TeMA

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The fragile/resilience city represents a topic that collects itself all the issues related to the urban risks and referred to the different impacts that an urban system has to face with. Studies useful to improve the urban conditions of resilience are particularly welcome. Main topics to consider could be issues of water, soil, energy, etc..

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TeMA

Journal of
Land Use, Mobility and Environment

CALL FOR PAPERS: TEMA VOL. 11 (2018)

The Resilience City/The Fragile City.
Methods, tools and best practices.

The fragile/resilience city represents a topic that collects itself all the issues related to the urban risks and referred to the different impacts that an urban system has to face with. Studies useful to improve the urban conditions of resilience (physical, environmental, economical, social) are particularly welcome. Main topics to consider could be issues of water, soil, energy, etc.. The identification of urban fragilities could represent a new first step in order to develop and to propose methodological and operative innovations for the planning and the management of the urban and territorial transformations.

The Journal also welcomes contributions that strategically address the following issues:

- new consideration of the planning standards, blue and green networks as a way to mitigate urban risks and increase city resilience;
- the territorial risks and fragilities related to mobility of people, goods, knowledge, etc.;
- the housing issue and the need of urban regeneration of the built heritage;
- socio-economical behaviour and the "dilemma" about emergency and prevention economy;
- the city as magnet of the next future's flows (tourism, culture, economy, migration, etc.).

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

- first issue: 10th January 2018;
- second issue: 10th April 2018;
- third issue: 10th September 2018.

CALL FOR PAPERS: GENERAL CALL.

Papers in Transport, Land Use and Environment

The Journal welcomes papers on topics at the interdisciplinary intersection of transport and land use, including research from the domains of engineering, planning, modeling, behavior, economics, geography, regional science, sociology, architecture and design, network science, and complex systems

EDITORIAL PREFACE: TEMA JOURNAL OF LAND USE MOBILITY AND ENVIRONMENT 1 (2018)

THE RESILIENCE CITY/THE FRAGILE CITY. METHODS, TOOLS AND BEST PRACTICES

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The 11th volume of TeMA Journal consecrates the three issues of 2018 to promotes the scientific debate on the fragile/resilience city that represents a topic collecting itself all the issues related to the urban risks and referred to the different impacts that an urban system has to face with. Studies useful to improve the urban conditions of resilience represent the aim of our editorial work of this year. The identification of urban fragilities could represent a new first step in order to develop and to propose methodological and operative innovations for the planning and the management of the urban and territorial transformations.

The section “Focus” contains four articles. The first article, titled “Land use and climate change: Italian and European adaptation plans” by Floriana Zucaro and Rosa Morosini (University of Naples Federico II, Italy), deals on the reading of a sample of recent Italian and European adaptation plans, seeks to investigate the existence of environmental actions aimed at guaranteeing a sustainable use of natural and non-natural soil, in order to reduce the consumption of non-anthropized soil and also contribute to containing the effects of climate change.

The second article “Second law of thermodynamics and urban green infrastructure - A knowledge synthesis to address spatial planning strategies” by Raffaele Pelorosso, Federica Gobattoni, Maria Nicolina Ripa, Antonio Leone (Tuscia University, Italy) with a systemic review of Urban Green Infrastructure (UGI) planning and thermodynamics has been carried out to identify all the occurrences to date in the scientific literature. Secondly, a scoping review of second law of thermodynamics (SLT) related concepts of exergy, entropy and urban metabolism is presented in order to investigate the main applications of, and gaps in, urban spatial planning. Results indicate that UGI and ecosystem service planning based on SLT is a relatively new field of research. Moreover, some general indications are derived for the development of spatial UGI planning strategies based on SLT.

The third article, titled “The Adapting city. Resilience through water design in Rotterdam”, by Maurizio Francesco Errigo (University of Enna Kore, Italy), focuses on the strategies and the initiatives that Netherlands has been developing to improve the water management in urban areas and make them efficient waterproof cities. In particular the Delta Metropolis project and the Rotterdam case study are described by paying particular attention to the solutions that public open and green spaces offer in terms of water defence and climate adaptation.

