement of the land-use and transport integrated projects was studied by several multidisciplinary researches (Dubé et al., 2011). These studies proposed different techniques, methods and tools to evaluate the direct and indirect impacts. Great interest was focused on the evaluation of impacts surrounding the transit and land-use integrated projects considering the different territorial contexts (urban, peri-urban, rural), the temporal evaluation time (ex-post and ex-ante) and typology of transport infrastructures (rail, metro, tram and bus).

In particular, the evaluation of economic impacts in terms of variation in real estate values was considered a fundamental issue to support the planning decision of the policymakers and investors. This issue has been deeply debated in the scientific panorama and numerous case studies were analysed, which confirmed theoretically and quantitatively these statements (Duncan, 2010a; E. Papa & Pagliara, 2006; Ryan, 1999). The main approaches are based on the assumption that saving money and time for movements influences the locational behaviour of landlords, investors, firms, and house-holds (Paul & Luca, 2011). From the quantitative point of view, it has been proved that there is a direct dependency between proximity to transport nodes and the increase of real estate values (Cervero & Kang, 2011). The preliminary research that started to study the relationships between accessibility and variation in real estate values are based on the studies developed by Alonso (1964); Mills (1972); Muth (1969). In order to define the extension of catchment area where we can evaluate the changes of real estate values related to the improvement of accessibility at a micro-scale, we did not use the simple measure of Euclidian distance from the node of transport that changes with the type of transport infrastructures (Gutiérrez & García-Palomares, 2008; E. Papa, Carpentieri, & Guida, 2018). For this study, we considered that the walking distance on the road is a more correct measure to define the catchment area extension, as it is more in line with reality. According to with the indications of 100 Station Plan, we took into consideration a maximum walking distance covered in eight and half minutes.

3 METHODS AND APPLICATION

The aim of the research is to develop a GIS-based methodology that allows to quantify temporal and spatial variations due to the policy impacts within railway station (urban and metropolitan lines) catchment areas, in urban contexts.. In order to quantify the resulting impacts of integrated Land-Use and Transport strategies, in terms of real-estate values, accurate data sources were needed. Two important criteria were considered in order to ensure the replication and the accuracy of the methodology application. In particular, open access data sources were selected so that public administrations, technicians and scholars, interested in analysing these phenomena, can easily apply the methodology. This is an important point to the dissemination of the GIS-based methodology to other academic and practical contexts. Another considered criterion concerning data choice is the scale of detail: the methodology is based on a micro-scale that requires a data aggregation for small territorial units.

According to the above criteria and the scientific literature, four different indicators were selected with respect to real estate values. The selected indicators, also used in other studies, allow to carefully evaluate how

immovable property values changed in time and space, within station catchment areas, as consequences of integrated interventions (Duncan, 2010a; Pagliara & Papa, 2011; E. Papa & Bertolini, 2015; Singh et al., 2014; Soria-Lara et al., 2015). In this study four property categories were identified to assess changes in real estate values (Residential, Tertiary, Commercial and Manufacturing). Typically, in these types of analysis the alphanumeric and spatial data are selected from different sources and characterized by a different spatial aggregation scale. In order to solve these problems a hexagonal spatial unit was introduced which allows to compare time series data (Carpentieri & Favo, 2017). The regular hexagonal shape has a 50 m side and 6,495 mq surface. The use of a regular grid is a very common technical and scientific solution in spatial phenomena studies (Yigitcanlar & Dur, 2010), since it helps comparing data computed and recorded for different spatial units and in different temporal moments. The use of the regular grid has allowed to compute variations in real estate rates linked to different territorial boundaries identified by Inland Revenue (Agenzia delle Entrate). The Inland Revenue is a national non-economic public agency that operates to collect tax revenues, inspections aimed at avoiding tax evasion, provides cadastral and geo-cartographic services. The data used to compute the variation in real estate values for each hexagonal cell is provided in euros per square meter and they are the output of a methodology developed by the Italian Inland Revenue and they are shared on the Agency website every six months. Within the municipal territory, uniform territorial zones are identified (OMI zones), and for each of them and for each property category, changes in market and rental values are assessed.

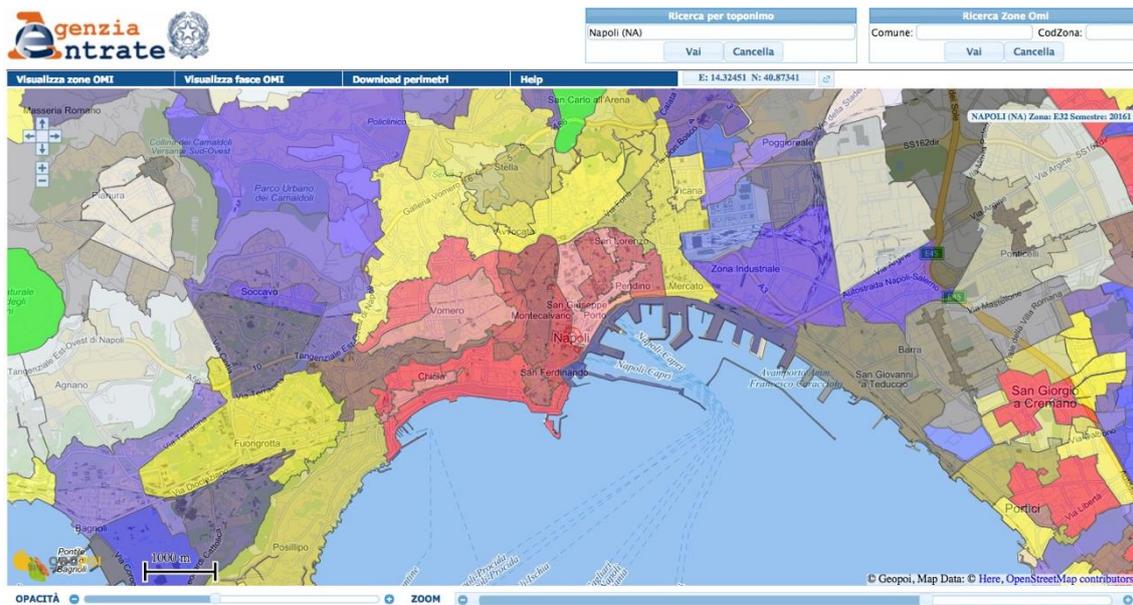


Fig. 1: Inland Revenue website page
Data provided by the Inland Revenue allowed to compute indicators for real estate values exclusively for the 2001-2011-time frame. However, in order to improve the analysis' accuracy, two other temporal moments were added i.e. 2004 and 2008. The introduction of these two additional moments permitted to better evaluate and interpret the impacts of the international economic crisis (2008), that has inevitably had an impact on real estate.

3.1 THE CASE STUDY OF NAPLES

The city of Naples was selected to apply and verify the reliability of the proposed methodology, in order to measure the real estate value impacts due to the implementation of policies aimed at integrating the Land-Use and the Transport Systems. Naples represents a significant case study to verify the GIS-based methodology's robustness, with almost 1 million inhabitants, population density of 8.273 inhab/kmq and about 500.000 of workers (ISTAT 2011). Naples is not a structured city: it is the sum of several cities, one inside the other, and balance is found through the ability to capture the new identities while keeping the well-adjusted socially static

nature (Punziano & Terracciano, 2017). Its characteristics, its shape and its history and its complexity and the clear coexistence of a variety of typical situations of degraded urban contexts, the city is a privileged laboratory in the study of urban development (Russo, 2012). The role of infrastructure is essential to manage these issues. Transport in particular, although requiring a system-wide and not a few investments, is a good basis for restarts (Gargiulo, 2008).

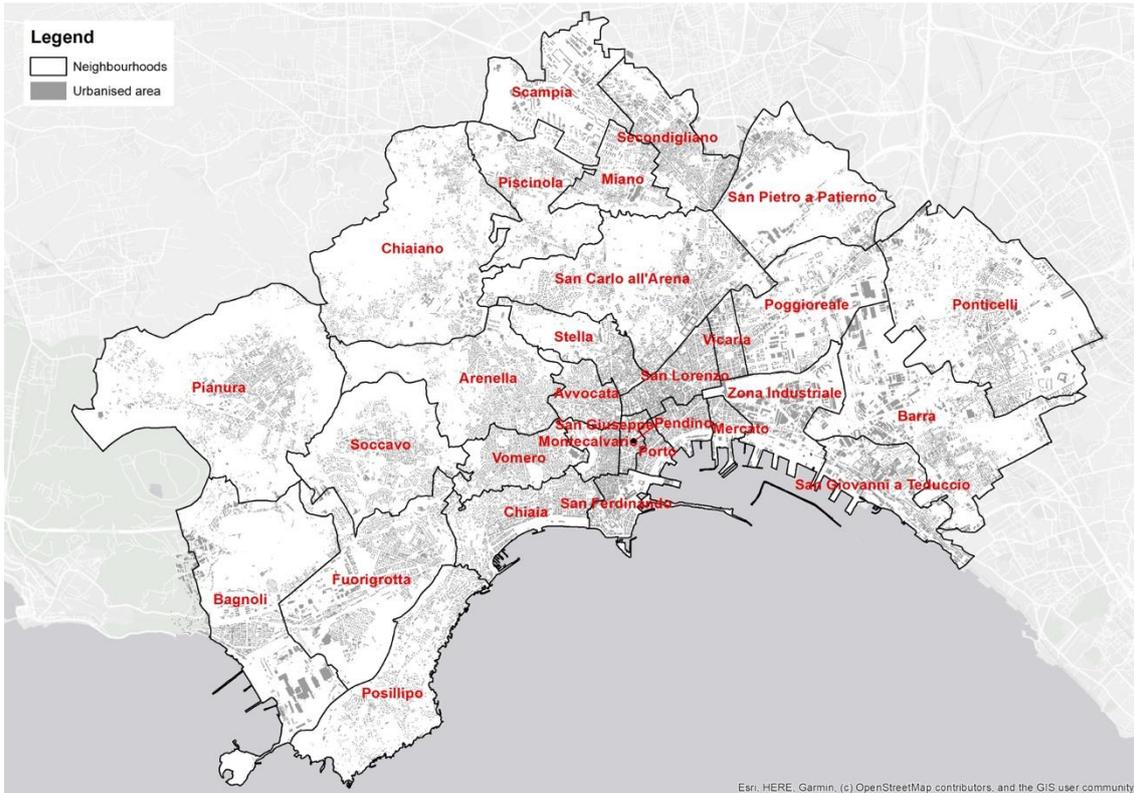


Fig. 2: The Municipal Territory of Naples, with the delimitation of each neighbourhood

A further element that influenced the choice of this case study is the knowledge of the socio-economic and settlement dynamics of the last decades (Fistola & Papa, 1998; R. Papa, 2010). This has proven extremely helpful in verifying the output of the application of the methodology. According to what is stated above, Naples is considered a good example for the implementation of integrated development policies, as demonstrated by the construction of new railway infrastructure (metro) accompanied by urban renewal interventions. The new offer of public transport services has prompted the regeneration of areas nearby transport nodes. The first programmatic document, developed by the city Municipality, was signed in 1994, and it explains the main reasons for orienting policy choices towards the integration between the Land-use and the Transport Systems. Following these general indications, in later years, the municipal administration developed further tools for the city government, such as the Municipal Transport Plan (1997), the Primary Road Network Plan (2000), the Railway Stations Plan (2003) and the Variant to the Municipal Master Plan (2004). At the same time, administrative authorities of Campania Region and Naples Metropolitan Area drafted and approved several legislative and programmatic documents, such as the Regional Law for the Mobility System Reform (2002) and the proposal of Provincial Territorial Coordination Plan (2007), that further favoured the implementation of Transport and Land-Use integration strategies. The *trait-d-union* of these documents was the will to link the transformations of urban fabric to the construction of new railway infrastructures. One of the emerging and innovative elements is the role of the public transport network which has to promote the upgrading of urban and rural areas (Cascetta & Pagliara, 2008). The whole Naples Metropolitan area has attracted large

investments concerning the building of new railway lines and modal interchange stations, thanks to this new integrated approach. This has led to an increase in urban accessibility levels, notably within stations catchment areas, promoting transformation processes that concerned large parts of the city. In the Norme di Attuazione (Implementing Rules), the new City Master Plan identifies a specific urban framework (Ambito n. 30) that includes stations as interchange nodes. These rules govern the possibility of interventions in order to allow “the greatest accessibility to the areas served , building renewal, traffic conditions and the introduction of new functions and activities that could be the engine for new commercial activities, aimed at the exploitation of interconnection places” (Comune di Napoli, 2004).

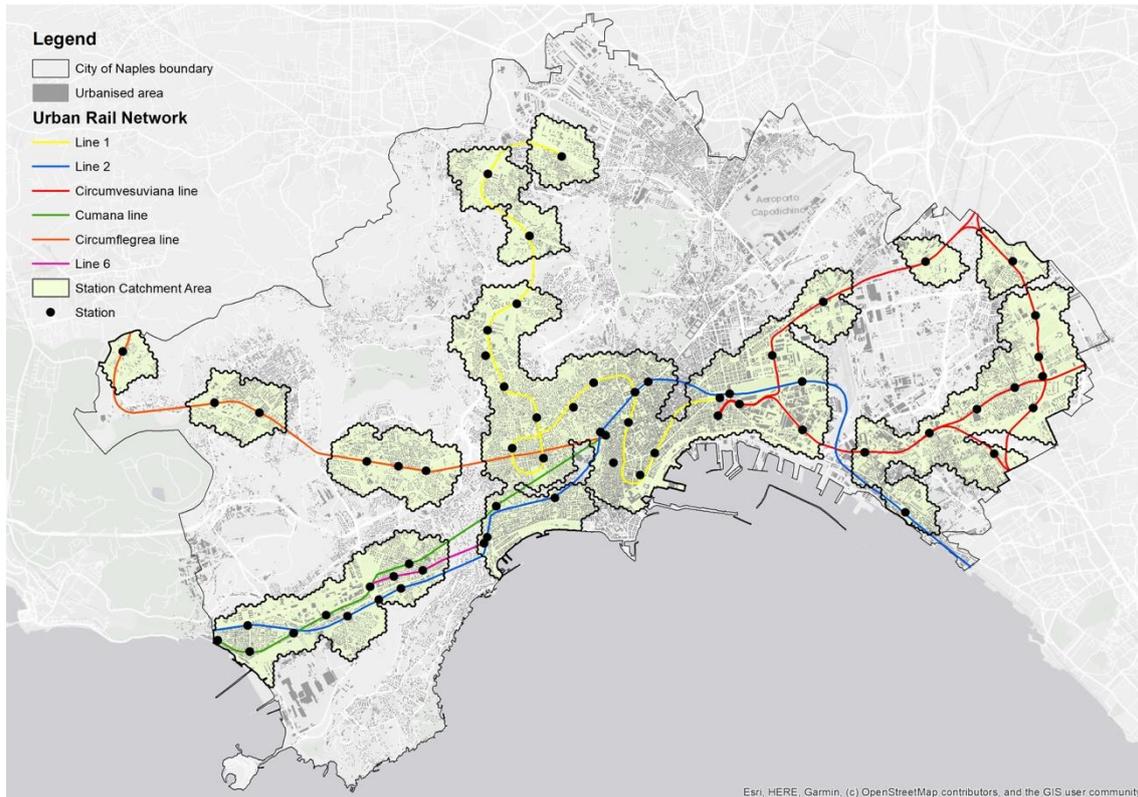


Fig. 3: Urban railway lines and stations in the city of Naples

RAILWAY LINE	NUMBER OF STATIONS	POPULATION	WORKERS	LOCAL UNITS
Line 1	18	464,594	251,487	55,823
Line 2	10	180,509	72,717	18,417
Circumvesuviana	16	162,676	71,614	13,673
Cumana	8	126,491	39,289	10,666
Circumflegrea	7	107,084	21,476	7,087
Line 6	4	70,477	24,889	7,298
Network	62	1,111,833	481,471	112,965

Tab. 1 Data referring to railway infrastructure and socio-economic characteristics, for each railway station catchment area within Naples. The data was computed from ISTAT census 2011

The main indications of the City Master Plan have been further worked out in the 100 Stations Plan, which identifies for each station its role in promoting urban redevelopment (Napoli, 2003). The principal innovation of this plan is that the renewal of urban environment is led by interventions in the railway transport network, concerning both the level of service and its building stock. The plan is focused on some significant aspects, such as the architectural and functional quality of railway stations buildings and nearby areas, that makes

these places more accessible and capable of taking new activities in. Moreover, the plan considers that not every station has the same accessibility level and that there are many contributing aspects making them distinctive from each other, such as the topography of the city, their location, the presence of infrastructure barriers, the distance to residences and, more in general, to places of interest from transport nodes (E. Papa & Trifiletti, 2010). These features mostly characterize those stations located in remote areas (architectures from 1950 and 1960, illegal (unauthorised) buildings from 1980 and 1990 or social housing), since they are distant from residences and urban facilities, and not easily accessible from the principal road network (ANCE, 2004). A key-element is the pedestrian accessibility, that is computed as the average time of access to stations, equal to eight and half minutes (Napoli, 2003). The plan describes catchment areas around railway stations and identifies several potential interventions, such as:

- Interventions on existing station buildings, in order to provide new entrances and to serve densely populated areas that suffer a steep topography, infrastructure barriers, a poor building refurbishment and renewal that should make existing constructions adequate to the mandatory removal of architectural barriers and fire safety;
- Interventions on traffic conditions around stations, through the reduction of crossings on high volume roads, the renewal of the pedestrian environment, the construction of new roads to reduce distances towards station entries;
- Third-party interventions, promoted by landlords and/or the managers of activities of public interest located in stations catchment areas, which aim at removing existing barriers to access points to the public transit network;
- Interventions to increase intramodality, through the realization of interchange parking, bus terminals for urban, rural and tourist routes.

The integrated and planned actions concern the whole municipal territory, which was divided in urban sections, as proposed by the Inland Revenue (Agenzia delle Entrate), in order to better analyse the impacts produced during last years. This territorial division was introduced by the Inland Revenue as part of studies concerning real estate values, through the detection of different areas, on the basis of their geographical location within municipal boundaries, their urban structure and the prevalent type of building (Central, Semi central, Inner Urban and Suburban zones). Figure 3(?) and table 2 show the data analysed for each urban section: the population was computed as the total number of served users, computed as the sum of the population for each cell within each station catchment area. Therefore, it is worth noting when analysing central areas there is an overlap of stations catchment areas, which are part of different railway lines. In other words, the residential population of a cell is counted twice if the cell is situated in more than one station catchment area.

URBAN ZONE	POPULATION	JOBS	WORKING UNITS
Central	204,038	84,800	26,604
Semi Central	272,387	115,458	24,186
Inner Urban	120,865	53,244	8,911
Suburban	359,570	61,488	12,444
City of Naples	956,919	314,995	72,145

Tab. 2 Data refers to 2011, for each urban section (Data processing from ISTAT 2011)

In order to verify the existence of different users' behaviours deriving from integrated actions, this study compares each indicator computed for a station catchment area with a similar type of areas outside the station catchment area.

The following paragraphs show the main results concerning indicators computed in four different temporal moments (2001, 2004, 2008, 2011), for residential, commercial, tertiary and manufacturing properties located in Naples. The first and last year correspond with the dates of the last Italian national census surveys. The

other two years are selected as intermediate time points but considering that in 2008 the global crisis of real estate started.

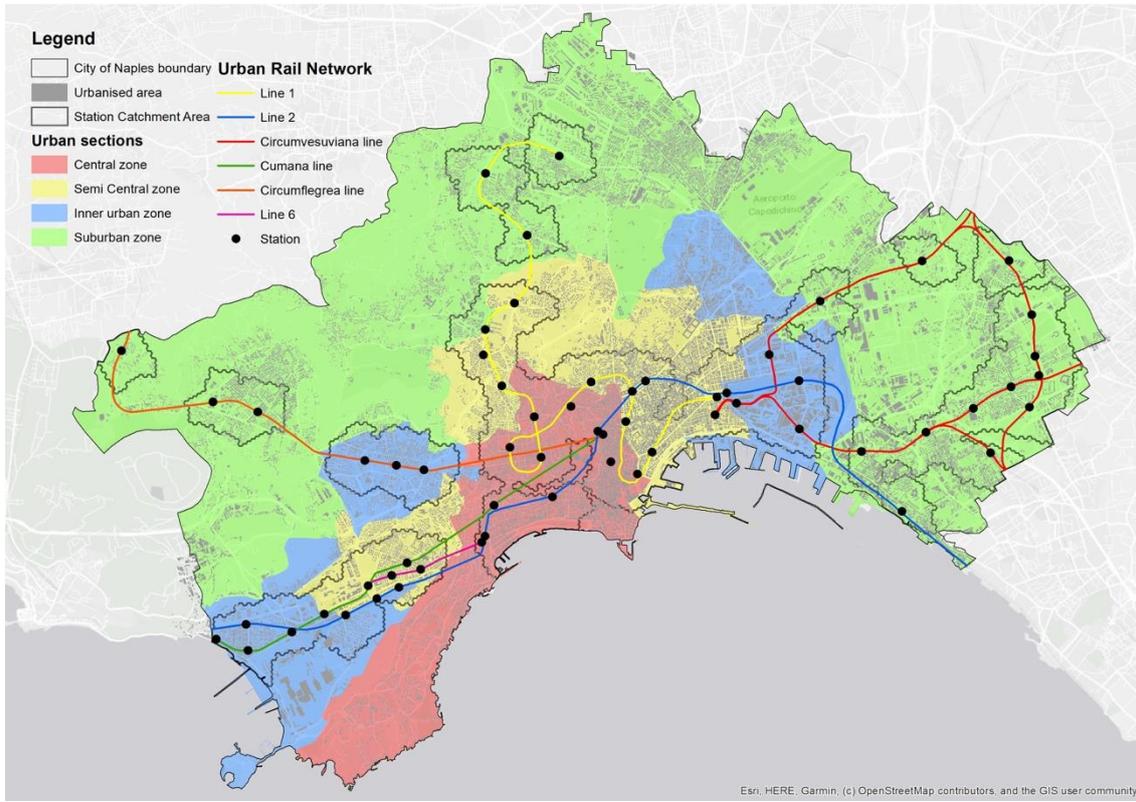


Fig. 4: Municipal division according to four urban sections identifies by the Inland Revenue

4 RESULTS AND ANALYSIS

In the following paragraphs, we present and discuss the results obtained through the application of the developed GIS-based methodology at the city of Naples for the four different category properties (Residential, Tertiary, Commercial and Manufacturing).