The fourth article, titled " Geographic determinism Vs urban resilience: italian scenario analysis " by Stefano De Falco (University of Naples Federico II, Italy), proposes a geographic approach in which the characteristics of urban resilience, synthesized by a wide review of scientific articles, are associated with determinants of geographic type (urban dimension, latitude and prevalent urban attribute). The proposed analysis both introduce methodological elements of evaluation useful for this topic and both shows, based on the stratification of real data regarding some main urban variables (Living, Environment, Mobility and Legality), the scenario of Italian cities characterized by high, medium and low resilience actions as a function of their geographical characteristics, trying to make clearer the question regarding the geographic determinism paradigm declined to the urban frame, analyzing the eventual geographical influence on the processes of urban resilience.

The section "Land Use, Mobility and Environment" collects four articles. The first one, titled "Monitoring User-Based Accessibility Assessment in Urban Environments and in Public Buildings", by Gintaras Stauskis (Vilnius Gediminas Technical University), with a tool for facilitating the development of humane, socially sustainable and an inclusive urban environment. A group of users representing people with different kinds of disabilities, the elderly and families with children was created to assess the quality of access to various buildings with different functions and locations across Vilnius and in Singapore. A school, two hospitals, a rehab centre and two offices were selected for access monitoring in Vilnius City, while a hotel, a café and two metro stations with public squares were chosen for access assessment in Singapore.

The second article, titled "Regenerating Urban Spaces: A Brief Commentary on Green Infrastructures for Landscape Conservation", by Matteo Clemente (University of Rome Sapienza, Italy), Fabio Bianconi, Marco Filippucci (University of Perugia, Italy), Luca Salvati (CREA), debates on the issue of urban regeneration in contemporary cities, adopting a strategic vision which includes the use of vegetation and green infrastructure to create a network of public spaces. The authors focus on peripheral urban areas and they highlight how greening present cities may promote both biodiversity conservation and urban regeneration by recovering public spaces with social purpose. The case study refers to the city of Perugia and relates to the opportunities offered by the extraordinary program for the Italian peripheries.

The third article, titled "An analytical tool to support the pedestrianisation process: The case of via Roma, Cagliari", by Alfonso Annunziata (University of Cagliari) and Carlo Pisano (University of Florence), with focuses on the case of the modification of an urban road network: the transformation of a portion of an important distributor road in the urban area of Cagliari into a pedestrian space. By means of this case study the article aims to point out how pedestrianisation interventions have not been completely defined within a theoretical system that clearly establishes modes and conditions of implementation.

The fourth article, titled " Expectation management at the local scale: Legal failure of public participation for large urban planning projects" by Thomas Hartmann, Fennie van Straalen (Wageningen University & Research, Netherlands), Tejo Spit (University of Utrecht, Netherlands), investigates how planning law supports public participation in large planning projects that cross municipal borders. The juridical analysis of German and Dutch codified law is based on four elements: literal content, institutional positioning, historical context, and teleological meaning of a legal text. The paper furthermore distinguishes four rationales for participation in planning: support, legitimization, improving plan quality, and education.

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 on the subject of energy reduction consumption in the transport sector. In particular, the Web section by Rosa Morosini describes three web resources of: (i) European Green Capital; (ii) European Green Leaf and (iii) Cresco Award.

. The Books section by Gerardo Carpentieri briefly reviews three relevant books related to the Issues' theme: (i) How To Make Cities More Resilient A Handbook For Local Government Leaders; (ii) The London Plan - The Spatial Development Strategy for Greater London and (iii) Cities Taking Action. The Law section by Maria Rosa Tremiterra keeps readers up to date with comparison between three legislative documents, in order to climate change adaptation of coastal areas in EU member states (Netherland, Germany and Denmark) . The Urban Practices section by Gennaro Angiello presents two case studies in the us for planning for sharing mobility: (i) Rotterdam and (ii) Thessaloniki. The News and Event section by Andrea Tulisi, proposes a selection of conferences on the topic of decision support tools where developed for supporting adaptation and mitigation policies at urban scale.