4.1 RESIDENTIAL PROPERTIES

This subparagraph shows the main results of the methodology applied for residential properties in Naples, with the support of tables and graphs that highlight the variation in prices of real estate, between 2001 and 2011. Analysing the values shown in Fig. 5 and Fig. 6, the trend of real estate values for each railway line is very similar to the trends recorded for the whole city. The only exceptions is the Circumvesuviana that had an upward between 2001 and 2011. Moreover, it is worth noting that values for residential properties located nearby line 1 stations recorded a greater decrease between 2008 and 2011, compared to other lines. This phenomenon is probably due to a poorer resilience to the 2008 economic crisis for these city areas. The Fig.6 shows the values for the Circumflegrea stations, and those located in General urban (Piave, Traiano and Soccavo) and Sub-urban (La Trencia, Pianura and Pisani) zones have the better performances compared to Montesanto station, which is in the central zone, according to Inland revenue classification. Tab. 3 shows that between 2008 and 2011 the only line that recorded an increase of real estate variation on prices is Circumvesuviana. For what concerns data related to the whole analysis period (2001 – 2011), it was observed that Circumflegrea shows in the residential real estate values, nineteen percentage points over the city mean. From the period 2008 to 2011 the general impact of the world economic crisis is evident, and it is related to the real estate market, whose consequences influences also this territorial context.

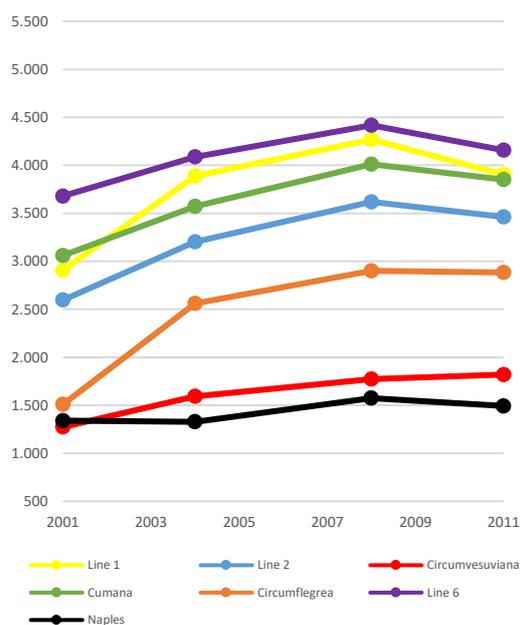


Fig. 5: Variation in Euro of residential average property values in the catchment areas for urban railway lines in the city of Naples.

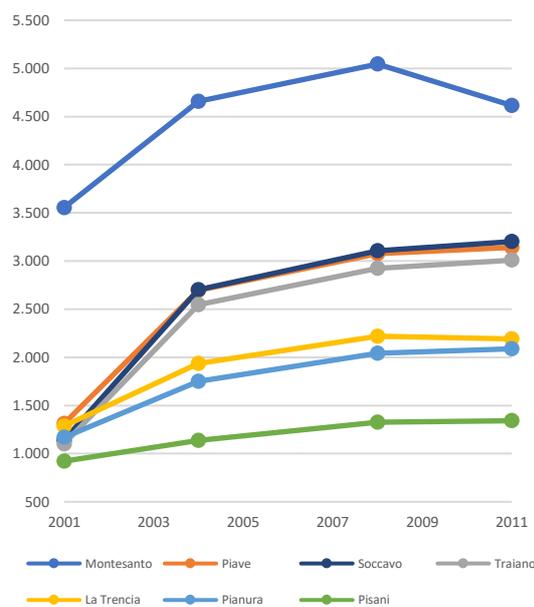


Fig. 6: Variation in Euro of residential average property values in the catchment areas for the Circumflegrea stations.

LINE	PROPERTIES VALUES [€/mq]				VARIATION [%]			
	2001	2004	2008	2011	2001-2004	2005-2008	2008-2011	2001-2011
Line 1	2,908	3,888	4,268	3,904	25%	9%	-9%	26%
Line 2	2,597	3,204	3,619	3,461	19%	11%	-5%	25%
Circumvesuviana	1,274	1,595	1,772	1,820	20%	10%	3%	30%
Cumana	3,061	3,573	4,011	3,851	14%	11%	-4%	21%
Circumflegrea	1,509	2,562	2,901	2,883	41%	12%	-1%	48%
Line 6	3,680	4,086	4,417	4,158	10%	7%	-6%	11%
City of Naples	1,768	2,299	2,563	2,473	23%	10%	-4%	29%

Tab. 3 Comparison between real estate variations in prices for each railway line, within Naples Municipality

STATION	PROPERTIES VALUES [€/mq]				VARIATION [%]			
	2001	2004	2008	2011	2001-2004	2004-2008	2008-2011	2001-2011
Botteghelle	1,087	1,489	1,687	1,733	27%	12%	3%	37%
Madonnelle	987	1,352	1,532	1,574	27%	12%	3%	37%
Argine Palasport	750	1,025	1,160	1,193	27%	12%	3%	37%
Villa Visconti	927	1,179	1,343	1,447	21%	12%	7%	36%
Vesuvio De Meis	1,082	1,331	1,520	1,672	19%	12%	9%	35%
Bartolo Longo	1,043	1,313	1,497	1,623	21%	12%	8%	36%
Officine Ponticelli	1,118	1,508	1,710	1,775	26%	12%	4%	37%
Ponticelli	1,221	1,558	1,769	1,898	22%	12%	7%	36%
Ponticelli Neighbourhood	972	1,276	1,448	1,527	24%	12%	5%	36%
Suburban zone	949	1,201	1,376	1,436	21%	13%	4%	34%

Tab. 4 Comparison between real estate variations in price, for residential properties, for some Circumflegrea stations in Ponticelli neighbourhood

More, the best performances in terms of percentage change have been seen for railway stations located in the Ponticelli neighbourhood (Tab. 4): data show that some stations had nearly double increases of real estate

values compared to others in the same neighbourhood or urban zone, within their catchment areas. These results could be explained as a consequence of an increased number of heterogeneous activities within the neighbourhood (functional mix) and of workers. Based on ISTAT census data from 2001 and 2011, population and workers density were computed for each station catchment zone and both of them respectively average increase of almost 10% and 5%, during the analysis period (2001 – 2011). These positive variations of the real estate values depend to great extent of the investments to improve the urban accessibility and by localization of some new urban important services by public authorities (e.g. Del Mare Hospital, Sports and Instruction structures). Unresolved remains the effective participation of private investors should be encouraged in this neighbourhood.

4.2 COMMERCIAL PROPERTIES

This subparagraph refers to the changes in real estate values in prices, between 2001 and 2011, for commercial properties in Naples. As is shown by the graphs and tables, it is possible to note a common decreasing trend between 2004 and 2011, for each line and for the whole city. This trend is also found when analysing the three stations of line 1 presented in Fig. 8. The last period of analysis (2008 – 2011) presented a lower reduction in percentual variations of real estate values compared to the urban centre zone. Moreover, the same stations recorded for the whole period 2001 – 2011 a successful increase of real estate values, greater than other stations of Line 1.

Looking at Tab. 5 in more detail, a 21% decrease of commercial property values may be observed for line 2, while Circumvesuviana and Cumana lines recorded a minor reduction during the observation interval. The only railway line that shows a positive change in real estate values for this property category is line 6. This positive result is influenced exclusively to the catchment area of Mergellina station that in these years becomes a place very attractive for commercial activities.

LINE	PROPERTIES VALUES [€/mq]				VARIATION [%]			
	2001	2004	2008	2011	2001-2004	2004-2008	2008-2011	2001-2011
Line 1	1,663	1,557	1,550	1,444	-7%	0%	-7%	-15%
Line 2	3,983	4,580	3,967	3,304	13%	-15%	-20%	-21%
Circumvesuviana	2,902	3,583	3,259	2,868	19%	-10%	-14%	-1%
Cumana	1,582	1,665	1,693	1,561	5%	2%	-8%	-1%
Circumflegrea	3,467	3,901	3,466	3,073	11%	-13%	-13%	-13%
Line 6	2,105	2,753	2,565	2,394	24%	-7%	-7%	12%
City of Naples	2,240	2,396	2,240	2,006	7%	-7%	-12%	-12%

Tab. 5 Comparison between commercial properties values within observation interval

The values reported in Tab. 6 shows that the commercial real estate values are negative within the line 2 station catchment areas, except for Gianturco, Piazza Amedeo and Mergellina. The results of Piazza Amedeo and Mergellina are significant since they are diametrically opposed to the performance of the urban zone where they are both located (Semi Central zone) but confirm (as the results of Line 6) that these two specific catchment areas are particularly targeted for the commercial sector.

They are characterized by a strong and high-level residential vocation and the reason for their performance in terms of commercial properties could be found in the increased number of local units, especially of luxury retail trade. For what concerns Gianturco, during the last decades, it attracted large investments to localization some large wholesale shops, since it is at the east edge of the city in the proximity of the port and highway exits. This may explain the increase of commercial properties' values around Gianturco railway station.

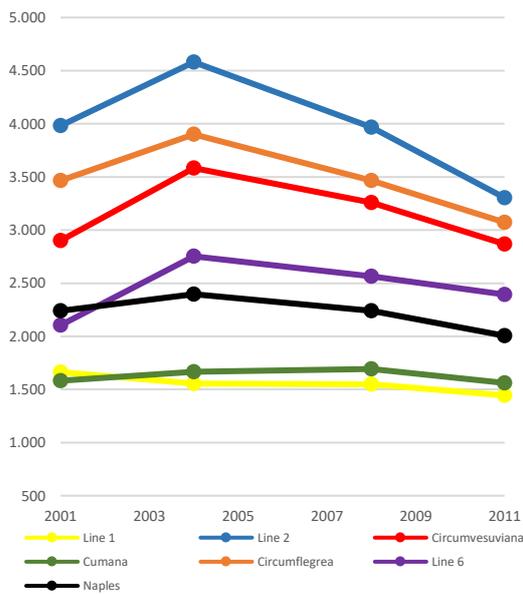


Fig. 7: Variation in Euro of commercial average property values in the catchment areas for urban railway lines in the city of Naples.

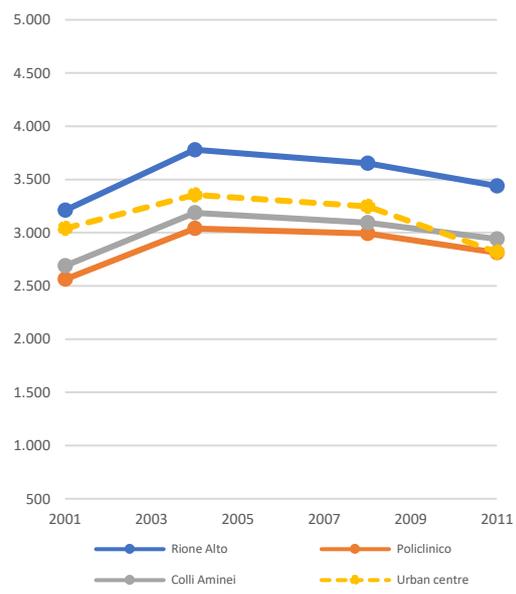


Fig. 8: Variation of commercial average property values in the catchment areas of Line 1 stations in Urban centre zone.

STATIONS	PROPERTIES VALUES [€/mq]				VARIATION [%]			
	2001	2004	2008	2011	2001-2004	2004-2008	2008-2011	2001-2011
Napoli San Giovanni Barra	1,551	1,734	1,697	1,564	11%	-2%	-9%	1%
Gianturco	1,408	1,452	1,738	1,708	3%	16%	-2%	18%
Piazza Garibaldi +	2,673	2,522	2,694	2,430	-6%	6%	-11%	-10%
Piazza Cavour +	2,898	3,298	3,123	2,569	12%	-6%	-22%	-13%
Central zone	3,040	3,356	3,247	2,816	9%	-3%	-15%	-8%
Montesanto FS +	4,185	5,190	4,538	3,856	19%	-14%	-18%	-9%
Piazza Amedeo +	2,959	6,987	5,556	4,618	58%	-26%	-20%	36%
Napoli Mergellina +	4,169	6,613	5,576	4,693	37%	-19%	-19%	11%
Semi Central zone	5,308	5,430	4,611	3,924	2%	-18%	-17%	-35%
Piazza Leopardi	3,234	3,710	3,319	3,037	13%	-12%	-9%	-6%
Napoli Campi Flegrei +	3,230	3,600	3,229	2,998	10%	-11%	-8%	-8%
Urban Center zone	3,040	3,356	3,247	2,816	9%	-3%	-15%	-8%
Cavalleggeri Aosta	2,609	3,100	2,762	2,463	16%	-12%	-12%	-6%
Bagnoli-Agnano Terme	3,728	2,817	2,699	2,483	-32%	-4%	-9%	-50%
Inner Urban Zone	1,726	1,838	1,806	1,708	6%	-2%	-6%	-1%

Note: + Interchange Stations.

Tab. 6 Comparison between commercial properties values for some line 2 stations

4.3 TERTIARY PROPERTIES

This subparagraph is dedicated to the changes in real estate values, between 2001 and 2011, for tertiary real estate in Naples, properties used to service activities for businesses and people, such as professional offices and to private facilities such as clinics, schools and training centres (D.Lgs. 1150/1942 – Legge Urbanistica). Tab. 7 shows the results of the methodology highlighting a significant increase in prices of tertiary properties between 2001 and 2011, but, focusing on 2008-2011 period, the economic crisis had impacts on this category for nearly every line and within the whole city with a significant decrease. However, Circumvesuviana and Circumflegrea recorded a better presentation than the other lines because these peripheral areas became

more attractive for the tertiary activities considering the low real estate value compared to the central areas and the improvement of urban accessibility.

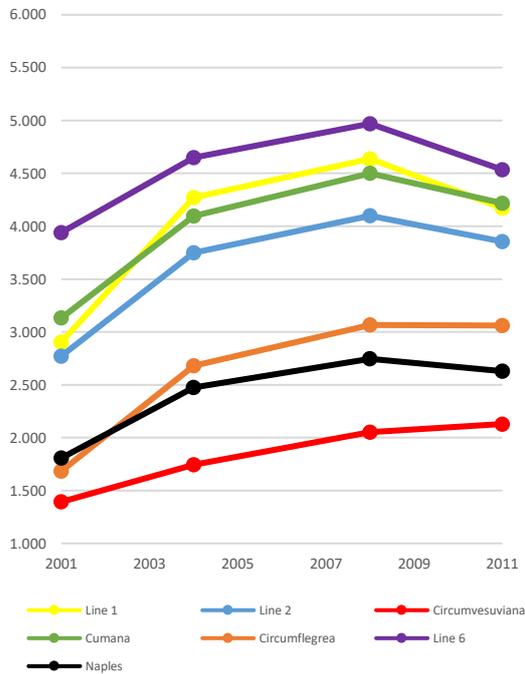


Fig. 9: Variation in Euro of tertiary average property values in the catchment areas for urban railway lines in the city of Naples.

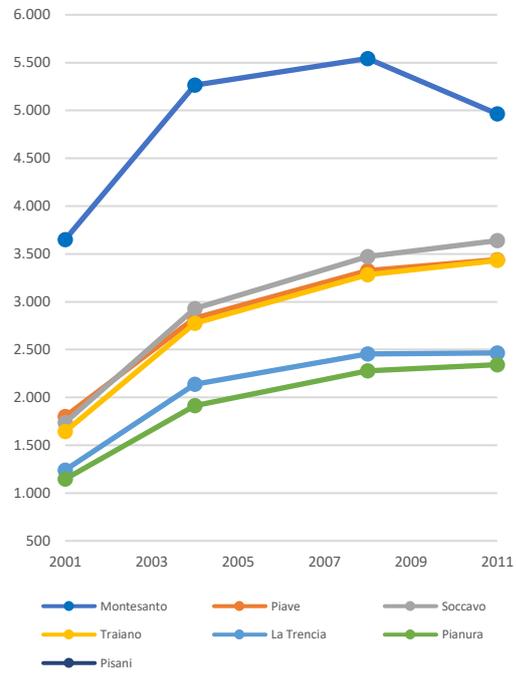


Fig. 10: Variation in Euro of tertiary average property values in the catchment areas of Circumflegrea line.

Tab. 7 shows in more detail the results of the methodology and it is worth noting that line 1 and line 6 recorded the greatest reduction in prices between 2008 and 2011. As stated above, Circumvesuviana is the only line whose stations catchment area have seen an increase between 2008 and 2011.

LINE	PROPERTIES VALUES [€/mq]				VARIATION [%]			
	2001	2004	2008	2011	2001-2004	2004-2008	2008-2011	2001-2011
Line 1	2,905	4,272	4,637	4,171	32%	8%	-11%	30%
Line 2	2,772	3,749	4,099	3,856	26%	9%	-6%	28%
Circumvesuviana	1,393	1,745	2,051	2,129	20%	15%	4%	35%
Cumana	3,132	4,097	4,500	4,217	24%	9%	-7%	26%
Circumflegrea	1,684	2,682	3,066	3,062	37%	13%	0%	45%
Line 6	3,941	4,649	4,970	4,534	15%	6%	-10%	13%
City of Naples	1,807	2,474	2,745	2,628	27%	10%	-4%	31%

Tab. 7 Comparison between tertiary properties values within observation interval

Napoli Porta Nolana and Garibaldi EAV are the only Circumvesuviana stations that recorder a negative variation in tertiary properties' prices after the 2008 world economic crisis, and they are the only stations located in Semi-Central zone (Tab.8). This negative effect may be explained as a consequence of economic crisis and the consecutive bank close: the most widespread tertiary activities in Napoli Porta Nolana and Garibaldi EAV catchment areas are banking services. All the suburban stations, apart from Poggioreale, recorder higher values that the average for that urban section.

STATION	PROPERTIES VALUES [€/mq]				VARIATION [%]			
	2001	2004	2008	2011	2001-2004	2004-2008	2008-2011	2001-2011
Napoli Porta Nolana	2,823	3,309	3,694	3,404	15%	10%	-9%	17%
Garibaldi EAV +	2,178	2,499	2,888	2,825	13%	13%	-2%	23%
Semi Central Zone	2,922	3,597	3,949	3,610	19%	9%	-9%	19%
Via Gianturco	1,618	1,683	1,992	2,190	4%	16%	9%	26%
Centro Direzionale	2,172	2,735	3,209	3,280	21%	15%	2%	34%
Inner Urban Zone	1,412	1,918	2,248	2,309	26%	15%	3%	39%
San Giovanni a Teduccio	1,266	1,739	2,117	2,233	27%	18%	5%	43%
Barra	1,210	1,663	1,996	2,069	27%	17%	4%	42%
Santa Maria del Pozzo	1,151	1,581	1,915	1,990	27%	17%	4%	42%
Poggioreale	1,816	1,867	1,824	2,010	3%	-2%	9%	10%
Botteghele	1,127	1,547	1,888	1,966	27%	18%	4%	43%
Madonnelle	1,024	1,405	1,714	1,785	27%	18%	4%	43%
Argine Palasport	777	1,066	1,300	1,354	27%	18%	4%	43%
Villa Visconti	931	1,241	1,506	1,610	25%	18%	6%	42%
Vesuvio De Meis	1,072	1,409	1,706	1,845	24%	17%	8%	42%
Bartolo Longo	1,043	1,384	1,679	1,801	25%	18%	7%	42%
Officine Ponticelli	1,152	1,571	1,915	2,006	27%	18%	5%	43%
Ponticelli	1,227	1,638	1,987	2,117	25%	18%	6%	42%
Suburban Zone	924	1,215	1,434	1,500	24%	15%	4%	38%

Note: + Interchange stations.

Tab. 8 Comparison between tertiary properties values within observation interval, for Circumvesuviana stations

4.4 MANUFACTURING PROPERTIES

This paragraph analyses the main results of the methodology applied for manufacturing properties in Naples, within railway station catchment areas and their changes in prices between 2001 and 2011.

LINE	PROPERTIES VALUES [€/mq]				VARIATION [%]			
	2001	2004	2008	2011	2001-2004	2004-2008	2008-2011	2001-2011
Line 1	2,563	2,670	3,084	2,745	4%	13%	-12%	7%
Line 2	1,610	2,003	2,412	2,168	20%	17%	-11%	26%
Circumvesuviana	800	813	1,088	1,095	2%	25%	1%	27%
Cumana	1,589	2,085	2,311	2,167	24%	10%	-7%	27%
Circumflegrea	1,176	1,382	1,630	1,686	15%	15%	3%	30%
Line 6	1,970	2,139	2,361	2,292	8%	9%	-3%	14%
City of Naples	1,340	1,328	1,575	1,492	-1%	16%	-6%	10%

Tab. 9 Comparison between manufacturing properties values within observation interval

The average values of Tab. 9 and Fig. 11 show that stations of Line 2, Circumvesuviana, Cumana and Circumflegrea recorded a high increase when compared to other stations. Analysing the values for each station showed significantly increased for the stations localized in the periphery areas (Inner urban zone and Suburban zone) that are become more adequate for this category of activities (more accessibility and transformable areas). In the last temporal interval, 2008-2011, Circumvesuviana confirmed as the line that is the least affected by the impacts of the economic crisis as in the other categories of properties.

According to Fig. 12, line 1 stations in semi central urban sections, in the last observation period, are characterized by an even higher increase compared to other stations in the same urban section. Analysing data from Tab. 9, manufacturing properties recorded significant increases for all lines, with the exception of

line 1 that only increase of 7%. This result is mainly influenced by the conformation of urban structure around the station nodes is not adequate for this type of activity. Looking at Tab.10 it is worth noting that those Circumvesuviana stations located in peripheral sections, for this real estate category, had better performances rather than central stations. Moreover, for almost all stations, the values of manufacturing properties are higher than the average value of each urban section.

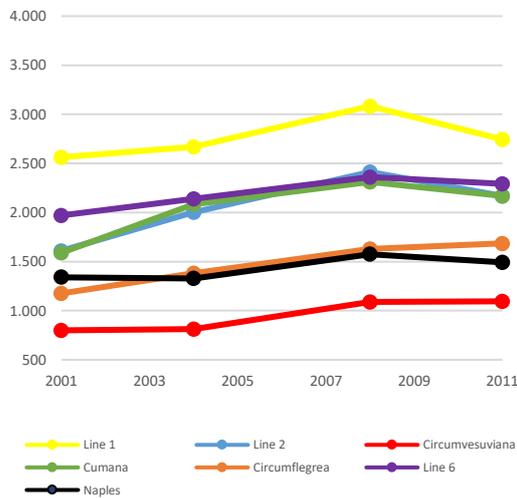


Fig. 11: Variation in Euro of manufacturing average property values in the catchment areas for urban railway lines in the city of Naples.

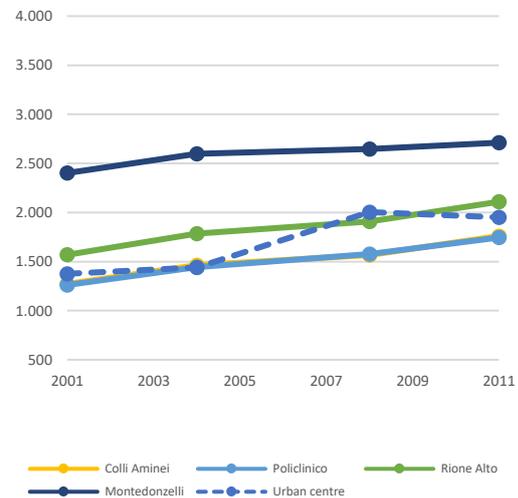


Fig. 12: Variation in Euro of manufacturing average property values in the catchment areas of Line 1 stations in Urban centre zone.

STATION	PROPERTIES VALUES [€/mq]				VARIATION [%]			
	2001	2004	2008	2011	2001-2004	2004-2008	2008-2011	2001-2011
Montesanto +	3,359	3,569	4,080	3,547	6%	13%	-15%	5%
Corso Vittorio Emanuele	3,289	5,755	6,151	4,819	43%	6%	-28%	32%
Central zone	4,399	3,888	4,175	3,514	-13%	7%	-19%	-25%
Fuorigrotta	1,683	1,723	1,919	2,052	2%	10%	6%	18%
Mostra +	1,522	1,526	1,672	1,844	0%	9%	9%	17%
Zoo-Edenlandia	986	1,376	1,518	1,552	28%	9%	2%	36%
Semi Central zone	1,376	1,441	2,004	1,952	5%	28%	-3%	30%
Agnano	582	1,163	1,300	1,302	50%	11%	0%	55%
Bagnoli	578	1,018	1,141	1,173	43%	11%	3%	51%
Dazio	641	1,193	1,403	1,432	46%	15%	2%	55%
Inner Urban zone	705	870	1,017	1,079	19%	14%	6%	35%

Note: + Interchange stations.

Tab. 10 Comparison between manufacturing properties values within observation interval, for Circumflegrea stations

5 CONCLUSIONS

This study concerns the development of an ex-post methodology useful to quantify the impacts of Transit-Oriented policies on the Land-Use System: the mutual interactions between the two systems make it difficult to quantify their social, economic and territorial effects in the government of territorial transformation process. The city of Naples represents an interesting case study considering the implementation of several tools developed by the local administrations (municipality, provincial and regional) in order to improve the quality of both the level of public transport service and the urban environment. The results presented in this paper further support the scientific assumption whereby the introduction of rail transit investment brings benefits to

the transportation system and to the accessibility of the population to employment, retail, and recreational activities (Pagliara & Papa, 2011). Similarly, the main results also confirm the policy strategy and objective: increase the accessibility to rail transit nodes, improving architectural and urbanistic quality of built environment within station buildings and their catchment areas. The municipal administration also aims at reducing the environmental damage of the rail infrastructure and its neighbourhoods (Napoli, 2003). This study is focused on the impacts on real estate values around transit nodes and within their catchment areas, but still points of reflection could be studied such as the impacts in social, generational and gender equity, safety and security perceptions. The results for the city of Naples showed that in some catchment areas and for some types of properties the effects of the world economic crisis of real estate had less effect in terms of reduction of the prices. Moreover, the results show that the methodology is useful to quantitatively assess ex-post the main impacts of actions aimed at the integration between the Transport and Land-Use Systems, but its application could be extended to support the implementation of these strategies in different territorial context, on the basis of well-known best practices and their economic impacts on urban environment. This study could be further developed by extending the analysis period and including more recent data, in order to quantify the impacts of 2008 global crisis on real estate values over the years. Moreover, different indicators may be selected to assess and quantify the main impacts of integrated transport and land-use policies on the urban environment: increased accessibility and employment, as two examples of improvement of quality of life within transport node catchment areas.

AUTHOR CONTRIBUTIONS

Paragraph 1, 3 and 4, Gerardo Carpentieri; Paragraph 2, 3 and 5 Carmen Guida; Paul Chorus has made substantial contributions to the essay's improvement, design, and conclusions.

REFERENCES

- Alonso, W. (1964). *Location and land use. Toward a general theory of land rent*. Cambridge, Mass.: Harvard Univ. Pr.
- Beyazit, E. (2015). Are wider economic impacts of transport infrastructures always beneficial? Impacts of the Istanbul Metro on the generation of spatio-economic inequalities. *Journal of Transport Geography*, 45, 12-23. Retrieved from <http://www.sciencedirect.com/science/article/pii/S0966692315000496>. doi:<https://doi.org/10.1016/j.jtrangeo.2015.03.009>
- Bonotti, R., Rossetti, S., Tiboni, M., & Tira, M. (2015). Analysing Space-Time Accessibility Towards the Implementation of the Light Rail System: The Case Study of Brescia. *Planning Practice & Research*, 30(4), 424-442. doi:<https://doi.org/10.1080/02697459.2015.1028254>
- Brueckner, J. K. (2000). Urban sprawl: diagnosis and remedies. *International regional science review*, 23(2), 160-171. doi:<https://doi.org/10.1177/016001700761012710>
- Carpentieri, G., & Favo, F. (2017). The End-use Electric Energy Consumption in Urban Areas: A GIS-based methodology. An application in the city of Naples. *Tema. Journal of Land Use, Mobility and Environment*, 10(2), 139-156. doi:<https://doi.org/10.6092/1970-9870/5173>
- Cascetta, E., Cartenì, A., & Carbone, A. (2013). The quality in public transportation. The Campania regional metro system. *Ingegneria Ferroviaria*, 68(3), 241-261.
- Cascetta, E., & Pagliara, F. (2008). Integrated railways-based policies: the Regional Metro System (RMS) project of Naples and Campania. *Transport Policy*, 15 (2), 81-93. doi:<https://doi.org/10.1016/j.tranpol.2007.11.001>
- Cervero, R., & Kang, C. D. (2011). Bus rapid transit impacts on land uses and land values in Seoul, Korea. *Transport Policy*, 18 (1), 102-116. doi:<http://dx.doi.org/10.1016/j.tranpol.2010.06.005>

Papa, R., & Mazzeo, G. (2014). *Characteristics of Sprawl in the Naples Metropolitan Area. Indications for Controlling and Monitoring Urban Transformations*. Paper presented at the International Conference on Computational Science and Its Applications.

Paul, C., & Luca, B. (2011). An application of the node-place model to explore the spatial development dynamics of station areas in Tokyo. *Journal of Transport and Land Use*, 4 (1). Retrieved from <https://jtlu.org/index.php/jtlu/article/view/145>. doi:10.5198/jtlu.v4i1.145

Punziano, G., & Terracciano, A. (2017). Urban Voids: renewal and regeneration experiences in Naples. *TeMA Journal of Land Use, Mobility and Environment*, 10 (3), 299-323. doi:<https://doi.org/10.6092/1970-9870/5171>

Ratner, K. A., & Goetz, A. R. (2013). The reshaping of land use and urban form in Denver through transit-oriented development. *Cities*, 30, 31-46. doi:<https://doi.org/10.1016/j.cities.2012.08.007>

Russo, M. (2012). *The experience as a project: to know the East area of Naples*.

Ryan, S. (1999). Property values and transportation facilities: finding the transportation-land use connection. *Journal of planning literature*, 13 (4), 412-427. doi:<https://doi.org/10.1177/08854129922092487>

Singh, Y. J., Fard, P., Zuidgeest, M., Brussel, M., & van Maarseveen, M. (2014). Measuring transit oriented development: a spatial multi criteria assessment approach for the City Region Arnhem and Nijmegen. *Journal of Transport Geography*, 35, 130-143. doi:<https://doi.org/10.1016/j.jtrangeo.2015.07.003>

Soria-Lara, J. A., Valenzuela-Montes, L. M., & Pinho, P. (2015). Using 'Mobility Environments' in Practice: Lessons from a Metropolitan Transit Corridor in Spain. *Journal of Environmental Policy & Planning*, 17 (5), 553-572. doi:<https://doi.org/10.1080/1523908X.2014.991779>

Te Brömmelstroet, M., & Bertolini, L. (2010). Integrating land use and transport knowledge in strategy-making. *Transportation*, 37 (1), 85-104. doi:<https://doi.org/10.1007/s11116-009-9221-0>

Travisi, C. M., Camagni, R., & Nijkamp, P. (2010). Impacts of urban sprawl and commuting: a modelling study for Italy. *Journal of Transport Geography*, 18 (3), 382-392.

van Wee, B. (2002). Land use and transport: research and policy challenges. *Journal of Transport Geography*, 10 (4), 259-271. Retrieved from <http://www.sciencedirect.com/science/article/pii/S0966692302000418>. doi:[http://dx.doi.org/10.1016/S0966-6923\(02\)00041-8](http://dx.doi.org/10.1016/S0966-6923(02)00041-8)

Wegener, M., & Fürst, F. (2004). Land-use transport interaction: state of the art. doi:<http://dx.doi.org/10.2139/ssrn.1434678>

Yigitcanlar, T., & Dur, F. (2010). Developing a sustainability assessment model: The sustainable infrastructure, land-use, environment and transport model. *Sustainability*, 2 (1), 321-340. doi:<https://doi.org/10.3390/su2010321>

AUTHOR'S PROFILE

Gerardo Carpentieri is an Engineer, Ph.D. in Civil Systems Engineering at University of Naples Federico II and Research Fellow of Land Use Planning at the Department of Civil, Architectural and Environmental Engineering at University of Naples Federico II.

Carmen Guida is a Ph.D Student in Civil Systems Engineering Hydraulic and Transportation Systems Engineering at Department of Civil, Architectural and Environmental Engineering at University of Naples Federico II.

Paul Chorus is an urban planner with a PhD-degree in urban planning from the University of Amsterdam. Currently he is working for the province of Noord-Holland in the Netherlands as a policy advisor on transit-oriented development.

TeMA

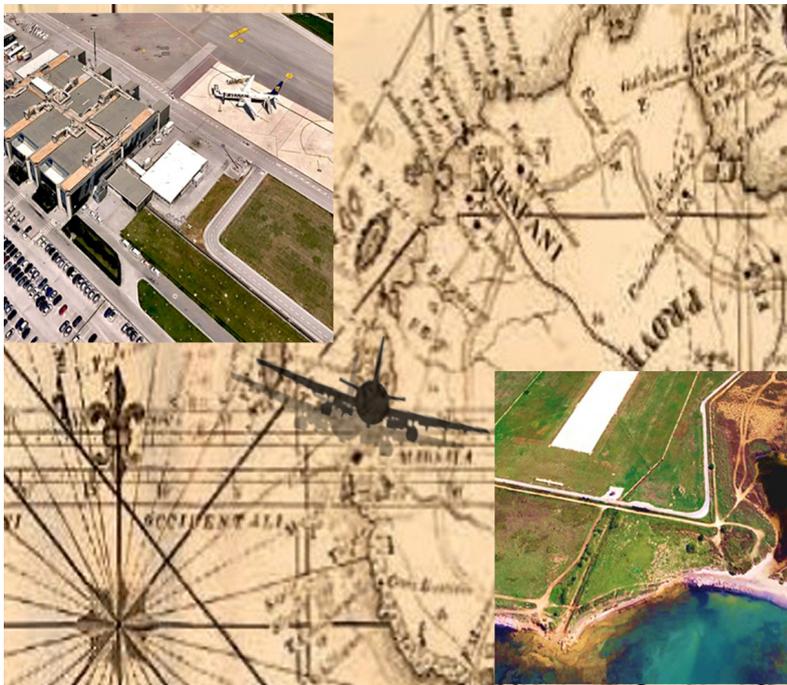
Journal of
Land Use, Mobility and Environment

TeMA 3 (2019) 331-350
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: 10.6092/1970-9870/6298

paper received 16th Septmeber 2019, accepted 19th December 2019
Licensed under the Creative Commons Attribution - 4.0 International License
www.tema.unina.it

How to cite item in APA format:

Massaro, A., Ventura, P. & Calderon, E. (2019). Transport Implications in Tourist Destinations. *Tema. Journal of Land Use, Mobility and Environment*, 12(3), 331-350. doi: <http://dx.doi.org/10.6092/1970-9870/6298>



TRANSPORT IMPLICATIONS IN TOURIST DESTINATIONS

TTHE TRAPANI AIRPORT IN WESTERN SICILY

Enrique Calderon^a, Paolo Ventura^b, Alessandro Massaro^c

^a Universidad Politécnica de Madrid, Spain

^{b,c} University of Parma, Italy

e-mail: ejcalderon@caminos.upm.es; a.massaro.a@gmail.com;
paolo.ventura.universita@gmail.com

^c ORCID: <https://orcid.org/0000-0001-9109-1187>

ABSTRACT

This search following the Sicily, the largest island in the Mediterranean Sea (25,460 sq km) and a self-governing Region, located in the southernmost part of Italy, has at least four tourist-related airports, sited between the eastern and western coast, separated from each other by a vast territory without efficient transport links and suffering from many diverse environmental problems. Utilizing a desk search methodology based on GIS software, this paper discusses the impact upon the regional development of the tourist traffic of the Trapani Airport situated in the westernmost part of Sicily. Ultimately it analyzes the critical role of connectivity and accessibility in the development of the area and tourism, seeking a maximum involvement of stakeholders. The recent growth of low-cost carriers have had a definite impact on the economic growth of the entire territory, where those choices could determine the life or the death of firms and, inevitably, their annual incomes. Tourism and connectivity are strictly related, thus showing deficiencies of the area in terms of accessibility, as well as the trade-offs between the different government (central and local) investment policies and the specific benefits emerging from the airport in the regional mobility.

KEYWORDS:

Regional and Urban Planning; Network; Tourism; Connections; Economic Data; Accessibility; Environment

TeMA

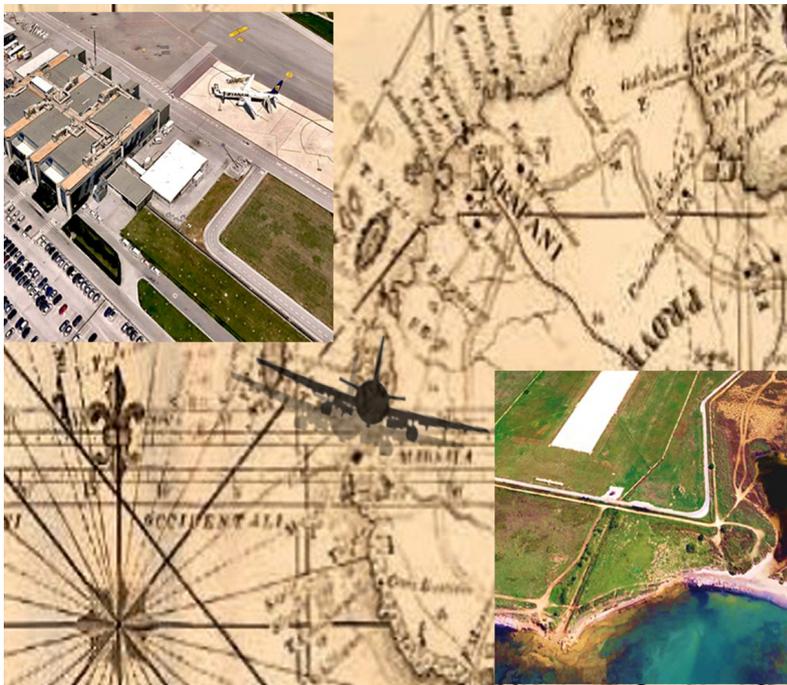
有关土地使用、交通和环境的杂志

TeMA 3 (2019) 331-350
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: 10.6092/1970-9870/6298

paper received 16th Septmeber 2019, accepted 19th December 2019
Licensed under the Creative Commons Attribution - 4.0 International License
www.tema.unina.it

How to cite item in APA format:

Massaro, A., Ventura, P. & Calderon, E. (2019). Transport Implications in Tourist Destinations. *Tema. Journal of Land Use, Mobility and Environment*, 12(3), 331-350. doi: <http://dx.doi.org/10.6092/1970-9870/6298>



航空运输对旅游目的地的影响： 西西里岛西部的特拉帕尼机场

Enrique Calderon^a, Paolo Ventura^b, Alessandro Massaro^c

^a Universidad Politécnica de Madrid, Spain

^{b,c} University of Parma, Italy

e-mail: ejcalderon@caminos.upm.es; a.massaro.a@gmail.com;
paolo.ventura.universita@gmail.com

^c ORCID: <https://orcid.org/0000-0001-9109-1187>

摘要

本研究针对地中海最大的岛屿（25,460 平方公里）——西西里岛，这一位于意大利最南端的自治区在其东海岸和西海岸之间设有至少四个与旅游相关的机场，但彼此之间被辽阔的土地所分隔而缺少有效的交通枢纽，同时还受到各种各样环境问题的困扰。本文利用基于 GIS 软件的桌面研究方法，讨论了西西里岛最西端的特拉帕尼机场对地区游客流量发展的影响。最后，它分析了连通性和可达性对该地区及旅游业发展至关重要的作用，以寻求让各方利益相关者尽量参与其中。近期低成本航空公司的发展对整个地区的经济增长产生了一定的影响，这些选择可能会决定企业的生死存亡，并且不可避免地决定其年收入。旅游业与连通性息息相关，因此在可达性方面存在不足，并且不同的政府（中央和地方）投资政策与机场在区域流动性方面的具体效益之间存在权衡取舍。

关键词：

机场； 高铁； 集水区； 联运互补性； 方案

1 A SHORT HISTORIC OVERVIEW

A quick overview of the Sicily planning history shows the existence of three airports in the territory of Trapani since the '20s¹. For military reasons, the first base was built in Milo (1920-1949), followed by Chianisia (1955-1961), and lastly, in the '60s, Birgi, which is the only one still in operation. Close to the Balata river, the mouth of the Birgi river was thoroughly altered in 1961 to build the Airport, in the northwest regional coast of the island. It is essential to highlight the use of the airport today, both for civil and military traffic. Runway maintenance is still carried out by the Military Government. Thus, it is essential to stress the close collaboration with both the Apulian airport of Galatina (Military Airport) and Brindisi Airport, as well as with the Grazzanise Airport of Campania (Military Airport), in the Military Programs of the Mediterranean Basin Defense. Moreover, it is not a little notice that in 1975 Italian Space Agency installed a "stratospheric hot-air balloons launching base" in the currently disused Chianisia Airport, an issue that underpins the crucial role of the transportation system for the area².

Trapani Birgi Airport stays at the same distance, 15 km, from Trapani, about 60,000 inhabitants, and Marsala, about 80,000. The Palermo Punta Raisi International Airport location, instead, is approximately 90 km from Birgi. Trapani's origins probably date back to a village founded³ in the 5th century BC. Although a great deal of population passed through those lands and consequently through a port with a crucial importance in the middle of the Mediterranean Sea, the layout of the city, as well as of others alongside the entire west coast (Marsala, Mazara del Vallo, etc.), derive their form from the Medieval Age.

The urban distribution made by frequent migrations from and to the coast and the extensive urbanization carried out by Arabs and Normans is both related to the role of the sea and of local agricultural resources.

Today, it is possible to discover the transformed grid of ancient paths to the hinterland, as all along the coast. Some of those have become all-purpose roads, while others nowadays are new highways. Presently, the road network (1.781 km long) has a density index (km per 1,000 sq km of the territory) higher than the whole of Sicily and Italy, too⁴, strictly related to the Metropolitan Area of Palermo. The two provinces of Trapani and Palermo connect a particular territory that has a geomorphologic shape sloping down gradually from the mountains to the sea. Likewise, the flat land of Trapani province stretches out to the south, becoming the Trapani Valley. Along the coast, history records the intense activity of the 21 existing ports, most of them with an inadequate structure. The port of Trapani displays a particular hooked shape. Fortified from the 5th century, it continues to receive today a vital load of cargo traffic (particularly with origin/destination in Africa). Only recently, it was opened to the most significant tourist ferries, thus attaining a leading role in the ports system of Sicily, above all in the relationship with the port of Palermo.

The port of Marsala, on the other hand, is a vital hub for links with other islands, as acknowledged in the recent Regional Transport Plan. The deficiency of the port system lies in the connections with the hinterland, due to the road and railway systems inefficiency. A closer look at the railway system would provide many explanations about the functioning of connectivity in the region. The birth of the Sicilian railway system can be traced back to the debate on the unification of the whole national railway system, the arrival of Garibaldi in Sicily, and the sulfur production activities on the island in the first half of 18th century. Nevertheless, the link with the peninsula system played a crucial role in the connection between Catania and Syracuse and the exclusion and abandonment of the western cities. The first railway line started from Trapani to the southern ports of Marsala and Mazara del Vallo. In the same years, the railway linked Mazara to Palermo. The entire

¹ (<http://www.aerohabitat.eu>, s.d.) (<http://www.aeronautica.difesa.it>, s.d.)

² (<https://www.asi.it>, s.d.)

³ It was founded by the Elymians, a nation of not well-known origins that arrived in Sicily before 1000 BC.

⁴ Road Density Index: 718 (Trapani), 663 (Sicily), 551 (Italy), (<http://www.provincia.trapani.it>, s.d.)

railway network has a length of only 120 km. The shortcut from Alcamo to Trapani started in the '30s, but underutilized.

Significantly, later on, the railway network neglected that first grid, stopping the necessary maintenance and modernization from guaranteeing the right development and the linkage with the rest of the island. These facts underpin the critical role of the ancient postal liaison, with its dense connection grid and the part of the firm, historic coastal navigation network, although with inadequate intermodal infrastructure. Therefore, if the connectivity in the Sicilian Region were to be enhanced, the primary role of roadway and navigation network should be highlighted, as well as the secondary, inefficient, the role played by the railway system.

Furthermore, the ports of Trapani and Marsala have not an efficient railway connection. This fact hinders trade and the tourism of the entire province concerning the Eastern coast of the Region. Moreover, in a zone dotted by small ancient communities and a dense network of minor roads, the airport is isolated, if only 1 kilometer away from the old single-track railway line (Fig. 1).