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SUSTAINABLE LAND USE AND CLIMATE ADAPTATION: A REVIEW OF EUROPEAN LOCAL PLANS

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ABSTRACT

Adaptation plans are the result of a political decision based on the awareness that climate change has altered environmental conditions and action is therefore needed in order to return to, maintain or achieve the desired outcome. A crucial role in defining adaptation actions is played by the use of resources, in particular of non-renewable resources such as soil. This paper, based on a sample of recent Italian and European adaptation plans, seeks to investigate the presence of actions aimed at guaranteeing a sustainable use of natural and non-natural soil, in order to minimize the consumption of non-anthropized soil andalso contribute to containing the effects of climate change.
The paper is divided into three sections: the first one describes the methodology employed; the second one focuses on the most up-to-date plans regarding the effects of climate change in some urban systems; the third one proposes hints for further reflections and useful recommendations to local decision-makers in the development of tailor-made adaptation actions aimed at guaranteeing an efficient use of both natural and anthropized soil.
The reading of the plans has exposed that soil consumption is not among the factors that need direct action to reduce the vulnerability of urban systems to current climate change, but rather it is a phenomenon that can be contained by increasing green areas and/or infrastructures and encouraging agricultural and environmental regeneration. The attention seems to be drawn to not yet sealed soil, thus leaving out the already anthropized one that, as such, would require, instead, greater adaptation efforts.

KEYWORDS:
Soil, climate changes, adaptation plans, overview, review.

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有关土地使用、交通和环境的杂志

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土地可持续利用与气候适应：欧洲规划回顾

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摘要

适应规划是基于认识到气候变化改变了环境条件的政治决策的结果，因而需要采取措施以恢复、维持或实现期望的结果。明确适应措施的关键作用是利用资源，特别是土壤等不可再生资源。
本文以近来的意大利与欧洲适应规划为样本，研究是否存在旨在保证天然与非天然土壤的可持续利用的措施，以使非人为化土壤的消耗降到最低，并且有助于遏制气候变化的影响。
本文分为三个部分：第一，描述所采用的研究方法；第二，聚焦在某些城市系统中有关气候变化影响的最新规划；第三，为当地决策者就旨在确保天然与人为化土壤的有效利用所量身定制的适应措施的发展提供进一步反思的线索与有用的建议。
这些规划的解读表明了土壤消耗并不是需要采取直接措施以减小城市系统对当前气候变化的要害/脆弱性因素之一，而是一种可以通过增加绿地和(或)基础设施以及鼓励农业和环境再生来遏制的现象。人们的注意力似乎只关注尚未封盖的土壤，而忽视了需要作出更大的适应努力的已经人为化的土壤。

关键词：
土壤；气候变化；适应规划；概览；回顾

1 SCIENTIFIC OVERVIEW AND OBJECTIVE

Climate on Earth has always undergone natural changes and so will be in the future. About 11.000 years ago, during the Holocene era, climate became progressively warmer and wetter thus determining more comfortable life conditions that facilitated the spread of flora and fauna and consequently the development of human activities (Gupta, 2004; Wanner, et al. 2008).

Nevertheless, in addition to these natural factors, others related to human activities arise. Over recent years, the scientific community has been investigating the rapid global warming phenomena that could potentially determine a 0.3 °C increase (at least) of global mean surface temperature by the end of the 21st century compared to the period 1986–2005 (IPCC, 2014a). This projection is related to the rate of greenhouse gases emissions caused by human activities that have increased by about 90% from 1970 (Le Que´re´et al., 2009; IPCC, 2014b) to 2011.

Even though modeling extreme weather events such as heat waves, floods, etc. may be difficult and the effects of climate change vary differently from one city to another (depending on place-specific micro-climatic, geomorphological, etc. charateristics), global warming is unequivocal and, as a result, many studies have focused on the urban scale.

In fact urban settlements are areas of high vulnerability mainly due to "a high concentration of 'elements at risk' to climate and weather impacts, such as people, critical infrastructure, and buildings" (Scatterthwaite et al., 2007; Reckien et al., 2014).

The vulnerability of urban areas can be due to three main factors: location, as they can be situated near the coast, mayor rivers, low-lying zones exposed to the risk of coastal erosion, flooding, sea-level rise, etc.; economy, as many activities and sectors can be weather-related; size, the biggest they are, the most aggregated risks they can have (Rosenzweig & Solecki, 2001; De Sherbinin et al., 2007).

According to several authors (Bigio, 2003; McEvoy, 2007; Wilby, 2007) who identified the main climate change effects on cities, these can be mainly resumed as follows:

- health: heat and cold mortality, food and water security and availability, increase of diseases;
- energy use: e.g. heating and cooling, energy price shock;
- accessibility and supply: critical infrastructure out of order;
- forced migration: e.g. due to disease, overcrowding;
- economic and fiscal crises: related to the concentration of economic activities;
- social instability.

In addition to the points listed above, the specific characteristics of each urban area can worsen both the climate change and extreme weather effects. For instance, focusing on the soil resource which is one of the research issues of this work, the high rate of non-porous surfaces can intensify the flood risk as a sealed soil is not able to retain large portions of atmospheric precipitations and hence contribute to regulating surface run-off (Whitford et al., 2001; Wood et al., 2005; Woods-Ballard et al., 2007). Indeed, it has to be considered that a natural soil can store up to 3,750 tons of water per hectare, or about 400 mm of rainfall and that the infiltration of rainwater through the soil should cause it to take longer to reach the rivers, thus reducing the flow rate and therefore the risk of flooding. Soil and artificial surfaces leaching by surface runoff waters also determines an increase in the solid load and the content of pollutants, causing a strong impact on the quality of surface waters and aquatic life (EEA, 2006; ISPRA, 2013).

The gradual expansion of urban areas and the consequent soil sealing causes less vegetal transpiration and an increase in the surfaces with a high heat refraction coefficient; moreover, the decrease of the evapotranspiration must be combined with the heat produced by the anthropic activities, determining the heat island phenomenon (EC, 2012).

These effects may have an even greater impact on the Mediterranean arid areas with consequent negative effects on human life (Salvati et al., 2011; Potchter & Ben-Shalom, 2013).
Soil is a fundamental natural resource for ecological balance and human labour productivity. However, a serious environmental problem detected in many parts of Europe is soil degradation caused by its improper use or poor management (European Environment Agency, 2006). The European Commission, on the basis of the Soil Thematic Strategy (COM(2012)46), carried out important research activities regarding land-take assessment and soil sealing monitoring (Joint Research Centre and European Environment Agency, 2012). According to Genske (2003) & Scalenghe et al. (2008), phenomena such as soil erosion, decline in organic matter, local and widespread soil contamination, sealing, compaction and salinization are the result of changes in the use of land that can adversely affect soil functions and ecosystem services (see, for instance, Sauer et al., 2011).
Furthermore, in the continuous effort to improve the resilience of urban areas and promote the integration of climate change issue into governance and planning practice, Europe has developed a Climate Change Adaptation Strategy in 2013 with the following three primary aims: encourage all Member States to adopt global adaptation strategies and their action plans, inviting them to make a commitment drawn on the model of the Covenant of Mayors and supporting them with funding useful to develop their adaptability; further promote adaptation in particularly vulnerable sectors such as agriculture; foster awareness in the decision-making process by addressing knowledge gaps in adaptation plans and increasing the European Climate Adaptation Platform (COM(2013) 216 final). The adoption of this strategy represents a further attempt of the European Community to lead the way towards sustainability and resilience to climate change at all levels (national and local) of territorial governance.
In particular, the adaptation plans provided are the result of a political decision based on the awareness that climate change has altered environmental conditions and action is therefore needed in order to return to, maintain or achieve the desired outcome (Parry et al., 2007). Everything should be renewed and redesigned to increase resilience, thus reducing the risk.
The adaptation should be undertaken and developed by the local authorities, as it is at the local level that the greatest impacts occur. Historically, efforts have focused more on mitigation but the challenge must be double (Blanco et al., 2009), that is to say, actions must be geared towards an integrated mitigation and adaptation perspective. A decisive role in defining these actions is played by the use of resources, as climate change will challenge the ability of the current reserve network to provide protection for biodiversity, to satisfy human basic needs and to carry out their ecosystem functioning (Lawler, 2009; Blanco et al., 2011). "For instance, changes in the global climate have a significant impact on local and regional hydrological regimes and processes, which in turn affect ecological, social and economical systems" (Lin et al., 2012). Protection of soil as a precious resource means being able to guarantee the functional capabilities of the land and, therefore, the ability to absorb water by infiltration in case of meteoric events and decrease the volume and speed of surface flow, improving water management in the event of floods that are much more frequent due to climate change. Furthermore, soil is the second carbon tank after the oceans, therefore ensuring a sustainable use of the soil means helping to reduce the presence of carbon dioxide in the atmosphere, with a consequent reduction of the greenhouse effect. Lastly, soils with a high content of organic carbon are more fertile and productive, more capable of purifying water and contribute to increasing the resistance capacity of livelihoods to the impacts of climate change. An exasperating soil sealing generates further negative effects on the quality of water, air and products consumed by both the population and animals, as well as on biodiversity and climate change. Preserving soil use by promoting, for example, interventions, such as green infrastructure, can represent an effective response to the impacts of climate change like flooding phenomena: "the climate adaptation benefits of green infrastructure are generally related to its ability to moderate the expected increases in extreme precipitation or temperature.