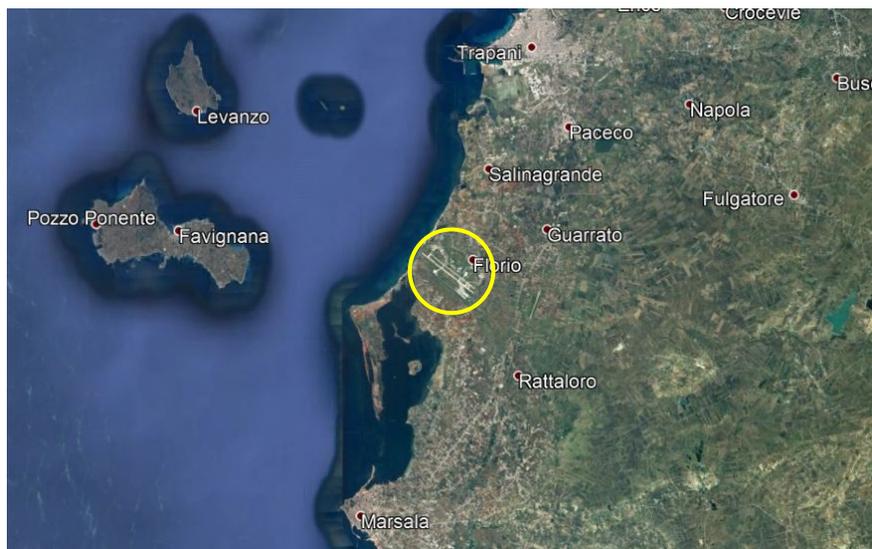


Fig. 1 Trapani Airport Location

2 THE TRAPANI BIRGI AIRPORT SITE AND ITS ACCESSIBILITY

Since the 14th century, the Municipalities of Birgi Nivaloro, Birgi Novi, and Birgi Vecchi occupy the territory around the Airport. The first rural settlements appeared in the early 19th century, and they are all now just south of the runway. Along the coast, near the Airport lie the Villaggio San Teodoro, an exclusive bathing resort to the south, and Posidonie with its little bath village of Tritoni, both of them part of the Marsala Municipality.

The ancient territories belonging to Vincenzo Florio⁵ are today part of the Air Force base and the NATO Base in the Trapani Municipality. The entire aerodrome (almost four sq km), the immediate agricultural land, and the mouth of the Birgi River (Balata River) are enclosed by the coastline to the west and by the roadway SP21 to the east. Almost all the Aerodrome Area is part of the Trapani Municipality.

Thus, Birgi Airport is a new center in the disperse lands between Trapani and Marsala, each one with its specific planning documents, not always adequately coordinated

Birgi Airport has a strategic role in the Italian context, as a part of the final section of the TEN-T network (the Scandinavian - Mediterranean corridor). Notably, the National Airport Plan considers the Sicilian Airports as part of two different strictly connected systems: the East Pole (Catania - Comiso) and the West Pole (Palermo - Trapani).

⁵ Vincenzo Florio (1799 –1868) was a wealthy Sicilian entrepreneur and politician.

Problems of connectivity and accessibility have soon arisen between the two poles and the hinterland. The National Airport Plan underlines the need to improve the connection between the nearest airports, stresses the two systems working model, and puts forward suggestions for the development of the roadway and railway links, which could boost up development opportunities for the south of the Island.

However, Birgi Airport accessibility enhancement requires significant infrastructure investments following the expected increase in passenger traffic. Thence, the Regional plan accepts the national hypotheses and consequent public works envisaged

At a sub-regional scale, the picture becomes more specific. The airport is connected to the main road via the A29 DIR motorway branch, linking the airport with the A29 Palermo - Mazara del Vallo motorway. Also significant is the SS 115, which connects it with the neighboring cities of Trapani and Marsala. From the Airport, it is possible to reach the cities of Trapani, Marsala, Palermo, Agrigento, as well as nearby locations. There is no direct access to the railway network, although the Alcamo, Castelvetrano, and Trapani railway line is less than 1 km away from the airport. The nearest station is Mozia-Birgi, 3 km from the airport, but there are no public transport connections between the two nodes. The Trapani and Marsala railway stations stay about 15 km from the airport. These connectivity issues should be improved with a new railway section between Trapani and Palermo, passing through Milo and Alcamo, as well as with a new road link between Mazara del Vallo and Trapani, consisting in one cat. C1 section with an overall width of 10.5 m. The road project has a total length of about 15.6 km plus a 900 m - the leg from the Marsala south junction to the Marsala Hospital roundabout. Furthermore, the new project boasts a viaduct of about 140 m, plus 5 m under - and 4 m overpasses. It presents some significant construction problems related to the numerous quarries and pits in the area. Moreover, the new link would not serve the population of the Southern territories of the island. The last version of the Regional Transport Plan details the maritime connections and accessibility links in the national Ports Plan. It confirms the Administrative reorganization of the Port Authorities in the new Port System Authority. The port of Trapani enjoys an excellent geographical position that allows it to be a reference point for traffic to and from the continent, Sardinia and North Africa. Furthermore, the presence of a large pool of consumers and the absence of production facilities give the node a potential logistic role. The location of the port and city center allows the independence of the commercial traffic from the urban road system. As in the previous Transport Plan of 2002, the New Regional Transport Plan highlights the synergy between the harbor and the airport of Trapani as relevant poles in the western transportation system. Specific programs for the port of Marsala, a critical connection with Egadi, Lampedusa, Pantelleria, and Africa, are, likewise, envisaged.

The New Regional Transport Plan notices that the airport lacks good road accessibility and that the single-track railway Palermo-Trapani line via Castelvetrano is underused, although it runs close to the airport. The port development seems aimed towards recreational uses. In May 2016 an agreement was signed between the MYR firm and the Sicilian Region to allocate the entire port basin to leisure uses. The highlighted planning applies choices of the National and Regional infrastructure to the Provincial and local planning.



Fig.2 Airport, Marsala and Trapani constraints around the aerodrome

A closer look at Airport accessibility and connectivity points out some relevant necessary additional interventions. Among those, fixing the connection with the A29 motorway (1,5 km); the railway connection with the Palermo-Alcamo line branch Castelvetrano-Trapani (1 km); some Airport Terminal renovation works and the linkage of the airport water supply system to the Public Aqueduct⁶. These elements show only a minimal part of the issues and programs on the broader planning scale and highlight other essential problems of environmental impact assessment that the airport traffic growth would generate. Water demands and pollution growth link the planning issues to the nearest river and the sea alike.

Local planning underpins the leading role of Birgi Airport. Its development is shared in the planning policies of both central municipalities of Trapani and Marsala, and considered an urgent problem to solve (Fig. 2). Only 4 % of the Airport surface area falls within the district of Marsala, but most of the small communities close to the runways are part of Marsala. Indeed, the Airport Risk Plan (2014), managed by Marsala Municipality, imposes specific prescriptions on the areas around the aerodrome. The Plan does not consider the adjacent areas north of the runway, because they are under the control of the Trapani municipality. On the other side, the General City Plan of Trapani (2010) encloses the aerodrome in different specific zones of constraint. Both plans could work better, and the implementation of issues be more effective if considering various stakeholders and a single management board established.

Sicily Airport system has an essential role in the Scandinavian - Mediterranean corridor, the longest of the entire TEN-T network. Sicily is the furthest point in this corridor, a natural contact point with Africa⁷. The focus on maritime connections among the EU states gives more strength also to the hallway between the North Sea and the Mediterranean Sea. Due to the priorities of the European Policy, the transport sector in the southern regions has attracted financial support for infrastructure projects to improve air traffic and maritime control and logistics services in ports. The establishment of the Trans-Mediterranean-Network-Transport-TMN-T⁸ has become a toolkit to develop the entire EU infrastructure system. This statement puts Sicily in the core of the investments, clearly as a strategic place in the south of Europe.

The location of the airport of Trapani-Birgi is 15 km from both city centers of Trapani and Marsala (TP), 115 km from Palermo center, and 168 km from Agrigento one. The airport has a strong tourist vocation due to the presence of low-cost carriers and the characteristics of a relevant catchment area of cultural, bathing, archaeological, and eno-gastronomic sites. Since 1992, the civil airport management is carried on by the stock company Airgest SpA, almost totally owned by the Regione Sicilia. The passenger terminal is sited southeast of the airport runway and covers 14,700 sq m, 66% open to passengers. The ground floor, of 9,500 sq², houses the arrival and departure halls, boasting 15 check-in counters. The first floor provides eight boarding gates, covering an area of 5.200 sq². There is a medium-long term parking area for cars consisting of 829 stalls. The runway for take-off and landing has a 13-R/3-L orientation, almost perpendicular to the coast, with a length of 2,695 m and a width of 44 m. The main taxiway of the same size, parallel to the runway, is used for take-off and landing, only by military aircraft, and is paved with bituminous conglomerate as the main runway. The other taxiways are partly in bituminous conglomerate and partly in concrete. The apron has an extension of approximately 64,900 sq² and contains nine stalls for aircraft, four on flexible flooring, and five on the rigid pavement (concrete).

⁶ (Territorial Provincial Plan, 2013)

⁷ Scientific literature highlights the important role of the Mediterranean Region in the international coordination, specifically in the development of transports connectivity, in the approval of multilateral agreements, plus the multi-modal maritime, road and rail corridors for connections. A report by the Ministry of Foreign Affairs of the Italian Government (MAECI), officially presented at the 3rd edition of the Mediterranean Dialogues-MED 2017, held in Rome, 30 November, 2017 did state - "Italian strategy in the Mediterranean: stabilizing the crisis and building a positive agenda for the region" – defines the Mediterranean as "a geopolitical paradox" because it has become "an increasingly fragmented region and - at the same time - more interconnected." (Giampaolo Basoli, 2018). The involvement of the investors in the connectivity is a structural issue of the development and growing with the years; it has finally changed the TEN-T programs, focusing on maritime services improvement, stimulating the transfer of road traffic to short sea shipping connections, with economic and environmental benefits.

⁸ (Bruxelles, 2013)

3 LEGAL REGULATIONS IN TURKEY AFTER GÖLCÜK EARTHQUAKE IN 1999

The Gölcük earthquake in 1999 caused a moral and economic collapse firstly but then caused an awakening in the overall country. As a result of this earthquake, 18,373 people lost their lives; 285,211 houses and 42,902 workplaces were damaged (Wikipedia, 2019).

These extreme damages have taught the reality which unplanned urbanization puts human life at risk, especially in disaster risk areas. The earthquake revealed that the country was not prepared at a sufficient level for many issues. For example, transportation and telecommunication nets were collapsed. Search and rescue works were inadequate. It was understood that there was no proper insurance system. Generally, emergency legal arrangements were always entered in the force in order to bind up wounds after every earthquake in the country (Şengün, 2007). In this regard, the Decree-Law no 574 was issued, immediately after the earthquake. However, this earthquake affecting the whole of Turkey expressed the necessity of some radical changes for this time. Renewal of urban areas which are collapsed and not resistant to earthquakes became the main topic. There were a few urban transformation projects in Turkey until that day and the projects could usually be applied by special laws. An example was the "Dikmen Valley Urban Transformation Project", which was adopted in 1990 in the capital city, Ankara (Demirci, 2004).

Another example was the "Northern Ankara Entrance Urban Transformation Project" implemented with the special law no 5,104 in 2004 (Resmi Gazete, 2004). Especially, it can be said that the purpose of the "Northern Ankara Entrance Urban Transformation Project" was a physical transformation. Until that date, there was still no clear legal regulation which defines urban transformation's purposes and control mechanisms. Article 73 with entitled "Urban Transformation and Development Area" of the "Municipal Law" No. 5393, which entered into force in 2005, provided a major expansion.

This article authorized municipalities to implement urban transformation in order to rebuild older parts of the city, to create housing, commercial, industrial and social areas, to take precautions against earthquake risk, to preserve the historical and cultural structure of the city. Unfortunately, many projects based on this article have received negative criticisms that urban transformation has diverged from its renewal and conservation purposes. Following the Van earthquake where 644 people lost their lives in 2011 according to Disaster and Emergency Management Presidency (AFAD)(AFAD, 2014), the necessity of regulating a specific law to reduce the losses before the disaster has become the main topic again. Finally, Law No. 6306 on "Transformation of Areas under Disaster Risk" was published on 16 May 2012.

This law sets out the principles of improvement, re-settlement, and renewal in order to create healthy and safe living spaces in disaster risk zones (Resmi Gazete, 2012a). Unfortunately, this law has caused many discussions and many of its articles have been rescinded or rewritten.

Besides legal regulations related to urban transformation, some other important regulations have been entered into force after the earthquakes in 1999. "Building Inspection Law" No. 4708 which came into force in 2001 can be given as an example (Resmi Gazete, 2001).

The purpose of this law is to ensure the construction of structures conforming to standards for safety of life and property. Also, one of the important regulations is the "Regulation on Buildings to be Constructed in Seismic Zone" which were arranged in 2006 but entered into force one year later (Resmi Gazete, 2006). This regulation includes many crucial changes to build resistant-constructions against earthquake. Unfortunately, this regulation was started to be implemented in some provinces, and it was decided to implement it all over the country after the Van earthquake in 2011. Another regulation is the decree-law no 587 named as "Compulsory Earthquake Insurance" was entered into force in 1999 (Resmi Gazete, 1999). This regulation was rearranged as "Disaster Insurances Law" No. 6305 in 2012 (Resmi Gazete, 2012b).

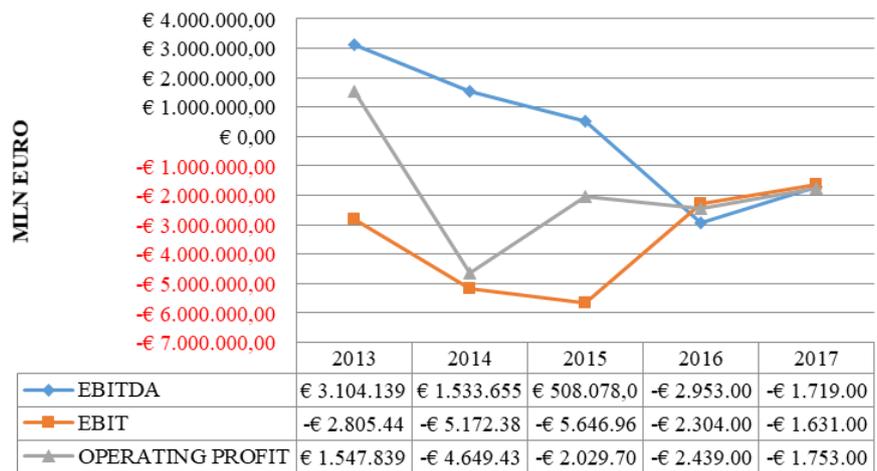


Fig.3 Comparing EBITDA, EBIT, O.P. of Airstg SpA

3.1 THE TRAPANI PROVINCE TOURISM GROWTH

The Regional Transport Plan (2017) stresses the relationship between the population and the job market in terms of GDP. Data show the evidence highlighted by ISTAT⁹ and MEF¹⁰ conclusions about the low employment rate of Trapani and Palermo provinces in the Sicily Region. Building construction leads the Trapani and Marsala's active population employment, followed by the agricultural sector, with a concentration in the Trapani district. Employment in tourism plays today a marginal role but it is expected to attain a leading position in the future. The income per capita calculated for the inhabitants shows a deflection in the Trapani curve over the years. Still, on the other hand, the same indicator for the occupied population shows a positive trend in recent years. This fact underlines the growth of different market types. The population decline explains the fall of the personal GDP and highlights the marginal role of Trapani Province in the Sicily Region. The income per capita in the Province of Trapani is significantly higher on the coast, due to building construction and the pervasive presence of tourist activities.

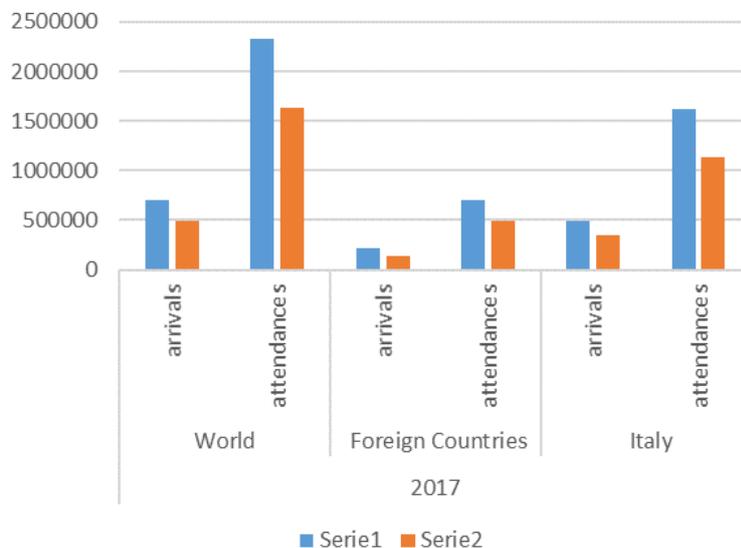


Fig.4 Tourism Facilities Use

⁹ (<http://www.istat.it>, s.d.) Italian National Statistic Institute

¹⁰ (<http://www.mef.gov.it/>, s.d.) Italian Ministry Economic and Finance

Arguably, all those issues related to planning, as discussed earlier, but also to the Airport's management joint-stock company and its specific point of view (Fig. 3). The balance sheet of Airgest SpA¹¹ shows continuous growth with a peak in 2012 (Fig. 4).

The growth of air traffic over the years, associated with low-cost carriers, as argued further ahead, has had an initial direct effect on the tourist facilities, increasing the number of beds made available to match the arrivals. Especially the percentage of international tourists from 2007 has rated high concerning all other airports (13%). This growth matches the territorial expansion of tourist facilities, industry, and commerce, enough to generate a noticeable escalation of the GDP in the entire Province¹². The Chamber of Commerce data show the relevant growth of the employment levels in the same period in the tourist and restaurant companies and in the building trade. The Chamber of Commerce provides monthly updates allowing to verify the direct correspondence with the tourist traffic, with its peaks in the warmer seasons.

3.2 THE COMPETITION OF PALERMO PUNTA RAISI INTERNATIONAL AIRPORT

The annual growth of Trapani Airport has to deserve the steady growth of Palermo Airport. The linkage and the cooperation with Palermo in the western part of Sicily undergo some overriding levels of planning, as argued before.

However, in the specific airport planning, it is challenging to introduce cooperation as a principal element. The airport management, in the hands of a stock company, creates competitiveness in the specific market sector. The complicated factors related to the proximity between airports are a further matter of research. The different types of influences play a leading role in defining a framework allowing a comprehensive assessment of the impact of various institutional market programs¹³. The time distance by road between Trapani and Palermo Airports is of about two hours. That time stresses the need for cooperation and a comprehensive, integrated approach, but also the need to consider the infrastructure problems throughout the territory. The accessibility to the airport of Palermo implements the links with the east regional area, especially with the provinces of Messina and Catania, applying a significant amount of the investments to facilitate that relationship. On the other hand, Trapani could catch the southern populations. These issues influence the use, modernization, and maintenance of the airport infrastructure. Punta Raisi Airport has faster connections to the east and to the peninsula, which is an advantage for carrier's attractiveness. So, the traffic flows of Palermo prove the positive effect of the presence of different air carriers. On the other hand, Birgi Airport has had a consistent growth between 2008 and 2015, paired with the presence of Ryanair. Still, now its withdrawal reveals the difficulties to match new carriers and new routes and to gain a steady growth similar to Palermo's.

3.3 THE ROLE OF LOW-COST CARRIERS: BENEFITS AND DRAMA OF THE AIRPORT COMPETITION FOR TOURISM

Arguably, in the last years, tourist traffic has slumped, and this has had profound consequences in airport management. The main factor in this story is the presence of Ryanair. The report of Airgest in 2012 emphasizes the neat link between the GDP generated by the Airport and the entire province.

¹¹ The Airgest SpA is a limited company made up by 99% of Public Bodies, which manages the Trapani-Birgi Airport since 1992. Airgest SpA, in June 27, 2012, has stipulated with ENAC (Italian National Civil Aviation Authority) a 30-year Concession for Managing the Trapani Birgi Civil Airport Infrastructures, which has recognized its role as Directing Manager of the airport infrastructures. Furthermore, Airgest is also a handling company— currently the only one at the Trapani airport – in charge of passenger, baggage, aircraft and goods services. (<http://www.airgest.it/>, s.d.)

¹² Results from 2004 to 2010: Trapani + 2.2%, Sicily +2.0%, Italy +1.1% (<http://www.airgest.it/>, s.d.)

¹³ The literature shows us, that airport costs are driven by external factors, such as traffic structure (percentage of international passengers, percentage of business passengers, LCC share and share of cargo traffic), delays or the degree of competition between airports. The type of ownership and the level of outsourcing also matter. (...) For small airports with inadequate passenger throughput, subsidies play a very important role for their financial survival (AA.VV., 2014)

The analysis of passenger flows reveals the essential role of low-cost traffic, primarily due to the number of Ryanair routes. In 2012, the Trapani province revenue amounted to 290 M euros, a sum that encompasses the GDP of all municipalities and all other market benefits. All Municipalities subsidize the cost of Ryanair base in the Birgi Airport for a total amount of 2,150,000 euro per year. This subsidy, even if the benefits are more than proportional to the paid amount, recognizes the monopoly of Ryanair and its specific costs. Moreover, yet if the territorial benefits balance the relative amount, it increases the uneven interrelations between Airport and Municipalities. The reason could probably lie in the dispersion of revenues and the consequent spillover effect, giving advantages to some zones as opposed to others. The specific market of the low-cost airlines in the years, the reduction of prices, the unrest of the workers and, last but not least, the difficulties on the specific territory of Trapani, the long-term measures to improve connectivity and to enlarge catchment areas, are all reasons that determine the reduction of routes from Birgi in 2017 only to four airports in Italy, slashing the number of international passengers. The agreement with Ryanair and the obstacles¹⁴ for other airlines evidence the marketing attempts to regain the traffic routes. This is perhaps the last step of a bad chronicle. Other companies were excluded following complaints from airliners interested in the low-cost traffic (Alitalia in this case). All those experiences affected the Airport management. The decline in passenger numbers and a parallel slump in the Airgest revenues led to a shrinking GDP and subsequent economic risks. In this framework, the Chamber of Commerce database is reassuring anyway. In fact, the benefits of the previous years have slightly lifted up the definite curve of GDP, demonstrating again the importance to look in perspective. Trapani commercial firms committed to significant investments are becoming scared by the fall of tourism-related revenues. The significant number of press articles collected in recent years bear witness to this situation. The cash flow and the Gross Operating Surplus (GOS) derived from the last Airgest balance sheet are negative. In the first half of 2018, passenger numbers fell by a hefty 67%, back to the figures of 2008. The reports about the future try to regain the past growth rate, but the solutions are just a part of the specific possibilities of the Airport. The overall corporate planning remains the same and does not provide a quick solution to this problem. The path to follow could be in the strategic marketing plans, and it should pledge for the return to positive balance levels. Probably now, the need to merge the two Airports in a single corporation as in Bari-Brindisi in Apulia or Milan is emerging.