Benefits include better management of storm-water runoff, lowering incidents of combined storm and sewer overflows (CSOs), water capture and conservation, flood prevention, accommodation of natural hazards (e.g., relocating out of floodplains), reduced ambient temperatures and urban heat island (UHI) effects, and defense against sea level rise (with potential of storm-surge protection measures). The U.S. Environmental Protection Agency (EPA) has also identified green infrastructure as a contributor to improving human health and air quality, lowering energy demand, reducing capital cost savings, increasing carbon storage, expanding wildlife habitat and recreational space, and even increasing land-values by up to 30%" (Foster et al., 2011; Gargiulo et al., 2017).

The green infrastructure can provide more efficient and more flexible benefits compared to the "network of infrastructures and urban settlements, namely that system consisting of buildings and equipment connected by various types of linear infrastructures" (the so-called grey infrastructures, see Socco et al., 2008), as the improvement to adapt to the impacts of climate change.

In other words, soil and its vegetation contribute to mitigate and balance the local climate, regulating waterflows and energy between the Earth's surface and the atmosphere and storing large quantities of carbon. Conservation and sustainable soil management are therefore an important opportunity in the context of actions to be taken to mitigate and adapt to the effects of climate change and to offset emissions from fossil fuel consumption (Papa et al., 2016).

In this perspective, this paper proposes a reading of the most recent Italian and European adaptation plans in order to understand the effective role played by the containment of soil consumption in the choices of the urban setting and in the reduction of the negative impacts on climate change. There are many studies concerning the reading of successful tools and practices aimed at adapting to climate change, all of them faced in a broad and general way and at a supra-municipal level (Sovacool & Brown, 2009; Biesbroek et al., 2010; Baker et al., 2012; Carter, 2011; Reckien et al., 2014). The number of studies aimed at investigating the relationship between adaptation and specific components and/or characteristics of the urban system is lower than the above mentioned ones (Hamin & Gurran, 2009, Geneletti & Zardo, 2016).

The paper is divided in the following three sections: the first one describes the methodology employed; the second one focuses on the most up-to-date plans regarding the effects of climate change in some urban systems and the adaptation actions to be taken to contain soil consumption; the third one proposes hints for further reflections and useful recommendations to local decision-makers in the development of specific adaptation actions aimed at guaranteeing an efficient use of both natural and anthropized soil.

2 METHODOLOGY

This paper, through the reading of the adaptation plans of some Italian and European cities, seeks to investigate the presence of actions aimed at guaranteeing a sustainable use of natural and non-natural soil, in order to minimize the consumption of non-anthropized soil and also contribute to containing the effects of climate change.

It should be pointed out that the number of adaptation plans in force is still small, as they are "new" tools of territorial governance so far, which, together with the mitigation plans, define the actions to be implemented in order to reduce the risks to which the cities are subject because of the effects of climate change. In fact, on the basis of the national strategic guidelines, the cities have drawn up their own adaptation plans, since they have been affected – although in different ways - by the impacts of climate change in recent years.

The sample under investigation consists of 3 Italian and 5 European adaptation plans.

The choice of the Italian plans has been a rather simple operation, as the selected cities are the only ones to be provided with an existing adaptation plan. Having identified the Italian cities, the search for the related plan documents was carried out by consulting the websites of the municipalities chosen.