4 TRAPAN AND PALERMO AIRPORTS: IMPACTS ON TOURISM DEVELOPMENT

The role of low-cost traffic in Birgi Airport is determinant, and closely related to the Ryanair vector, as disclosed in the Airgest SpA analysis of traffic¹⁵. Sicily complies with EU recommendations, and the Birgi Airport growth has been strictly proportional to the Ryanair decisions about routes. After 2009 the relative growth of traffic was higher than in other airports, and it continued so in the years till the recent downfall. The passenger traffic growth of Catania and Palermo airports is ranked among the first ten airports in Italy. Trapani, on the other hand, has experienced the most significant reduction of its traffic in the last years. This fact reflects the different load factors for vectors too. It depends not only on the tourism effect but on the possibility of extending the tourist passengers over to the winter season. Concerning tourist facilities, the difficulties of Trapani to extend its tourist catchment area towards the south and to attract other airliners depend on the overlapping with the Punta Raisi catchment area. The connectivity to the broader southern Region should be a pivotal issue to transform the competition between the two neighboring airports to enhance their cooperation. However, this brings about the problem between the plans for airport accessibility. The specific location of the Birgi

¹⁴ The Regional Administrative Court for Sicily has ruled against the restricted procedure issued by Airgest SpA for allocation of promotion and communication services for the creation of an advertising campaign aimed at favoring the increase of tourist presences in the territorial area related to the Trapani Birgi Airport, infringing free competition, as it contains conditions which are tailor-made to Ryanair, thus excluding other firms, especially Alitalia which has appealed (Palermo, 23.01.2018).

¹⁵ (<http://www.airgest.it/>, s.d.)

Airport could be a reason to extend its shape, to promote the airlines' attraction, and to meet the need for ground facilities: all costs should be jointly considered. The airlines have to comply with PSO programs and to bear their costs¹⁶. The distance between the two airports must be analyzed at a broader scale, where the current size of the catchment area may be extended¹⁷. Moreover, pollution and the mandatory environmental impact assessment are the elements on which the ideal development should be analyzed. Public service obligations, both for airports and vectors, depending on the possibilities to evaluate the increase the air traffic and the different benefits to be accrued by the affected territory. The impact of tourist traffic growth is well described in the Airgest SpA documents. At the same time, the local plans should put the Airport in its specific context: the benefits on the province GDP growth do not offset the problems of the urban settlements in the vicinity of the Airport and the territorial location. The Airport and the region, indeed, are strictly linked, as witnessed in the transformation of the mouth on Birgi River, carried out for the construction of the Airport (1961). The infrastructure is sited in a highly protected area between the Salt Flat of Trapani and the Stagnone of Marsala, home to different types of fauna and flora.¹⁸ Moreover, the lack of water resources affects the entire area, both an important territorial issue for agricultural development and one of the tourist assets of the whole Province. Again, regarding tourism development, the beaches close to the airport lack public lighting. A little bit more to South (less than 10 km) one of the most prominent examples of the archeological industrial heritage of entire Italy, the structures of the old seaplane base of Marsala, built by Pierluigi Nervi, a real point of tourist attraction, show a remarkable state of neglect. Sicily Region has now invested 17 M Euro to promote the development of the Province, trying to solve the problems of Birgi Airport following the Ryanair defection. Therefore, notwithstanding action about the problem of coexistence between aircraft and the birds, there are no other programs in terms of pollution or general territorial risks. The particular features of the Largest SpA management underpin this character in terms of regional adaptation. Still, in the recent past, the underassessment of risk determined the congestion of the airport. Therefore, from the perspective of new routes and touristic traffic growth, the analysis of risks acquires the central importance. All the highlighted problems have a distinct impact on the territory in terms of accessibility and connectivity, in terms of future costs to manage for the Airgest SpA and the tourist companies in general.

4.1 TOURIST SITES CATCHMENT AREAS

The Regional Transport Plan¹⁹ highlights the relationship between urban sprawl and the environmental problem in a system of analysis that starts with data acquired by phone calls (CATI). The following formula supports the results of the CUBE software model adopted:

$$S_{ij} = (E_i \cdot A_j \cdot f(T_{ij})) / (\sum A_j \cdot f(T_{ij}))^{20}$$

$j=1, \dots, n$

The OD matrix obtained through the application of the Friction Factor based on extensive phone calls (CATI model), was split between the different transport modes, the choice of one certain alternative being based on utility (Multinomial Logit). Crossing this evaluation with the matrix OD derived from home-based return trips,

¹⁶ Public Service Obligation (PSO) which involves the concept of Level of Service (LOS)

¹⁷ "From this finding, it can be concluded that an optimal long-term strategy for small-sized airports should be not to increase the capacity unless a certain threshold for the utilization of current capacity is reached." (AA.VV., 2014)

¹⁸ The archipelago of the Stagnone Islands covers an area of 2,000 hectares and extends between Punta San Teodoro and Capo Lilibeo. The Reserve, established in 1984, includes the entire lagoon bounded by the open sea from the island Grande or Longa, with three small islands in its interior, Mozia, Santa Maria and Schola. The lagoon has a very relevant naturalistic interest and great scenic beauty.

¹⁹ (<http://pti.regione.sicilia.it/>, s.d.)

²⁰ Formula deduct from the methodology applied by the Regional Transport Plan (Technical Report, Regional Transport Plan), which determines the distribution of occasional travels through a gravitational model, where: E_i is the number of total trips with origin in zone i ; A_j is the number of total displacements attracted by the zone j ; $f(T_{ij})$ is the impedance factor between zones i and j .

which provides a measure of the result of the mobility demand, confirms the metropolitan city of Palermo as the most important regional attractor of mobility, with a share of about 17% of the total movements, including home-based return trips. In the Region, Trapani generates the largest number of movements to Palermo with 21,100 daily trips. The CUBE software, using time as the deterrence factor: $TC = T_0 [1+a(V/C)b]^{21}$. The CUBE software explains that the metropolitan areas and the coasts are mostly affected by the transport system. Likewise, it shows the importance of the railway system and the difficulty of reaching the coastal zone of Trapani from the metropolitan area of Palermo. The investment requirements emerging from this analysis focus on the road and railway systems to improve connections between Trapani and Palermo and on to the nearest south zones. The weakness of this approach is to be found in the multiple management plans, in deregulation, but also in the absence of environmental considerations, the absence of bonds with risk analysis, above all related to the different time scheduling of the investments.

The current analysis places the Airport System of Sicily Region and, consequently, the Airport of Trapani as the key nodes of the network.

The network is built around the principal roads of Sicily Region, subdivided into different sections by typology, length, and maximum speed. The primary maritime routes which connect the Province of Trapani with its Islands are included too, converting average rate from knots to kilometers per hour. On the other side, railway lines and railway stations, always subdivided into sections with maximum speed and typology, complete the network. Sicily Region is mapped by Provinces and by Municipalities, and they are all subdivided by population from 2011 to 2018 and by GDP from 2011 to 2016. Thus, it has been possible to describe the variations in percentage both in terms of population density per year and GDP per year. The work about the Municipalities has been completed by the georeferenced districts subdivided by population with 2011 as the base year.

About the Province of Trapani, the tourism facilities have been georeferenced, classed by Municipality, Address, Typology, Bed Places, and Category (2016 values).

In the same way, Health facilities have been located and classed by Address, Name, Typology, Phone Number, Bed Places, Ward typology, Day Hospital, and Use (2016 values).

The connectivity measurement has been performed by Network Analysis tools, building the following matrixes:

- Origin - Destination Matrix between Municipalities and Airports (TP and PA Provinces);
- Origin - Destination Matrix between Tourist Facilities and Municipalities with small tourist villages (TP province);
- Origin - Destination Matrix between Health Facilities and Municipalities with small tourist villages (TP province);
- Origin - Destination Matrix between Trapani and Palermo Airport and Touristic Facilities (TP province);
- Location - Allocation Matrix between Airport of Trapani, Health facilities and Tourism Facilities.

Looking for the areas which have the best GDPpc variation and the highest lack of connections in terms of travel time, so the lowest accessibility, the structure of the work done, can be displayed as in the following scheme (Graph 3). The OD Matrix bases its development on the Dijkstra's algorithm on a graph with edges V and vertices A , expressed as a function of the number of edges, denoted $|V|$, and the number of vertices, denoted $|A|$, using big-O notation (a mathematical notation that describes the limiting behavior of a function when the argument tends towards a particular value or infinity):

$$O((|A|+|V|)\log_2 |A|)$$

It is useful to determine the distribution of journeys by minimum time and minimum cost, to build a classification of time-journey and time-cost between the different vertices and the demand points of the diverse using models.

²¹ Formula deduct from the methodology applied by the Regional Transport Plan (Technical Report, Regional Transport Plan, (<http://pti.regione.sicilia.it/>, s.d.))

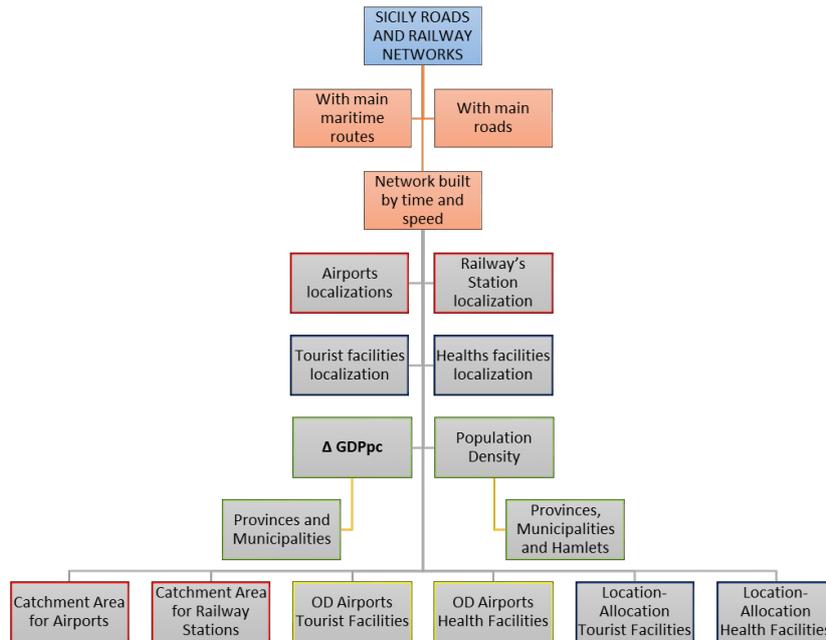


Fig.5 GIS Model

A direct survey of the catchment area for both airports (Fig.6), served by fast routes and railways, shows the difficulty for the Southern regions (especially the Province of Agrigento), to reach Birgi Airport. The consequent GDP reduction could be relevant for the Airport management. This means that in 2017 for 102 Municipalities in that area, the time-lapse to reach any of the four airports are more than 90 minutes and the corresponding sum of the same municipalities' GDP is almost of 900,000 euro, affecting nearly 700,000 inhabitants, 25% of the entire population of Sicily. For nearly 130,000 inhabitants, the travel time from the airports of the West coast is of 1.5 hours, involving GDP losses of almost 250,000 euros. Those data point out the possibility to extend the catchment area of the West Airport Node to the West part of the Provinces of Agrigento, Enna, Caltanissetta and Messina and towards the easternmost part of the Provinces of Palermo and Trapani.

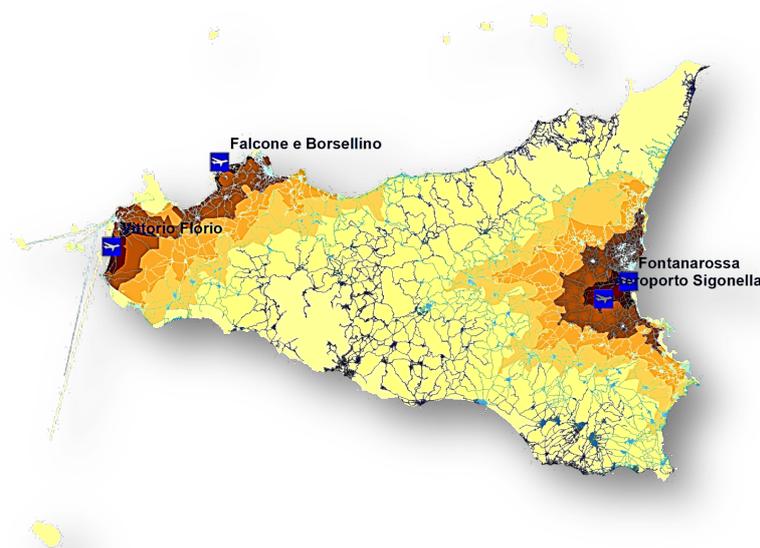


Fig.6 Sicily' Airports Catchment Area

In the same way, the analysis of the tourist and health facilities time distances, always made by travel time on road and railways, could be essential to appraise the possibility to improve the railway connections in the province of Trapani and to the others, provinces, to strengthen the railway capacity and to speed up the introduction of new technologies.

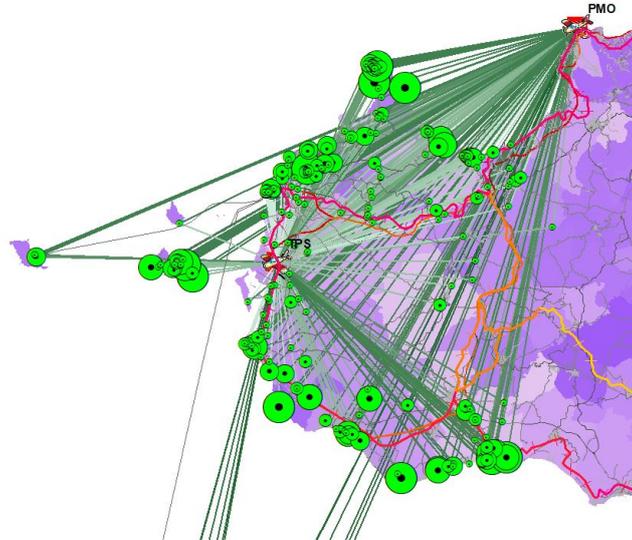


Fig.7 OD Cost-Matrix Facilities of Trapani Province and the Airports of the West Pole

The OD Matrix between the two airports connects the 322 tourist facilities in the Province of Trapani (Fig. 7) with the two Airports of the West Node; results highlight the possibility to arrive faster from Palermo to a lot of facilities in the Province of Trapani, especially those located in the South of the Province.

Concerning health facilities, the network shows the most used hospitals of Castelvetrano and Alcamo with a deep connection to the tourist facilities of the territory, and this underlines the role of the two neighboring provinces, but also the risks of increasing demands of coastal tourism development. This simple consideration highlights the possibility to consider the links between the Airport and the towns: in the OD matrix between the two Airports and Towns (including their sections the Province of Trapani, the lack of the road and transport network towards the East and the South area of the province of Trapani appears obvious again. The analysis of the buffers (creating polygons around input features to a specific distance) shows the lack of linkages. The polygons are managed crossing data between the two new roads, built to connect the Airport of Trapani and both the Tourism Facilities and Towns (with hamlets, and villages) of the Province of Trapani (considering the main Island) in the highway network. The result shows a critical unserved area in the middle of the province and low service connections in the South-east. The gap follows the variation of the percentage of GDPpc, underlining the active link between the transport network, tourism, and GDPpc. But also the contrast with the significant number of overserved zones highlights redundancies in the network system. Likewise, the same GIS analysis shows in the maps, the edge of the GDPpc polygon emerging from the appraisal of the other polygons in the research area, also built around the railway stations. The GDPpc variation is underlined by the evaluation of the different regions, elaborated crossing data from the area's polygons built around the railway stations, too (the zone regards the 15 minutes to achieve the stations).

The development of the railway network can be beneficial for the Province and connections with the South and the central part of the Sicily. Still, it must be considered in the development of the roadway network in the central zone of the Province. Thence, the accessibility becomes a more significant problem, in regard not only to the specific Airport and Railway but also to the different possibilities to reach those. Railway and other systems of mobility could guarantee the growth of the central zone (Fig. 8), also addressing there the tourist growth, linked to an expected boom of passenger flows in Birgi Airport.

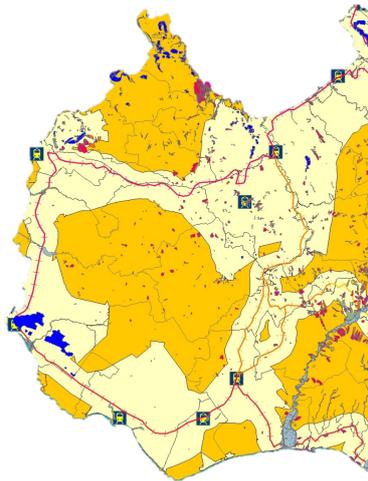


Fig. 8: Unserved Area

This should be for certain advantages in terms of time, costs, and connectivity, but also a way to reduce environmental pollution and to grant the public direct access to the airport's terminal. The links between the airport and surrounding areas should be considered in terms of quality and environmental assessment but a multi-scale coordinated growth plan. As in the Regional Transport Plan, the connections between the maritime routes acquire a crucial dimension in terms of capacity. Therefore, it all implies re-thinking the entire design of the coastal development in one organic and structured plan for accessibility, the centrality of the Airport, and the protection of its specific neighborhoods.

4.2 PLANNING COORDINATION AND MARKETING ALTERNATIVES

The dialogue between the infrastructure and its surrounding areas should be approached in terms of capacity and designed with a particular perspective of integration and preservation of the areas from the impact of pollution. This means to grant particular importance to the integration among the different structures of the landscape. Preservation of the different functions involves the development of the entire system: neighborhoods, coastal and other protected areas (water pollution, green preservation, bird's diversity, etc.); likewise, the development of the airport functions (civil, military, parking slots, etc.) should take care of the impact on anthropic growth.



Fig. 9 Idea for a design planning of the node. 1) Connection to the railway; 2) Adequate, new terminal; 3) Green road to protect the existent canal to the sea (Font: Authors)

Thence, at least, the different air carriers could find in the specific airport the possibility to develop their traffic and to guarantee the presence of more vectors. Even if in support of the Palermo traffic growth, that type of development should ensure the independence of Trapani growth. In the overall consideration made about the companies of the Trapani Airport, design plays a crucial role in terms of different types of tourist traffic too. This feature could take advantage of the contraction of revenues from aeronautical and airport fees from the perspective of growth, playing on the differentiation of tourist traffic. Moreover, a complex design re-thinking of the aerodrome and its specific surroundings should guarantee the benchmark development of the non-aviation components (Fig. 9). In the GIS model described, the problems of impact assessment derived from the growth of tourism traffic related to the Airport go on unsolved.

The infrastructural development approached through a single perspective of control where the different interests live together, the distribution of revenue, and the military functions are the main topics upon which to build up the dialogue.

Both the regional infrastructure plans and the airports' marketing strategies may be considered a practical approach to increase tourist flows and the involvement of residents at a broader scale, which is the least served area at a greater distance from the airports.

In September 2018, after the first summer season without Ryanair, in the heart of the touristic crisis, newspapers and the media at large were focused on the visit to Trapani of the US ambassador, to promote tourism and the cargo operations with the US. This recent visit strengthens the importance of the other continents, and it underlines the freight traffic improvement too, as shown in the actual data furnished by the Chamber of Commerce, which highlights the primary role of Trapani's exports.

The importance of a comprehensive design plan finds its justification in the tourist hub and the single infrastructure design with the involvement of railways, roadways, and ports, there included the dialogue among municipal and provincial plans.

The simple SWOT analysis shown below can summarize the development perspectives to be implemented for the Trapani Airport (Tab. 1).

STRENGTHS	
The Traffic PAX growth	The increase of passenger traffic using Low-Cost Carriers is an asset for the business of the entire Province
The History of Trapani and the cultural tourism	History and the cultural framework highlight the main role of the city in the Sicilian heritage, by way of growth and business development. A key issue is that of contemporary engineering, architecture and artistic presence in the Province. The scenic reserve of Stagnone Island and its archipelago is another important attraction point.
Export Statement	The positive value of the export business gives both Trapani and Marsala a relevant role in the Sicily Region
Capacity Building	With its location in the middle of the West Coast transport system development, the Airport can be improved: there is some derelict land around it and runways could seemingly be improved. The possibility of using undeveloped areas to cater for growth adapted to the needs and in which to plan the desired expansion of the take-off and landing runways
Stock Company Balance Sheet	The reduction of debts in the last year, in the dramatic situation of the collapse of tourist flows, allows hope to reach a Pax growth.
WEAKNESSES	
Accessibility	The airfield suffers from limited accessibility, but also in the entire Province the transportation infrastructure is in a dangerous state of decay.

Setting up network connections	The disproportional surge in tourist traffic as well as a shortage of transport infrastructure in Sicily, make up a barrier to keeping part of the transit tourist flows in the area
Location	The management of the area in which the airport is situated, between the two cities of Trapani and Palermo has to be sorted out
Low-Cost Companies	The low-cost market increases the multimodal system while boosting tourist traffic growth and economic benefits
OPPORTUNITIES	
<i>Comprehensive</i> Airport near <i>Core</i> Airport	Trapani is a part of the Core Palermo Airport and a part of Scan Med in the Trans-European Transport Network
Terminal Building	Despite the last adjustment, the Terminal needs some upgrade to cater for the expected growth
Network attractiveness	Joint management for both airports may satisfy more effectively the urge of the area for the airlines business, thus triggering a key role for Trapani
Public Transport Linkage	To link the railway station to Trapani Airport could change the habits, but it should be accompanied by a better service, which could be easily assured by bus.
Harbor Linkage	The link between Ports (Palermo and Marsala) and Airport can be an asset for the whole city
NATO Base	NATO activities can bring in additional traffic demands to the Airport
West coast tourism growth	The Trapani tourist attraction affects Trapani Airport and its forecast growth plan
Environmental development	The Airport is situated close to the Tirrenic Sea and the urban centers of two historical cities, in a Protected Area of the Region. Further resources could be mobilized integrating economic development with the valuable landscape, under a comprehensive policy of tourist resource development
THREATS	
Empiric attitude and short period interventions	The business catchment area strategy finds its basis in new tourist routes. A problem-solving strategy apparently depends on economic reasons only.
Predominance of private sectoral interests	The Trapani airport system is strictly dependent on single management, in turn, reliant on the public decision-maker, who in turn is dependent on government decisions about fund allocations
Underestimate of environmental risks	The current absence of links with the Public Aqueduct, casts some doubts regarding the choices on the system Military – Civil of the Airport to guarantee protection for the sensitive areas.
Further urban development in dangerous areas closed to the runways	There is no Development Plan for the areas close to the Airport and this stresses the dangerous impact, an obstacle for those areas to become integrated in the city the problem affects the development of Airport fringe areas
Technocratic attitude ignoring stakeholders	Insufficient administrative capacity to prepare and manage EU-funded projects
Potential Impact	The prospect of an additional income of the area, the underestimation of entry barriers and the environmental risk
NATO Base	The military functions could hinder the normal airport activities

Tab. 1 SWOT Analysis

5 CONCLUSION

In the Airport of Trapani, different planning systems coexist, and the constraints increase the specific characters of the surroundings. Investment perspectives focus on overcoming constraints, but the absence of a comprehensive design plan stresses the overlapping effects, above all, on the airports' fringe areas. The impact of the Airport on the surroundings underlines the disruption of the areas prospicient the sea, anyway on the

canal that starts from there, on the south of the Airport. A perspective of growth should be considerate as the possibility to link the railway line to the terminal. This one has to be enlarged, acquiring different new functions. Moreover, it must find a way to protect the fringe area and to improve accessibility, so a greenway along the canal seems to be the first step to protect the environment in proximity to the existing transport infrastructure²². Solving problems for an airport and a city must press the collaboration among the two airports, giving positive effects to the airline competition. The analysis conduct on the Sicily Airport System underlines the importance of the underserved areas and the economic evaluation of the most distant clusters of the catchment area. Therefore, it seems that the strengthening of the relationships between the two airports can give more possibilities to equilibrate growth. The cooperation can be an effort to discover and transform in resource the historical heritage of the hinterland. Despite the considerable difference of traffic between the two airports, the Airport of Trapani, in this sense, can play a leading role, helped by the key part of Marsala city on the South Coast. These considerations follow the idea of the European Agenda 2020, try to find a way to dialogue between the different transport systems in the network, improving the existent infrastructures to gain the most collaborative planning growth. The tourist traffic is only a part of the air traffic managed by the two airports, and the studies of the network are ongoing to give an effort to the impact assessment regarding the improvement of domestic transportation, their frequencies, over the new international routes' search. A more equilibrate system of the internal traffic flows can be assured by the involvement of Trapani Airport, so to underline its specific role in support to Palermo Airport, as depicted in the National Transport Plan.

REFERENCES

- Kepaptsoglou, K., Karlaftis, M. G., & Tsamboulas, D. (2010). The Gravity Model Specification for Modeling International Trade Flows and Free Trade Agreement Effects: A 10-Year Review of Empirical Studies. *The Open Economics Journal*. doi: <https://doi.org/10.2174/1874919401003010001>
- Bilotkach, V., Clougherty, J. A., Mueller, J., & Zhang, A. (2012). Regulation, privatization, and airport charges: panel data evidence from European airports. *Journal of Regulatory Economics*, 42 (1), 73-94.
- Ülkü, T., Jeleskovic, V., & Müller, J. (2014). *How scale and institutional setting explain the costs of small airports? An application of spatial regression analysis 35*, 2014). Joint Discussion Paper Series in Economics.
- Guan, C., & Peiser, R. (2018). *Accessibility, urban form, and property value: Toward a sustainable urban spatial structure* (No. eres2018_330). European Real Estate Society (ERES).
- Airport, B. I. (2005). *Environmental Impact Assessment of the Expansion of Bristol International Airport*. Bristol, UK: Entec UK Limited. al., S. A. e., 2016. *Atlas of Urban Expansion Vol. I, II*. s.l.:s.n.
- Alexander T. Wells, E. & S. Y. P., (2004) (5th edition). *Airport planning and management*. United States: McGraw-Hill.
- Anon. (2010). *Adaptive Airport Strategic Planning*.
- Antonín Kazdaa, M. H. B. M. (2017). Small regional airports operation: unnecessary burdens or key to regional development. *ScienceDirect - Transportation Research Procedia* 28 59–68.
- CESUR (2007). *The consequences of the growing european low-cost airline sector*. [Online] retrieved from: [http://www.europarl.europa.eu/thinktank/en/document.html?reference=IPOL-TRAN_ET\(2007\)397234](http://www.europarl.europa.eu/thinktank/en/document.html?reference=IPOL-TRAN_ET(2007)397234)
- COST - European Cooperation in Science and Technology, n.d. www.atard.net/publications/official-action-documents/. [Online] retrieved from: http://www.cost.eu/COST_Actions/tud/TU1408
- Di Pietro, G. F. (1978). Strumenti urbanistici e identità del territorio. *Parametro*, Issue 63.

²² Idea already promoted in TeMA Journal (Vinci & Cutaia, 2019)

Dimitriou, D., Voskaki, A. & Sartzetaki, M., (2014). Airports Environmental Management: Results from the Evaluation of European Airports Environmental Plans. *International Journal of Information Systems and Supply Chain Management* 7 (1), 1-14.

Van de Vijver, E., Derudder, B., & Witlox, F. (2016). Air passenger transport and regional development: Cause and effect in Europe. *Promet-Traffic&Transportation*, 28 (2), 143-154.

Giampaolo Basoli, M. R. (2018). *Transport Dimension of the BRICS Penetration in the Mediterranean Region*. Rome, European Institute of the Mediterranean Region.

GÜRLER, E., & GÜLERSOY, N. Z. (2010). Paradigm Shifts and Urban Regeneration Process in Planning History. In *14th International Planning History Society Conference*. Retrieved from: <http://iphs2010.com/abs/ID504.pdf>

Healey, P. (2003). Collaborative Planning in Perspective. *Planning Theory, SAGE Publications*, 2 (2), 101–123. doi: <https://doi.org/10.1177/14730952030022002>

Tavasszy, L., Bollinger, L. A., & Dijkema, G. P. (2016). Special issue on Climate adaptation of infrastructure networks. *European Journal of Transport and Infrastructure Research*, 16 (1).

Lupi M., a. c. d. (2009). *Methods and models for planning the development of regional airport systems*. Milano: Franco Angeli (Trasporti).

MIT (2010). *Stato del sistema aeroportuale nazionale*. Studio dello sviluppo futuro della rete aeroportuale nazionale quale componente strategica dell'organizzazione strutturale del territorio. In: Vol3_ParteII_CAP_08_SUD. s.l.:s.n.

Sameh, M. M., & Scavuzzi, J. (2016). Environmental Sustainability Measures for Airports. *Occasional Paper Series: Sustainable International Civil Aviation*.

Schaar, J. (2018). *The Geopolitical Impact of Climate Change in the Mediterranean Region*. Rome, IEMed. Mediterranean Yearbook.

Seth B. Young, A. T. W. (2011). *Airport planning & management*. New York: McGraw-Hill Professional.

Sheate, Y. C. N. & W. R. (1997). Environmental impact assessment of airport development proposals in the United Kingdom and Hong Kong: who should participate? doi: <https://doi.org/10.1080/02688867.1997.9727033>

Ventura, P., Montepara, A. & Sollazzi, J. (2015). *Regional Development and Airport in Northern and Central Italy*. Giuseppe Verdi Airport, Parma case study.

Ventura, P. & Tiboni, M., n.d. Sustainable Development Policies for Minor Deprived Urban Communities and Natural and Cultural Heritage Conservation. In: F. Rotondo, F. Selicato, V. Marin & J. López Galdeano, eds. *Cultural Territorial Systems*. s.l. Springer International Publishing.

Vicarelli, C. (2005). Hub-and-spoke or else? Free trade agreements in the 'enlarged' European Union. *The European journal of comparative economics*, 2 Febbraio.

Vinci, I. & Cutaia, F. (2019). Implementing the environmental dimension of the EU's urban agenda 2014-2020. *Tema. Journal of Land Use, Mobility*, 12 (2), 139-146. retrieved from www.trapaninostra.it/libri/, n.d..

Yu, N., Jong, M. d., Storm, S. & Mi, J. (2013). Spatial spillover effects of transport infrastructure: evidence from Chinese regions. Retrieved from <https://www.sciencedirect.com/science/article/pii/S0966692312002621?via%3Dihub>

SITIES

<http://www.ec.europa.eu/eurostat>

<http://pti.regione.sicilia.it/>

<http://www.aerohabitat.eu>

<http://www.aeronautica.difesa.it>

<http://www.airgest.it/>

<http://www.assaeroporti.com/statistiche/>

<http://www.cittametropolitana.pa.it/>

<http://www.comune.marsala.tp.it/>

<http://www.comune.trapani.it>

http://www.enac.gov.it/Aeroporti_e_Compagnie_Aeree
<http://www.enav.it>
<http://www.icao.int>
<http://www.istat.it>
<http://www.mef.gov.it/>
<http://www.mit.gov.it/>
<http://www.openflights.com>
<http://www.provincia.trapani.it>
<http://www.rfi.it/rfi/LINEE-STAZIONI-TERRITORIO/Nelle-regioni/Sicilia>
<https://www.asi.it>

IMAGE SOURCES

Figg. 1, 2, 3, 4,5, 6: Generated by authors
Graph 1: airgest; Graph 2, 3: Generated by authors
Fig. 3: Image is obtained from Google Earth.
Fig. 4: Images are obtained from Google Earth.
Fig. 5: Generated by authors using ArcMap 10.1.
Fig. 6: Generated by authors using ArcMap 10.1.
Fig. 7: Generated by authors using Microsoft Office Excel.

AUTHOR'S PROFILE

Enrique Calderon Presently retired, Professor Enrique J. Calderón has been Head of the Càtedra de Planificaci3n y Acci3n Territorial at the Department of Regional, Urban and Environmental Planning in the Polytechnic University of Madrid since it was created in 1982. He has a degree in Civil Engineering at the Polytechnic University of Madrid with subsequent degrees at Imperial College, London (M.Sc) and Madrid (Ph.D). He specializes in urban, regional and environmental issues at all levels, notably environmental subsidies, and social impact assessment, and the incorporation of environmental factors in government policies and programmes, and he has published widely in these field. He has been a regular consultant for various DGs of the European Commission and government departments within and outside Spain on the impact of EU policies upon Spanish economic and social development. He is, presently, General Secretary of Hispania Nostra, the Spanish subsidiary of Europa Nostra, a EU organization for the protection of the natural and built environment.

Paolo Ventura is full professor in Urban and Regional Planning, chaired the European Specialized Master's in Urban Regeneration (2014-2018) and the Graduate School of Architecture (2013-2016) at the University of Parma, where is member of the Doctoral School in Civil Engineering and Architecture and teaches Regional Planning. He has been National Delegate in the COST - Urban Civil Engineering committee on behalf of the Ministry of Scientific and Technological Research (1992-2006), member of the Architecture and Children Commission at UIA (2004-2010) on behalf of the Italian National Council of Architects. Since 1974 till 2006, he has done teaching and research activities at the School of Architecture of the University of Florence (PhD Program in Landscape Design within the Doctoral School in Landscape Planning) and other universities: in Nineties Regional and Urban Planning at Milan Polytechnic, at the University of Florence and at the Engineering School of the University of Brescia, then at the School of Architecture of Parma, since 2003. He has been President of the Council of Lombardy Boards of Architects (2010-2012) and President of the Board of Architects of the Province of Brescia (1993-2013). He has been chairman, organizer or invited speaker in many relevant international and national conferences. He is author of numerous national and international scientific publications with outstanding publishers (Mc Graw-Hill and Springer). He is author of important appraisals on Urban Planning and Construction on behalf of the Judicial Authority and of various urban and architectural plans and projects. He directed a several National or International Researches, among which the following ones: Regional Plan of Casentino Valley (about 800 sq.km); Buffer zone of the Casentinesi Forest National Park, (1996); preliminary study (1998-99) for The World Bank (Washington) for the Urban Retrofitting of the town of Saranda (Albania); National Research Program "Urban Planning of Housing Developments with priority pedestrian mobility" financed by MIUR; European Research Program C27 "Sustainable Development Policies for Minor Deprived Urban Communities from 2004 to 2010"; Scientific and Research Center project at the University of Parma (2009-10), Reconstruction Plan of the quake-damaged historic center of Navelli (2011-13).

Alessandro Massaro has an EU Masters Level II in Urban Regeneration - *Analytical techniques for the protection and redevelopment of the built environment*, DICATEA, University of Parma, Italy. Persistent, innovative, and reliable senior Architect, engineer, construction manager, business leader, and urban planner with broad experience collaborating with municipalities, regional governments, and academic institutions on historical renovations and in airport development. Expert at architectural design and renovation of commercial properties, residential properties, and historic buildings. Keen business intelligence and interpersonal skills to collaborate with key project stakeholders, contractors, sub-contractors, and local government representatives. Dedicated mentor, coach, and teacher to promote urban regeneration, accessibility, and intelligent cities.

TeMA

Journal of
Land Use, Mobility and Environment

TeMA 3 (2019) 351-371
print ISSN 1970-9889, e-ISSN 1970-9870
doi: <http://dx.doi.org/10.6092/1970-9870/6528>

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



REVIEWS PAGES

THE TIMES THEY ARE A-CHANGIN' 3(2019)

Starting from the relationship between urban planning and mobility management, TeMA has gradually expanded the view of the covered topics, always remaining in the groove of rigorous scientific in-depth analysis. During the last two years a particular attention has been paid on the Smart Cities theme and on the different meanings that come with it. The last section of the journal is formed by the Review Pages. They have different aims: to inform on the problems, trends and evolutionary processes; to investigate on the paths by highlighting the advanced relationships among apparently distant disciplinary fields; to explore the interaction's areas, experiences and potential applications; to underline interactions, disciplinary developments but also, if present, defeats and setbacks.

Inside the journal the Review Pages have the task of stimulating as much as possible the circulation of ideas and the discovery of new points of view. For this reason, the section is founded on a series of basic's references, required for the identification of new and more advanced interactions. These references are the research, the planning acts, the actions and the applications, analysed and investigated both for their ability to give a systematic response to questions concerning the urban and territorial planning, and for their attention to aspects such as the environmental sustainability and the innovation in the practices. For this purpose, the Review Pages are formed by five sections (Web Resources; Books; Laws; Urban Practices; News and Events), each of which examines a specific aspect of the broader information storage of interest for TeMA.

01_WEB RESOURCES

The web report offers the readers web pages which are directly connected with the issue theme.

author: Rosa Morosini
Tema Lab – University of Naples Federico II, Italy
e-mail: rosa.morosini@unina.it

02_BOOKS

The books review suggests brand new publications related with the theme of the journal number.

author: Carmen Guida
Tema Lab - University of Naples Federico II, Italy
e-mail: carmen.guida@unina.it

03_LAWS

The law section proposes a critical synthesis of the normative aspect of the issue theme.

author: Federica Gaglione
Tema Lab - University of Naples Federico II, Italy
e-mail: federica.gaglione@unina.it

04_UBAN PRACTICES

Urban practices describes the most innovative application in practice of the journal theme.

author: Gennaro Angiello
Tema Lab - University of Naples Federico II, Italy
e-mail: gennaro.angiello@unina.it

05_NEWS AND EVENTS

News and events section keeps the readers up-to-date on congresses, events and exhibition related to the journal theme.

author: Andrea Tulisi
Tema Lab - University of Naples Federico II, Italy
e-mail: andrea.tulisi@unina.it

TeMA

Journal of
Land Use, Mobility and Environment

TeMA 3 (2019) 351-371
print ISSN 1970-9889, e-ISSN 1970-9870
doi: <http://dx.doi.org/10.6092/1970-9870/6528>

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



评述页：

提高城市系统对自然及人为变化顺应能力的方法、 工具和最佳实践

TeMA 从城市规划和流动性管理之间的关系入手，将涉及的论题逐步展开，并始终保持科学严谨的态度进行深入分析。在过去两年中，智能城市（Smart Cities）课题和随之而来的不同含义一直受到特别关注。

学报的最后部分是评述页（Review Pages）。这些评述页具有不同的目的：表明问题、趋势和演进过程；通过突出貌似不相关的学科领域之间的深度关系对途径进行调查；探索交互作用的领域、经验和潜在应用；强调交互作用、学科发展、同时还包括失败和挫折（如果存在的话）。

评述页在学报中的任务是，尽可能地促进观点的不断传播并激发新视角。因此，该部分主要是一些基本参考文献，这些是鉴别新的和更加深入的交互作用所必需的。这些参考文献包括研究、规划法规、行动和应用，它们均已经过分析和探讨，能够对与城市 and 国土规划有关的问题作出有系统的响应，同时还对诸如环境可持续性和在实践中创新等方面有所注重。因，评述页由五个部分组成（网络资源、书籍、法律、城市实务、新闻和事件），每个部分负责核查 TeMA 所关心的海量信息存储的一个具体方面。

01_WEB RESOURCES

网站报告为读者提供与主题直接相关的网页。

author: Rosa Morosini
那不勒斯菲里德里克第二大学民用建筑与环境工程系 TeMA 实验室 e-mail: rosa.morosini@unina.it

02_BOOKS

书评推荐与期刊该期主题相关的最新出版著作。

author: Carmen Guida
那不勒斯菲里德里克第二大学民用建筑与环境工程系 TeMA 实验室 e-mail: carmen.guida@unina.it

03_LAWS

法律部分提供主题相关标准方面的大量综述。

author: Federica Gaglione
那不勒斯菲里德里克第二大学民用建筑与环境工程系 TeMA 实验室 e-mail: federica.gaglione@unina.it

04_URBAN PRACTICES

城市的实践描述了期刊主题在实践中最具创新性的应用。

author: Gennaro Angiello
那不勒斯菲里德里克第二大学民用建筑与环境工程系 TeMA 实验室 e-mail: gennaro.angiello@unina.it

05_NEWS AND EVENTS

新闻与活动部分让读者了解与期刊主题相关的会议、活动及展览。

author: Andrea Tulisi
那不勒斯菲里德里克第二大学民用建筑与环境工程系 TeMA 实验室 e-mail: andrea.tulisi@unina.it

THE TIMES THEY ARE A – CHANGIN' 3(2019)

REVIEW PAGES: WEB RESOURCES

ROSA MOROSINI

TeMALab – Università degli Studi di Napoli Federico II, Italy
e-mail: rosa.morosini@unina.it



In this number

SOIL: A RESOURCE TO PROTECT ONLY FROM WATERPROOFING? THE EFFECTS OF POLLUTANTS

The urgency to concretely adopt new patterns of development, promoting the reduction of soil consumption and of natural resources, in particular the ones that are not capable of regeneration in a foreseeable future, has led the attention of researchers and decision-makers on soil and land resources (Mazzeo & Russo, 2016; Zucaro & Morosini, 2018). As soil formation is an extremely slow process, soil can be considered essentially as a non-renewable resource; in order to ensure several functions, it is necessary to monitor and protect the functionality and the state of health of that system.

These needs have arisen in an increasingly way from the Earth Summit in Rio de Janeiro (1992), the first global conference of Heads of State concerning environmental issues and from the sixth action program of European Commission (EU, 2011), actualized in the Soil Thematic Strategy COM (EU, 2006). In this document, it is recognized that soil degradation is driven or exacerbated by human activities such as urban and industrial sprawl, but also by inappropriate farming and forestry practices.

If on one hand it is necessary to stop waterproofing phenomena, on the other hand it is essential to focus on farming and forestry activities that, due to the use of contaminants, can result in lack of fertility, of carbon, biodiversity, of water reservoir capacity, even alternating nutrients cycles.

In this perspective, it is possible to claim that contaminant have an extremely negative impact on soil, preventing the system to perform functions and services to men and the ecosystem. Moreover, contaminants tend to accumulate in soil for long period; this causes that damages are often detected in a very advanced state and sometimes they are irreversible. As a consequence, the quality of a good soil is different according to functions' priorities and its uses.

Moreover, it is not easy to link people health to environmental conditions; it gets even harder if soil is taken into account, because of long term effects and of multiple sources of exposure to contaminants.

A solution could be to monitor pollutants whose harmful effects on human beings have been proved by scientific literature. According to this perspective, it seems appropriate that, during decision-making processes concerning territorial transformation, technicians and administrators have to consider for each soil also past, present and in-coming contamination phenomenon, of every genre and nature, since it will have a limited destination and intensity of use. The contamination history has definitely effects on soil characteristics and its resilience fails both in terms of mechanical and functional features.



EPC

<https://www.environmentalpollutioncenters.org/soil/>

The Environmental pollution centers (EPC) is a website designed with the objective to raise awareness on environmental issues and on their impacts on people daily activities. The website contains wealth of information related to natural resources pollution. There are several detailed sections concerning these topics. In particular, on the top right of the homepage, there are links that lead to specific pages with one simple click; they are seven: about; latest news; soil; air; food; radiation. At the end of sections' links, it is possible to make a keyword search, directly from the Search box. Each section is organized in subsections, in particular, clicking on the one dedicated to soil, it is possible to access to the introductory page where the phenomenon of soil contamination is presented. Its subsections are five:

- causes;
- types;
- contaminants;
- diseases;
- facts.

In the subsections titled "causes", a lot of information is given concerning the causes of soil pollution classifying them in those naturally present and others produced by human action. In the first case, the attention is paid to contaminants that are generated from the microbial activity and from decaying organisms; while, for the second case the contaminants are produced by men, usually linked to improper disposal of industrial or urban refuse or from farming activities (pesticide). In the following section, "types", many kinds of contaminants are reported.

The third subsection "contaminants" gives a list of examples which are very harmful contaminants for people health and there are some boxes through which it is possible to deep the knowledge referred to each element. The following and last sections, "deseases" and "facts", are mostly dedicated to illnesses and consequences of a high presence of contaminants in soils.

The section "latest news" is very interesting and it is organized in two parts: on the right, there are different boxes, including the archive, arranged per month and per year; with one simple click you can access to a huge catalogue of articles. On the left, instead, there are articles and texts' previews, organized by topic.

At the bottom of each principal section, there are some links to articles that could be helpful to deepen the topic of this specific session.

In the homepage, above the search bar tool, there are the main social media links, Facebook, Twitter and LinkedIn.



ESDAC

<https://esdac.jrc.ec.europa.eu/themes/soil-contamination>

European soil data centre (ESDAC) has the aim to manage relevant information concerning soil and the European polices. Through the collection of data, the project includes the drafting of future scenarios thanks to advanced modelling techniques and analyses based on the main threats identified by the Soil Thematic Strategy (erosion, decomposition of organic matter, compaction, salinization, landslides, waterproofing,

contamination and lack of soil biodiversity). A strong scientific and technical support to the United Nations Convention to Combat Desertification (UNCCD) will be provided by promoting the reform of the Committee of Science and Technology (CST) of the UNCCD and by the development of an operational Global Soil Information System (GLOSIS) for the regular assessment of global soil degradation processes. ESDAC provides a coherent approach to soil data collection and distribution for all different policy areas and initiatives relevant to the EU, while assuring high scientific quality, policy relevance and technical support as needed.

The **European Soil Data Centre (ESDAC)** is the thematic centre for soil related data in Europe. Its ambition is to be the single reference point for and to host all relevant soil data and information at European level. It contains a number of resources that are organized and presented in various ways: datasets, services/applications, maps, documents, events, projects and external links. In fact, the website is well organized in three main sections: home, about ESDAC and Atlases. In the Home section there are three further subsections: dataset highlights; applications and services; scientific-technical reports. In these subsections there are several links that allow the user not only to easily consult the available scientific materials but also other websites. On the left, there is a box with useful links. Starting from the top, in the box there is the bar tool to make the keyword search and just below there are newsletter and events.