When the adaptation plan was not available online, local administrations were contacted directly. As for the choice of the European plans, the Covenant of Mayors for Climate & Energy platform was initially consulted. The platform was made available by the European Community in March 2011 and contains the initiatives and action plans adopted by the Member States to tackle the phenomenon of climate change. However, since these plans represent a rather recent initiative, those available on the platform are as yet very few and above all related to small municipalities (<5000 inhabitants). For the selection of foreign cities, the most vulnerable countries in terms of climate change and soil consumption have been identified, firstly, through the study of the National Adaptation Strategies (NAS); by the most vulnerable countries reference is made to those countries that since the publication of the Green Paper in 2006 began to develop the Strategies and update them over the years, and thus gaining a consolidated experience in terms of adaptation. Moreover, the Member States selected are also the ones that in their Strategies have referred to the soil sealing as one of the anthropic factors capable of increasing the negative impacts of climate change.

According to the most recent data (2016) by the European Environment Agency related to the Climate-Adapt platform, 29 EU Member States have already adopted a NAS: Austria, Belgium, Bulgaria, Croatia, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Lithuania, Luxembourg, Malta, Norway, Netherlands, Poland, Portugal, United Kingdom, Czech Republic, Romania, Slovenia, Spain, Sweden, Switzerland, Turkey, Hungary. In these countries, just some cities have drawn up the adaptation plan to climate change, but the ever increasing number of national strategies proves the awareness that climate-related extreme weather events are increasing in frequency and disastrous consequences, and the need for a concrete global climate policy that should encompass adaptation measures able to reduce and manage the risks associated with climate change.

In particular, Finland was the first European nation to develop a NAS in 2005, one year ahead of the 2006 Green Paper explicitly mentioning the need to reduce the use of non-anthropized soil.

"Better consideration of the impacts of climate change and natural conditions in general may require some adjustment to the planning principles applied to the use of areas and land. The damage risk posed by rains can be lowered by securing the capacity of drainage systems so that it corresponds to the heavy rains expected in the future. It will be possible to set restrictions and regulations for areas where flooding and a rising ground water level are expected in the future" (Finland's National Strategy for Adaptation to climate change, 2005).

Other countries such as Serbia, Germany, France and Great Britain do not relate directly to the issue of soil consumption, but their strategies include numerous green infrastructure interventions to deal specifically with flood risk.

"There is a need to step up soil protection with regard to the risks of erosion and declining humus content, especially in hydromorphic soils. To avoid conflicts of objectives, the federal and the Länder authorities discuss and coordinate protection objectives and adaptation strategies for the soil with all stakeholders on a cross-departmental basis (agriculture, forestry and water management, nature conservation, atmospheric and climate research)" (German Strategy for Adaptation to climate change, 2008). With regard to natural risks, France was marked by the occurrence of large-scale floods, some of which severe and violent in the Mediterranean regions (Aude en 1999, Gard in 2002).

Worth mentioning is the episode of the floods of the Somme in 2001, which gave rise to a report by the Senate 1. However, according to several meteorologists and hydrologists, it is impossible to link the increasing number of these disasters to climate warming; some anthropogenic reasons, such as soil sealing, use of agricultural land, occupation of floodplains, etc., may provide a better explanation to these phenomena (Strategie Nationale d'adaptation au Changement, 2007). For each of these four countries have been identified the cities that have drawn up, in the last 10 years, an adaptation plan that would recall the phenomenon of soil consumption in relation to climate change. Another criterion for selection has been the availability of the adaptation plan in the English language.

In accordance with these criteria, the sample consists of five European adaptation plans. Once the sample was built, each plan has been carefully analysed to identify the most registered risks for that urban area and all direct and indirect actions linked to the containment of soil consumption.