Another interesting section is Atlases where there are covers from Atlas such as "soil Atlas of Africa"; "soil Atlas of Europe"; "global soil biodiversity Atlas" and so on. For each Atlas, in addition to the cover, there is a short description of the contents and with one simple click on the link (above the description), it is possible to connect to the informative section of each atlas.



ECOREMED
<http://www.ecoremed.it>

ECOREMED is a project aimed at the reclamation of contaminated sites in Campania Region where, the storage of compounds derived from oil, steel industry, steelworks and from the production of concrete-asbestos is one of the main sources of pollution. In addition, the principal cause of pollution of the Vesuvian coast is the careless management of solid waste. It is a very innovative project that could be studied to promote its dissemination in other counties, since the during the last century a relevant increase of global pollution has been recorded, because of the excessive production and use of chemical compounds deriving from oil, recklessly released into the environment. The main objective is to promote a high-quality environment where levels of pollutants from human activities have no significant impacts or do not represent a risk for human health. In this regard, the action is planned to protect nature and biodiversity, following the specific indications on EU laws, 92/43/CEE – "Conservation of natural habitats and wild fauna and flora" (21.05.92); Decision 93/626/CEE of the Council – "Conclusion of the Convention on Biological Diversity" (25.10.93); COM (98) 42 def. – "The Communication on a Community Biodiversity Strategy" (05.02.98); COM (2001) 162 def. – "Biodiversity Action Plan for the Conservation of Natural Resources". Furthermore, the project is sustained by several partners such as Campania Region and in particular the Agricultural Department, Risorsa, which is a research society that deals with agriculture, and Arpac, the regional agency of environmental protection.

The website is organized in eight sections:

- home;
- the project;
- partners;
- download;
- dissemination;

- events;
- links;
- contacts.

Among these sections, the more interesting and user-friendly are download, dissemination, event and links. Referring to these sections, it is possible to consult and download several materials related to soil contamination issue. The download section, in particular, is made of three subsections: publications, where all works made in contaminated sites are listed, such as proceedings and Ph.D. thesis. The other two subsections are ECORMED paper and ECORMED results, where products and results obtained from the project activities can be consulted. Also, the section dissemination is made of three parts, where all the dissemination actions are presented as well as the interviews made during the project. The section “events”, instead, is rich of events organized by partners: from conferences to workshops. Finally, the section links show the logos of different national and international projects. With one simple click on the logo it is possible to access quickly to the website.

Links to social network such as Facebook, Twitter, and YouTube are shown on the right side of the homepage.

REFERENCES

European Commission (2006). *Communication from the Commission to the Council, the European Parliament, the European economic and social Committee and the Committee of the Regions. Thematic Strategy for Soil Protection*. COM 2006/231. Bruxelles.

European Commission (2001). *Comunicazione della Commissione al Consiglio e al Parlamento Europeo, al Comitato economico e sociale e al Comitato delle Regioni. Ambiente 2010: il nostro futuro, la nostra scelta. Sesto programma di azione per l'ambiente*. COM 2001/31. Bruxelles.

Mazzeo, G., & Russo, L. (2016). Aspects of Land Take in the Metropolitan Area of Naples. *Tema. Journal of Land Use, Mobility and Environment*, 9(1), 89-107. doi: <http://10.6092/1970-9870/3727>.

Zucaro, F., & Morosini, R. (2018). Sustainable land use and climate adaptation: a review of European local plans. *TeMA. Journal of Land Use, Mobility and Environment*, 11(1), 7-26. doi: <http://dx.doi.org/10.6092/1970-9870/5343>.

IMAGE SOURCES

The images are from: www.environmentalpollutioncenters.org/soil/; esdac.jrc.ec.europa.eu/themes/soil-contamination; www.ecoremmed.it.

THE TIMES THEY ARE A – CHANGIN 3(2019)

REVIEW PAGES: BOOKS AND JOURNALS

CARMEN GUIDA

TeMALab – Università degli Studi di Napoli Federico II, Italy

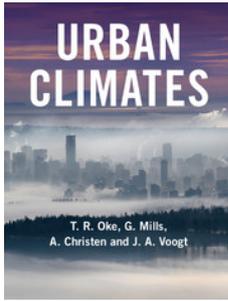
e-mail: carmen.guida@unina.it

In this number

CLIMATE CHANGE: TOWARDS ENGINEERING SOLUTIONS

The DICEA, Department of Civil, Building and Environmental Engineering of University Federico II of Naples, hosted, between the 7th and the 11st October, the first edition of the Short Mediterranean Ph.D. School on Impacts of Climate Change and Sustainable Engineering Responses. It was a great opportunity to highlight how climate change and the growth of urban population are widely recognized as the major drivers of change in the 21st century (Galderisi, 2014) and that engineering responses are useful both to mitigate the impacts of these phenomena and to adapt human environments, limiting their vulnerability.

The word *climate* derives from the Greek word *klima*, which means *inclination* and does not refer to weather forecasts but to the average status of the ocean-earth-atmosphere system in a long period, at least thirty years. According to IPCC (Intergovernmental Panel on Climate Change), climate change represents one of the most challenging issues of our time, and it refers to any change in climate over time caused both by natural variability and human activities. The exponential increase of GHG (Greenhouse gases) emissions during the last century is considered the main responsible of extreme weather events (Icaza, Van der Hoeven, & Van den Dobbelen, 2016). Urban environments play a double role in this scenario: on one hand urban lifestyle and economy are responsible for the 70% of GHG emissions (Gargiulo & Lombardi, 2016) and for the consumption of natural resources (Zullo et al., 2015); on the other, cities are both vulnerable and exposed to the impacts of climate change, so that they require serious and effective strategies in order to prevent the potential damage to urban population. Up to few years ago, major efforts have been paid to mitigation strategies, aimed at reducing GHG emissions, while less attention has been devoted to adaptation strategies, capable of improving cities' responses to phenomena related to climate change. The focus on adaptation strategies is due to the awareness that climate change will inevitably occur, and its impacts will be particularly severe in urban areas. Moreover, scientific models predict that by the end of the century the average temperature of global surface would increase of 2°C, that would produce irreparable damages to nature, human beings and animals: the XXI century could be remembered as the century during which people would have limited climate change, preserving resources to future generations. This awareness should further encourage policy makers to invest both in mitigation and adaptation strategies, starting from urban environments. The section "Books and Journals" is focused on engineering solutions, starting with the classification of urban climates and then defining strategies to make cities more resilient, both from the planning and the architectural point of view.



Title: **Urban Climates**

Author/Editor: T. R. Oke, G. Mills, A. Christen, J. A. Voogt

Publisher: Cambridge University Press

Publication year: 2017

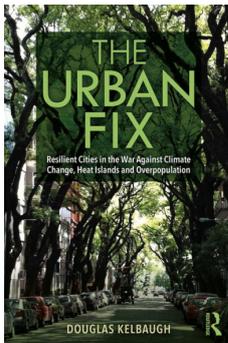
ISBN code: 9781139016476 (ebk)

Urban Climates is the first full synthesis of modern scientific and applied research on urban climates. The book begins with an outline of what constitutes an urban ecosystem. It develops a comprehensive terminology for the subject using scale and surface classification as key constructs. It explains the physical principles governing the creation of distinct urban climates, such as airflow around buildings, the heat island, precipitation modification and air pollution, and it then illustrates how this knowledge can be applied to moderate the undesirable consequences of urban development and help create more sustainable and resilient cities. With urban climate science now a fully-fledged field, this timely book fulfills the need to bring together the disparate parts of climate research on cities into a coherent framework. It is an ideal resource for students and researchers in fields such as climatology, urban hydrology, air quality, environmental engineering and urban design.

Urban climatology is concerned with interactions between a city and the overlying atmosphere. While interactions are two-way, this book is mainly focused on the impact of the city on the atmosphere. Urban development so fundamentally transforms the preexisting biophysical landscape that a city creates its own climate. The book also considers the effects of weather and climate on the city. As an object of study, a city initially presents a climatologist with a gloriously elaborate set of knotty challenges. They include questions of how to handle a dauntingly wide array of surface elements of very different sizes and compositions, along with the fact that the vast majority of them are alien to the natural landscape and include pulses of energy, water, gases and particles controlled by people rather than geophysical activity. Given these challenges and the desire of the rapidly growing world to live in cities, the book begins with an outline of the idea of urban ecosystems and suggests ways to approach the study of urban climates. Chapter 2 sets out a central theme of the book: to understand and effectively communicate about urban climate systems, a set of common terms, symbols, units, and descriptions of the urban surface is required. Here the authors adopted the Oke (1984) classification of urban climate systems that is built on scales of surface organization set by the roughness elements (mainly built structures) and scales of atmospheric motion and vertical stratification to systematize discussion. Chapter 3 is an overview of techniques used to obtain valid field observations and model results. The main exchange processes governing the budgets of momentum and radiation and the balances of heat, water, and carbon in cities are outlined. This permits description and analysis of the spatial distribution and dynamics of airflow, temperature, humidity, greenhouse gases, and air pollutants in urban areas in Chapters 4 through 11. These and other cloud processes are relevant to the potential effects of cities on cloud development, precipitation, and severe weather.

Urban air pollution has been a bane of urban living for centuries, but the mix of emissions keeps changing over history, as does the urban atmosphere into which it must be dispersed. It is useful and necessary to view things through the prism of scale. The text to this point deals with cases where micro and local effects are the prime controls on climate. On the other hand, Chapter 12 considers the role of orographic and coastal controls on urban climate, and the significance of the synoptic and macroclimatic context of a city.

In Chapter 13, the scale expands further to consider the increasing impacts of cities on global climate and how the altered state of that system in turn imposes impacts on city life. Chapter 14 introduces the fundamental climatic requirements of humans, our need for shelter and a comfortable environment to live and work, and how they set the context for the construction of appropriate buildings and urban infrastructure. In Chapter 15 we appeal to the principles outlined in the rest of the book to discuss ideas about intelligent and effective use of design elements such as construction materials, shade, shelter, water, and vegetation to create or modify urban climates at all scales. *Urban Climates* is thought to be a 'first' because it is a text designed to elucidate the general principles of the subject. There was an early attempt to do this in Chinese (Shuzhen and Chao, 1985), but this is the first in English.



Title: **The Urban Fix: Resilient Cities in the War Against Climate Change, Heat Islands and Overpopulation**

Author/Editor: Douglas Kelbaugh

Publisher: Taylor & Francis

Publication year: 2019

ISBN code: 9780429614453

Cities are one of the most significant contributors to global climate change. The rapid speed at which urban centers use large amounts of resources adds to the global crisis and can lead to extreme local heat. *The Urban Fix* addresses how urban design, planning and policies can counter the threats of climate change, urban heat islands and overpopulation, helping cities take full advantage of their inherent advantages and new technologies to catalyze social, cultural and physical solutions to combat the epic, unprecedented challenges humanity faces. The book fills a conspicuous void in the international dialogue on climate change and heat islands by examining both the environmental benefits in developed countries and the population benefit in developing countries. Urban heat islands can be addressed in incremental, manageable steps, such as planting trees and painting roofs white, which provide a more concrete and proactive sense of progress for policymakers and practitioners. This book is invaluable to anyone searching for a better understanding of the impact of resilient cities in the monumental and urgent fight against climate change and provides the tools to do so. The book is a collection of several studies, researches, professional and teaching practices.



Title: **Domus Ecoworld**

Editor-in-chief: Michele De Lucchi.

Print ISSN: 0012-5377

EcoWorld 2019 is the annex of Domus, an architecture and design journal, founded in 1928. Domus is listed as a Class A journal, according to the Italian Agency of Evaluation of University and research. EcoWorld 2019 tries to answer many questions related to the way architects and designers have to follow the 17 Global Goals, with the advice of Arup.

EcoWorld 2019 presents the main designing practices of current days and identifies potential policy areas, in order to meet the objectives defined by major world powers in 2015, as the evolution of those Millennium Development Goals signed in 2000, which were more focused on the poverty and needs of developing countries. Agenda 2030 has a wider range of action that previous agenda. Its 17 goals are very close to

designing practices, even though the difficulty in defining the sustainability language makes complex its translation into practical procedures.

EcoWorld is made of four essays that explore topics related to cities and complex systems, through the identification of best practices made by Piero Pelizzaro – chief resilience officer at the Municipality of Milan – and a discussion concerning how powerful the architecture could be in “saving the world” by Richard Ingersoll – who highlights that territorial planning strategies are the more effective tools in order to provide concrete answers to climate change. Paolo Cresci and Jo Da Silva’s works are on building practices and the main principles to design for man and nature, as also stated by four other international experts, interviewed by Domus. The journal also collects several architectural and design projects, selected worldwide, whose main topic is water saving and conservation.

REFERENCES

Galderisi, A. (2014). Climate Change Adaptation. Challenges and Opportunities for a Smart Urban Growth. *Tema. Journal of Land Use, Mobility and Environment*, 7 (1), 43-68. <https://doi.org/10.6092/1970-9870/2265>.

Gargiulo, C., & Lombardi, C. (2016). Urban retrofit and resilience: the challenge of energy efficiency and vulnerability. *Tema. Journal of Land Use, Mobility and Environment*, 9 (2), 137-162. <https://doi.org/10.6092/1970-9870/3922>.

Icaza, L.E., Van der Hoeven, F., & Van den Dobbelsteen, A. (2016). Surface thermal analysis of North Brabant cities and neighbourhoods during heat waves. *Tema. Journal of Land Use, Mobility and Environment*, 9 (1), 63-87. <https://doi.org/10.6092/1970-9870/3741>.

Kelbaugh, D. (2019). *The Urban Fix: Resilient Cities in the War Against Climate Change, Heat Islands and Overpopulation*. London: Routledge.

Oke, T.R., Mills, G., Christen, A., & Voogt, J.A. (2017). *Urban climates*. Cambridge: Cambridge University Press.

Zhou Shuzhen, & Zhang Chao (1985). Effects of 4 Thermal Islands on Urban Climate of Shanghai, in *Urban Climate and Planning*. Beijing: Science Press, (in Chinese). 128-137.

Zullo, F., Paolinelli, G., Fiordigigli, V., Fiorini, L., & Romano, B. (2015). Urban development in Tuscany. Land uptake and landscapes changes. *Tema. Journal of Land Use, Mobility and Environment*, 8 (2), 183-202. doi: <https://doi.org/10.6092/1970-9870/2864>.

IMAGE SOURCES

The images are from: <https://www.ilpost.it/2016/11/12/venezia-acqua-alta-foto/>

THE TIMES THEY ARE A – CHANGIN 3 (2019)

REVIEW PAGES: LAWS

FEDERICA GAGLIONE

TeMALab – Università degli Studi di Napoli Federico II, Italy

e-mail: federica.gaglione@unina.it



In this number

“IMPROVE THE SUSTAINABILITY OF CITIES THROUGH SOFT MOBILITY”

The World Health Organization report estimates that the population in urban areas will continue to expand by over 1.5% per year until 2030 (WHO, 2010). Rapid urbanization implies, on the one hand, the need to satisfy a greater demand for travel in terms of access to urban places and services, but, on the other, it entails negative consequences for the urban system, such as increased traffic congestion, atmospheric and acoustic pollution. This phenomenon requires the implementation of measures within cities aimed at spreading alternative modes of transport to the motorized one, which is still the most used transport mode, also for short distance trips. Encouraging pedestrian and cycle travels is a priority action to minimize urban air and noise pollution.

One of the possible solutions to discourage the use of private vehicles, without compromising the economic growth of cities and the possibility of accessing the services offered, is the creation of pedestrian and cycling networks, provided that their realization is effectively supported by road users (Masoumi & Shaygan, 2016).

The benefits of shifting from car use to cycling for urban trips would include saving 150 g of CO₂ per kilometre. For example, cycling 7 km would save 1 kg of CO₂ emission – compared to the same distance travelled by car – and could be a means to contribute to the pursuit of the goals of global sustainability set by the European Union in the context of international agreements for the transport sector. In favour of sustainable urban mobility, the European Union has promoted initiatives aimed at encouraging journeys on foot and by bicycle. In particular, the European Commission Work Programme for 2018 calls for the inclusion of an EU Roadmap for Cycling to take advantage of the environmental, health and economic cycling benefits. This document recommends a paradigm shift in transport policies to the European Commission, requiring a new sustainable hierarchy that gives priority to active modes of travel (walking or cycling). It highlights the need to promote, within the planning instruments, the improvement of pedestrian and cycling access to public transport stops and the realization, at the interchange points, of safe, attractive and easily accessible parking areas for the bicycles (available to all) and possible bike-sharing services, with the aim of increasing cycling mobility in the EU Member States over the next 10 years. It also underlines the active participation of local and regional authorities in compliance with the principles of subsidiarity, given that mobility and urban transport are the responsibility of local and regional authorities. Furthermore, cycling must become a distinct funding priority in the EU Research and Innovation programme called Horizon 2020 (Mobility for Growth).

In this perspective, it is recommended that the EC (Eurostat), on the one hand, draws up national documents as well as a database of good practices and an exchange of knowledge for the provision of cycling infrastructure, in order to obtain reliable and comparable data, on the other hand, that it develops a common methodology for collecting data and adopting harmonized definitions for national and urban data on bicycle use. It also proposes to include EuroVelo (the long-distance cycle route network) in the trans-European transport network (TEN-T), thus improving cross-border connections, developing tourism opportunities and increasing urban accessibility.



Cycling mobility

To achieve the set objectives, Law n. 2 of January 11, 2018 concerning the development of bicycle mobility provides for the creation of a national cycling route network aimed at developing the use of the bicycle as a means of transport to meet both daily and leisure needs and boost the tourist activity. The Member States, together with regions, local authorities and other interested parties, must pursue these objectives in order to make cycling a fundamental component of their mobility policies (Art. 1). In addition, the law introduces the regulatory definitions of cycle route, cycle route network, greenway, cycle path and their classification (Art. 2). Art. 3, in line with the objectives and aims of Article 1, provides for the adoption of a general three-year cycling mobility plan, which must be an integral part of the general plan for transport and logistics. The Plan will be adopted by decree of the Minister of Infrastructure and Transport, after consulting the Minister of the Environment and the Protection of the Territory and the Sea and the Minister of Cultural Heritage and Tourism, having subscribed to the agreement during the State-Regions and Autonomous Provinces Conference, and will be addressed to two specific areas of intervention:

- the development of cycling mobility in urban and metropolitan areas;
- the development of cycling mobility on routes defined at regional, national and European level.

The general plan for cycling mobility can be revised annually to take into account and incorporate future updates and amendments. Art. 4 regulates the identification of cycle paths of national interest that will constitute the national cycle network called "Bicitalia", the national-level infrastructure network that must be integrated into the "EuroVelo" trans-European network system within the plan for cycling mobility. This article defines some of the features of the Bicitalia network, such as:

- total development of no less than 20,000 km, articulated on routes throughout the national territory;
- integration and interconnection with the infrastructural networks supporting the other modes of transport, as well as with the other cycle networks in the area;
- continuity and interconnection with urban cycle networks, also through the construction of pedestrian areas and limited traffic zones, as well as through the adoption of traffic mitigation measures.

The financial, public and private resources allocated to cycling mobility and the identification of the methods of financing interventions are outlined in the Plans for cycling of municipalities and metropolitan cities. In order to achieve the aims of the provision, Art. 5 also requires that the regions prepare and approve, consistently with the regional plan of transport and logistics, a regional cycling mobility plan, lasting three years, to regulate the entire regional cycling system. The regional plan must be drawn up in accordance with the urban plans for sustainable mobility and the related programmes and projects presented by the municipalities and metropolitan cities; it must also define, among other things, the regional cycle network and the cycle routes included in the network called "Bicitalia". Metropolitan cities and non-metropolitan municipalities must define

the urban plans for cycling mobility (as regulated in Art. 6), called "Biciplan", which constitutes the sector-specific plan of the Sustainable Urban Mobility Plan (SUMP). Within this document, the municipalities should also outline the objectives, strategies and actions needed to promote the bicycle use. More in detail, Art. 6 includes the contents of the urban plans for cycling mobility, which define:

- the network of priority cycling routes or cycle paths in the municipal area that connects and crosses parts of the city along the main traffic routes, with efficient and safe infrastructures;
- the secondary network of cycle paths in neighbourhoods and inhabited centres;
- the network of green cycle paths that connects the green areas and the city parks to the rural areas of the municipal area;
- interventions that aim at the realization of networks, in coherence with the provisions of the superordinate sector-specific plans;
- the connection between the networks and the interventions defined in the previous points and the identification of areas of the city where priority must be given to cycle paths, roads 30 and pedestrian areas, and limited traffic zones;
- interventions that can be carried out on the main intersections with vehicular traffic, on the most dangerous points of the road network for pedestrians and cyclists and on the crossing points of large railway or motorway infrastructures;
- the objectives to be achieved in the territory of the municipality or the metropolitan city, in the three-year period of reference, in relation to the use of the bicycle as a means of transport, to the safety of cycling mobility and the modal split;
- any actions to encourage the use of bicycles for the daily commute to school or to work;
- interventions aimed at favouring the integration of cycling mobility with urban, regional and national public transport services;
- actions aimed at improving cyclist safety;
- actions aimed at combating bicycle theft;
- any useful actions to extend the spaces reserved for bicycle parking, primarily in proximity to school buildings, and those used for public functions or located near the main modal interchange nodes; actions to spread the use of bicycle sharing services (bike sharing);
- types of freight or people transport services that can be carried out by bicycles;
- the three-year financial program for the implementation of the interventions defined by the plan within a financial framework.

The Directorate-General for Climate and Energy, with the Ministerial Decree no. 417 of December 21, 2018, "Sustainable Urban Mobility Incentive Program", finances sustainable mobility projects in the municipalities with a population of not less than 50,000 inhabitants. In particular, it encourages the realization of projects involving the construction of new cycle paths capable of responding to the demand of daily commuter flows and the development of sharing mobility in urban areas.



City of Biella
BICIPLAN 2019-2021

In Italy, for example, the Municipality of Biella approved the Urban Plan for Cycling Mobility called "BICIPLAN" with a resolution of the City Council no. 18 of March 13, 2019. Within this Plan, the Municipality of Biella has set itself the objective of improving the safety of existing road connections through planned and widespread routine

maintenance to facilitate inflows and outflows and viability of vehicles, bicycles, pedestrians/sportsmen (improving the efficiency of public infrastructure), and to reduce traffic flows with interventions on the path direction and on critical pedestrian crossings, in order to improve cycling and pedestrian safety.

The provisions of the National Road Safety Plan (aimed at reducing the social costs deriving from road accidents and at improving air quality), regulate the creation of protected and reserved routes to: connect the pedestrian and bicycle tracks on urban and extra-urban stretches (through a reduction of the width of the roadway to slow down the speed of vehicles, a widening of pavements, the insertion of barriers to save pedestrians, the construction of raised pedestrian crossings with luminous signals, the removal of architectural barriers, a reorganization of vertical and horizontal signs to secure bus stops); strengthen the cycle network, in compliance with the technical standards required by the regulations, for sustainable mobility to support and enhance the usability of urban sites, starting from the busy main roads to encourage the use of bicycle as an alternative means of transport. These documents outline the need for a significant cultural change of the part of users who live in the city, depending on their will to change habits and behaviour.

The implementation of pedestrian and cycle networks, therefore, becomes a fundamental component to make cities more accessible to all, but also a new support able to enhance the historical and cultural heritage of the cities. In fact, the positive environmental impacts of the reduction of polluting emissions and the consequent overall improvement of air quality facilitates policies of re-appropriation of historical places of aggregation that can really make a cultural and social difference only without traffic congestion.

REFERENCES

WHO (2010). *Hidden cities: Unmasking and overcoming health inequities in urban settings*. Technical Report. Geneva: World Health Organization.

Masoumi, H.E., & Shaygan. M. (2016). A Longitudinal Analysis of Densities within the Pedestrian Sheds around Metro Stations. The Case of Tehran. *Tema. Journal of Land Use, Mobility and Environment*. S.I. 5-20. doi: 10.6092/1970-9870/3908.

Comitato Europeo delle Regioni (2017). *Una tabella di marcia dell'UE per la mobilità ciclistica. Parere (2017/C088/10)*. Gazzetta Ufficiale dell'Unione Europea, 21 marzo 2017. Retrieved from: <https://eur-lex.europa.eu/legal-content/IT/TXT/?uri=CELEX%3A52016IR1813>.

Comune di Biella (2019). *Piano Urbano della Mobilità Ciclistica "BICIPLAN"*. DGC n. 18 del 13/3/2019, "Studio Generale per la Mobilità Ciclabile". Retrieved from: <http://www.comune.biella.it/web/atti-pubblicazioni/biciplan-piano-urbano-della-mobilita-ciclistica-programma-finanziario-attuazione>.

Legge 11 gennaio 2018, n. 2. *Disposizioni per lo sviluppo della mobilità in bicicletta e la realizzazione della rete nazionale rete nazionale Bicalia, ciclovie regionali e locali*. Retrieved from: <https://www.gazzettaufficiale.it/eli/id/2018/01/31/18G00013/sg>.

IMAGE SOURCES

The images are from: <https://www.bikeitalia.it/2014/04/15/rapporto-oms-con-la-mobilita-in-bici-76-mila-posti-di-lavoro-e-10-mila-morti-in-meno/>; <https://www.canaleenergia.com/rubriche/smart-city/mobilita-attiva-e-la-giornata-mondiale-della-bicicletta/>

THE TIMES THEY ARE A – CHANGIN 3(2019)

REVIEW PAGES: URBAN PRACTICES

GENNARO ANGIELLO

TeMALab – Università degli Studi di Napoli Federico II, Italy

e-mail: gennaro.angiello@unina.it

In this number

PLANNING FOR URBAN RESILIENCE IN NORTH AMERICA: TWO CASE STUDIES

With a greater concentration of people and assets in urban areas, cities need to address an increasingly complex range of shocks and stresses to safeguard development gains and well-being. Managing disaster risk and the impacts of climate change have long been an important focus of urban resilience (Galderisi, 2014; Galderisi, Mazzeo & Pinto, 2016), but recent examples have shown how economic crises, health epidemics, and uncontrolled urbanization can also affect the ability of a city to sustain growth and provide services for its citizens, underscoring the need for a new approach to resilient urban development. In response of these concerns, in the last few decades, researchers from different disciplines have started investigating the meaning, aspects and elements of urban resilience, suggesting that resilience is a complex and multifaced concept with wide implications for planning practices (Salat and Bourdic, 2012), also arguing that achieving resilience in urban areas requires a strong partnership between local governments, research centers, the non-profit sector, businesses, and communities (Stumpp, 2013). Within this context, several initiatives involving both public and private stakeholders have been created in the last few years, aimed at fostering resilience in urban areas. A notable example in this direction is the *100 Resilient Cities* initiative, pioneered by the Rockefeller Foundation. The initiative represents one of the most remarkable effort to helping cities around the world become more resilient to the physical, social and economic challenges that are a growing part of the 21st century. The 100 Resilient Cities programme defines urban resilience as “the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience”. Based on this definition, a “*City Resilience Framework*” (CRF) has been established. The framework provides an innovative model for the local authorities to develop a holistic city strategy in collaboration with adjacent municipalities, local academic institutions, private stakeholders, and communities of the city and represents the foundation for the developments of a city resilient strategy. The programme has been established in 2013, in honor of Rockefeller’s 100th anniversary, and had initial funding of \$100 million (although the level of funding support has grown since the programme was launched). Since then, 102 cities worldwide have joined the programme, and 68 Resilience Strategies (with nearly 3,000 concrete actions and initiatives) have been developed.

This contribution presents two relevant Resilient Strategies, developed in two North American cities, within the 100 Resilient Cities framework: i) the Toronto Resilient Strategy and ii) the Chicago Resilient Strategy. Beside pertaining to the same geographic area, the two cities have been selected because they share a great portion of physical,

social and economic challenges, including: a) aging and poorly maintained infrastructures; b) persistent social inequalities and c) lack of civic engagement in decision making.



RESILIENT CHICAGO

A Plan for Inclusive Growth and a Connected City

With an estimated population of 2,705,994 (2018) Chicago is the most populous city in the U.S. state of Illinois and the third most populous city in the United States. As home to more than 400 major corporations, Chicago has one of the most diversified urban economies in the United States and is considered as an international hub for finance, culture, commerce, industry, education, technology, and transportation.

Time and again, the city has proven its ability to take on challenges and achieve unprecedented accomplishments. For instance, after the Great Fire of 1871 which destroyed several square miles and left more than 100,000 homeless, Chicago residents helped the city rise from the ashes and rebuilt a stronger, smarter, and reimagined urban landscape with innovations such as the modern skyscraper. With the reversal of the Chicago River in 1900, Chicago took a critical step to protect the city's supply of clean drinking water and Lake Michigan.

Despite all of Chicago's strengths, the city still faces many challenges. A rich history of migration and immigration has undoubtedly shaped the character and vibrancy of Chicago's neighborhoods, yet discriminatory practices and policies have caused disparities that disproportionately burden the city's most vulnerable residents. Beside persistent social inequalities, another important key challenge for the city is related to its aging urban infrastructures. Indeed, Chicago relies on aging infrastructures for many of its critical services. Nearly one quarter of Chicago's water mains are more than 100 years old, and the majority of its bridges were built before 1950.

In order to face these and other relevant urban challenges, on February 2019, the city of Chicago released its Resilience Strategy with the support of the 100 Resilient Cities initiative. The strategy aim is to create "a more connected city where residents, neighborhoods, institutions, corporations, and government agencies are successfully connected in pursuit of economic opportunity, safety, security, and sustainability for all". The strategy is organized around three pillars and 12 main goals which reflect the city's vision and needs for Chicago's future:

- **PILLAR I: STRONG NEIGHBORHOODS.** Chicago has always been a city of neighborhoods. However, as the city changed over time, disparities between neighborhoods has drastically increased, with poorer neighborhoods suffering for lack of accessibility to essential opportunities such as health, education and employment. The main aim of this pillar is thus to ensure that every resident in every neighborhood has the access and opportunity to participate in the social and economic life of Chicago. To meet this goal, the strategies proposes a series of coordinated actions, including; i) expand Transit-Oriented Development (TOD) to bus route to connect neighborhood and provide equitable access to opportunities; ii) expand affordable housing options in gentrifying neighborhood to protect economically vulnerable residents from the risk of displacement; iii) connect local institutions with resources, and coordinate programs and policies to make them more accessible to residents; iv) sustain initiatives aimed at developing skill sets for younger generations that will make up the city's future workforce.
- **PILLAR II: ROBUST INFRASTRUCTURES.** Pillar II brings together actions to improve the city's infrastructures so that they can create healthier, more resilient and safe urban environment for residents and visitors. Action under this pillar include initiatives target at improving transportation infrastructures, hydraulic networks and blue and green infrastructure. In particular the strategy envisions: i) new transportation and mobility options to be prioritized in neighborhoods traditionally disconnected from

areas of economic prosperity, thereby supporting access to jobs and workforce development opportunities ii) additional investments in hydraulic infrastructures that can reduce the risk of flooding, iii) additional investments in green infrastructure aimed at improving air and water quality, mitigate the urban heat island phenomenon, reduce greenhouse gas (GHG) emission, while improving at the same time livability conditions due to increased access to green spaces.

- PILLAR III: PREPARED COMMUNITIES. This pillar emphasizes the fundamental role of the Chicago's community in building urban resilience. According to this pillar, Chicagoans must be able to access resources, avail themselves of services, and communicate with ease in times of crisis. Furthermore, residents must be equipped with the relationships, skillsets, and knowledge base to anticipate and, when necessary, overcome challenging times. Actions under this pillar are mainly target at: i) leverage technology to increase accessibility and impact of information; ii) increase social connectedness and personal resilience of city first responders to better serve residents and iii) increase social connectedness and personal resilience of city first responders to better serve residents.



TORONTO First Resilience Strategy

Toronto is the provincial capital of Ontario and the most populous city in Canada, with a population of 2,731,571 as of 2016. The city is the anchor of the Golden Horseshoe, an urban agglomeration of 9,245,438 people surrounding the western end of Lake Ontario. It is an international centre of business, finance, arts, and culture, and is recognized as one of the most multicultural and cosmopolitan cities in the world.

For thousands of years before colonization, it was a place where many Indigenous communities would meet to trade, exchange ideas, and solve resilience challenges; today, Toronto continues to be a place for creating innovative solutions to resilience challenges.

However, Toronto has experienced a surge of growth over the past 20 years which has brought new opportunities and challenges. Among its most important challenges, social and geographical inequalities represent an issue of major concern for citizen and policy makers. Indeed, over the past 50 years, segregation in Toronto by race and income has worsened. Torontonians of different backgrounds are increasingly not living side by side and Toronto's non-White residents are disproportionately concentrated in low-income neighbourhoods. Beside issues related to spatial and social inequalities, urban mobilities also represent an important challenge for the city. Indeed, a mix of congestion, long commutes, and slow progress on transit and active transportation expansion is seriously affecting urban quality of life for Toronto's resident, with wide implication on the economy of the city and on the city's environment. These problems are particularly acute in neighbourhoods outside the city's core that are still heavily reliant on cars to get around, partly because they lack the mix of safe, reliable mobility options. Finally, a lack of diversity of those in power positions and the consequent inequity in decision-making has resulted in low levels of trust and civic engagement, both with government and within communities.

In response, the city of Toronto released its Resilience Strategy on April 2019, within the context of the 100 Resilient Cities programme. The strategy envisions a city where "residents feel empowered to help shape their communities and where government works in deep collaboration with the people it represents to advance an agenda of fairness and prosperity for everyone". The strategy is based on three main pillars and ten main goals:

- PILLAR I: PEOPLE AND NEIGHBOURHOODS. This pillar focuses on supporting residents, businesses, and communities to make Toronto's neighbourhoods more resilient.

It includes a focus on supporting Torontonians at home and in their neighbourhoods. A coordinate mix of action are envisioned under this pillar including: i) support homeowners and renters to prepare their

- homes for shocks; ii) enable wide-scale change in apartment towers to improve resilience through the improvement or retrofit of apartment towers and units; iii) enhance the capacity of neighbourhoods to prepare for and recover from shocks through grassroots action and network building; iv) prioritize the implementation and resourcing of the Toronto Poverty Reduction Strategy.
- PILLAR II: INFRASTRUCTURES AND ENVIRONMENT. This pillar addresses the environmental component of urban resilience. Its main aim is to protect natural green and blue areas while providing the city with an infrastructure system that is well-connected, modern, flexible, diverse and resilient to extreme natural hazards. Several actions will concur to the achievement of these objectives. These includes, among others: i) institutionalize an integrated, resilience approach to flooding by adopting the Flood Resilient Toronto Charter; ii) centralize resources towards a city-wide flood planning and prioritization tool; iii) review and update existing flood mitigation programs to account for resilience and iv) take action to mitigate the effects of extreme heat. This pillar also addresses the pressing issue of urban mobility. Actions under this theme are: i) create a city-wide mobility action plan through synthesis of ongoing mobility initiatives and priorities, and identification of resilience gaps; ii) move more people more efficiently within the existing rights of way by expanding demonstration projects and iii) improve integration between transportation investments and land use planning with the aim of creating walkable, mixed communities around transportation system main nodes.
 - PILLAR III. LEADING A RESILIENT CITY. This pillar focuses on the City of Toronto's role as the leader on resilience for residents, businesses, and partners. It includes changing how the City does business to lead a more resilient city. Action under this pillar are target toward improving trust and civic engagement by e.g. expanding corporate civic engagement initiatives and increase transparency and prioritize communications in the daily management of the city. Finally, under this pillar, the City intends to prioritize the most vulnerable people at highest risk of exclusion in decision-making.

REFERENCES

City of Chicago (2019). *Resilient Chicago. A Plan for Inclusive Growth and a Connected City*. Available at: <https://www.100resilientcities.org/strategies/chicago/>

City of Can TORONTO (2019). Toronto's First Resilience Strategy. Available at: <https://www.100resilientcities.org/strategies/toronto/>

Galderisi, A. (2014). Climate change adaptation. Challenges and opportunities for a smart urban growth. *Tema. Journal of Land Use, Mobility and Environment*, 7(1), 43-68. doi: <http://dx.doi.org/10.6092/1970-9870/2265>.

Galderisi, A., Mazzeo, G. & Pinto, F. (2016). Cities dealing with energy issues and climate-related impacts: Approaches, strategies and tools for a sustainable urban development. In R. Papa & R. Fistola (Eds.), *Smart Energy in the Smart City. Urban Planning for a Sustainable Future* (pp. 199-217). Springer International Publishing, Switzerland. doi: https://doi.org/10.1007/978-3-319-31157-9_11.

Salat, S., & Bourdic, L. (2012). Systemic resilience of complex urban systems. *Tema. Journal of Land Use, Mobility and Environment*, 5(2), 55-68. doi: <http://dx.doi.org/10.6092/1970-9870/918>.

Stumpp, E. M. (2013). New in town? On resilience and "Resilient Cities". *Cities*, 32, 164-166. doi: <https://doi.org/10.1016/j.cities.2013.01.003>.

IMAGE SOURCES

The images are from: <https://www.100resilientcities.org> and <https://www.tripadvisor.com/>.

THE TIMES THEY ARE A – CHANGIN 3(2019)

REVIEW PAGES: NEWS AND EVENTS

ANDREA TULISI

TeMALab – Università degli Studi di Napoli Federico II, Italy
e-mail: andrea.tulisi@unina.it

In this number

THE CLOUD VOLUME OF THE SMART CITY

In the twelfth edition of *Manifesta*, the biennial of contemporary art held in Palermo last year, there was an interesting installation by John Gerrard at Palazzo Ajutamicristo: the American artist has produced a detailed photographic survey of one of the main physical sites of Internet, the Google data center in Oklahoma; it is a huge structure composed of buildings of thousands of square meters that receive and distribute “immaterial” data produced every day in different parts of the world.

The interesting aspect of this operation lies in the ability to give body and volume to those that in the collective imagination are perceived as completely abstract and ephemeral networks that pervade our cities, providing them with a lot of services at “zero volume”.

According to IDC, an international IT consultancy agency, the global data sphere is expected to grow to 163 billion zettabytes by 2025 (one ZB equals one trillion gigabytes), which is ten times more than the 16.1 ZB of data that existed just two years ago. More than a quarter of this data will be real-time and, of the latter, the real time IoT data will be more than 95%. Unthinkable numbers in 1986, when, according to Gartner, the volume of data in circulation amounted to only 281 petabytes (a petabyte is a millionth of a zettabyte).

Nonetheless, this constantly growing flow of data requires enormous collection centres to archive and process it; furthermore, due to the great success of the cloud this huge amount of data is not distributed in millions of devices in the world but increasingly preserved in large structures, which occupy huge areas, consume a huge amount of energy (Rong et al., 2016) and affect the economic strategies of territories and city.

In Norway, for example, the government is focusing heavily on the data center asset as strategy to repopulate the internal areas as well as an important growth sector for the entire country; it is expected that the construction in a small village in the north of the polar circle of one of the largest data centers in the world, will bring a significant increase of about 10/15000 employees in the entire area, thus enhancing the job opportunity of the two hundred students that each year graduate in technology at universities nearby.

Therefore, the data, considered by most as the black gold of the twenty-first century, will take on increasingly more substance and volume, becoming places, defining spaces and thus establishing a tangible dialogue with territories and cities. In the current academic context, the issue raised has not received particular interest from researchers, more focused on the potential of smart cities in terms of city services improvement (Angelidou, 2017); the conferences selected are therefore mainly focused on the theme of the smart city;

however, it would be interesting to contribute to enrich the debate on the topics proposed in the conferences with the suggestions created in this article.

THE SMART CITY EVENT



Where: Fort Lauderdale, Florida, USA

When: 11-14 February, 2020

<https://www.thesmartcityevent.com/>

One of the main events of this conference is the IoT Evolution's Smart City Event, focused on showing attendees how smart city innovations are changing the face of the today's modern city, improving quality of life for citizens and driving enterprise opportunity. In particular, the specific topics proposed are the following:

- 5G and smart city rollouts
- Regulatory issues and smart city rollouts
- Smart Transport and telematics
- Heterogenous networks - enabling smart city applications

THE MEETING OF THE MINDS 2020 ANNUAL SUMMIT



Where: Phoenix, USA

When: 19-21 February, 2020

<https://events.meetingoftheminds.org/motm2020>

Each year, more than 500 urban practitioners convene at the Meeting of the Minds Annual Summit to showcase recent successes and to discuss the ongoing challenges facing the future of smart and sustainable cities. The main idea is that a city really smart can make the living conditions of the population much more pleasant and can reduce budgetary costs by deploying smart services; therefore, the solution in today's conditions is to manage cities using information technology and communication, where millions of citizens may enjoy the maximum benefit of a project of this kind.

NORDIC SMART CITIES 2020



Where: Copenhagen, Denmark

When: 19th March, 2020

<https://www.nordicsmartcities.com/>

The underlying concept of this conference is that nowadays the technology offers an opportunity to change our cities for the better, but it is just an enabler, not the solution, the people must come first.

For this reason bringing citizens, politicians & city halls together to co-create outside of the box solutions to some of our biggest challenges City leaders need new ways of thinking about planning, designing & building our cities - putting the citizen & liveability at the heart of all future projects, developments & transformations. Every city or municipality is different, with different challenges and a different culture - for cities to become really smart they must embrace their unique context.

SMART CITIES CONNECT



Where: Denver, USA

When: 6-9 April, 2020

<https://spring.smartcitiesconnect.org/>

Smart Cities Connect Conference and Expo offers a comprehensive conference, exposition and accelerator of smart city innovation in North America. It aims to deliver premium networking and educational opportunities with a keen focus on city leaders and their priorities.

In particular the main issues of the conference will be the followings:

- Community Engagement (Policy, Funding, Commerce, Inclusion, Governance);
- Digital Transformation (Data, AI, Sensors, IoT, Cyber Security, Privacy, Blockchain);
- Smart Mobility (Transportation, Autonomous, Public Transit, Ride Share);
- Urban Infrastructure (Networks, 5G, Utilities, Energy, Grid, Lighting, Water/Waste);
- Urban Operations (Public Safety, Planning, Emergency Response, Sustainability).



REAL CORP 2020

Where: Aachen, Germany

When: 15-18 April, 2020

<https://conference.corp.at/>

The conference is the result of a reflection on the main trends that the cities of the world have in common in this historical moment, thus trying to stimulate a discussion on strategies and concepts for quality change management in the light of the main challenges which arise in neighborhoods, cities, urban regions and metropolitan areas. This also raises the question of who the actual actors of current urban, regional and metropolitan regional development are and what role planners can play in the corresponding scenarios. One of the raised argument is the role that the new technologies and digitization play in the development of cities, urban regions and metropolises; it will discussed in the session called "Cities and Technologies, Real Smart Cities, Intelligent Cities – High Tech and High Quality of Life: Best Practices and Concepts for the Future".

REFERENCES

Angelidou, M. (2017). Smart city planning and development shortcomings. *Tema. Journal of Land Use, Mobility and Environment*, 10(1), 77-94. <https://doi.org/10.6092/1970-9870/4032>

Rong, H., Zhang, H., Xiao, S., Li, C., & Hu, C. (2016). Optimizing energy consumption for data centers. *Renewable and Sustainable Energy Reviews*, 58, 674-691. <https://doi.org/10.1016/j.rser.2015.12.283>

IMAGE SOURCES

<https://dribbble.com/shots/4863403-Power9-Chip-City>

AUTHORS' PROFILES

Gennaro Angiello

Engineer, Ph.D. in Civil Systems Engineering at the Federico II University of Naples. His research interests are in the field of accessibility analysis and modeling, land-use and transport interactions and sustainable mobility. He was involved in the research project Smart Energy Master and in the COST Action TU1002 accessibility Instruments for Planning Practice in Europe.

Federica Gaglione

Engineer, Ph.D. student in Civil Systems Engineering at University of Naples Federico II. Her research topic concerns the urban accessibility. The aim is to develop a decision support tool that, on an urban scale, allows to choose the most effective actions to improve urban accessibility for vulnerable users, by contributing to improve their quality of life.

Carmen Guida

Engineer, Ph.D. student in Civil Systems Engineering at University of Naples Federico II. She received a master degree in Hydraulic and Transport Systems Engineering at University of Naples Federico II with a thesis on the safety performance of urban intersections, developed at University of Central Florida, Orlando (U.S.). Currently, her PhD research concerns accessibility to urban services for elderly people with the aim of minimizing social exclusion and inequalities within urban areas.

Rosa Morosini

Engineer, Ph.D. student in Civil Systems Engineering at University of Naples Federico II. Her research topic concerns the urban planning transformations and soil consumption. The purpose is to identify supporting tools for the local authorities with the aim of minimizing the use of this resource and make it a sustainable use.

Andrea Tulisi

Architect graduated in Architecture from the University Federico II in Naples in 2006. In January 2014 holds a PhD in Environmental Technology with a research focused on rehabilitation strategies for semi-enclosed spaces in the "Compact City". He was involved in the project Smart Energy Master at the DICEA department of the University of Naples Federico II. His research activity is focused on the link between urban open spaces and energy consumption.