As regards the numerous risks resulting from climate change due to the different physical and geomorphological characteristics of the urban areas, and for which direct and/or indirect actions on soil consumption are foreseen, they can be classified into four categories:

– Landslide risk: this risk, although linked to natural factors such as geological and geomorphological conformation, is also strongly conditioned by the continuous anthropogenic interference on land modification which, on the one hand has increased the possibility of occurrence of these phenomena, and on the other has raised the presence of goods and people in areas where this phenomenon occurred, despite its catastrophic effects;

– flood risk: the increase in the frequency of this risk is undoubtedly linked to the high anthropization and to the widespread sealing of the territory which, preventing the infiltration of rain into the ground, increases the quantity and the speed of the water that flows towards the rivers;

– soil erosion risk: this risk, in addition to being linked to natural causes such as sea level rise, is also due to anthropogenic causes such as the increase of urbanization in the coastal strip for tourism and industrial purposes;

– heat waves: this risk depends on the climatic conditions and on the physical and environmental characteristics of a specific area and is defined not only by the air temperature and relative humidity but also by the duration of heat waves.

The general objective shall be achieved through the implementation of direct or indirect actions. Direct actions explicitly limit the use of soil, such as the definition of a threshold for buildability, protection of the green belt land or reuse of existing buildings/structures and infrastructures. Indirect actions, instead, are all those that do not directly concern soil protection, however they contribute to promote a more sustainable use of it, since the risk for which this specific action is expected can be reduced if less soil is sealed, for example the actions envisaged to implement the water drainage system as to limit the landslide risk which can be reduced by ensuring a greater deal of permeable soil. In summary, the reading of each of the adaptation plans collected was carried out (i) investigating the impacts of climate changes and the risks related to them in order to understand how a city intends to "adapt" in view of its vulnerabilities (in this regard, it should be noted that the reading covered only the impacts and risks mainly linked to soil consumption); (ii) identifying direct and indirect actions with a view to protecting soil consumption; (iii) using an integrated approach to the issue of soil consumption, where integration is understood as referring to the need to both preserve the natural soil and improve the use of the anthropized one, in order to overcome this issue from the point of view of governance of urban transformations, that is taking into account the dynamic development of urban systems which inevitably entails the consumption of this resource.

3 ITALIAN AND EUROPEAN ADAPTATION PLANS REFERRING TO SOIL CONSUMPTION

There is a growing recognition that climate change requires a substantial change in approaches to the urban and territorial transformations governance, both in terms of reducing the production of carbon dioxide emissions (mitigation) and in making urban systems more resilient to the gradual climate variability (adaptation). Adaptation plans aim to tackle the inevitable consequences of climate change on the cities to reduce them in order to secure the territory and infrastructures from the risks linked to climate change phenomena, and thus ensure the safety of the inhabitants. With reference to the methodology adopted (section 2), the following paragraphs propose a reading of the following selected plans: the Italian cities of Ancona, Bologna and Padua, the European Helsinki, Belgrade, Berlin, Paris and London. This reading can provide some clarification with regard to the risks related to soil consumption that arise from climate change (table 1) and therefore require certain adaptation actions, paying particular attention to those actions that provide - directly and indirectly - a reduction in soil consumption.

The reading of the plans has also been complemented by land cover data currently available, as an attempt to measure the effects determined by the actions contained in the adaptation plans in terms of soil saving. Through the use of CORINE Land Cover mapping - established by the EU-, sealed surfaces and green areas in the GIS environment were calculated for each of the currently examined cities. These measurements aimed to compare the prevalence of land use before and after adoption of the adaptation plans, so as to measure their effects quantitatively. However, this objective could not be reached because the most recent data available date back to 2012, when most of the plans were drawn up.

3.1 ANCONA

Ancona, the capital of the Marche Region, has just over 100,000 inhabitants and is characterized (above all from the environmental point of view) by several critical issues. After the event of the great landslide, which hit a large area of the urban territory (1982), the municipal administration developed a progressive adaptation policy in order to increase the resilience of the community and the territory. This policy, which led to the development of the Adaptation Plan in 2012, was developed on the basis of a direct knowledge of the territory, with its problems, sustainability of the solutions adopted and the potential impacts of climate change - direct and indirect - in the medium-long term.

The major climatic events involving Ancona in recent decades brought about the following phenomena: the "great landslide", caused by persistent and heavy rains; the flooding that occurred as a result of several extemporaneous and short-term but considerably intense phenomena; coastal erosion accentuated by intense rainfall and long-term periods of summer aridity and heat waves rising.

To reduce the landslide risk, the plan, in addition to drainage interventions which will allow an optimization of water consumption thanks to the use of the water collected from the landslide instead of drinking water, also includes naturalistic engineering interventions (based exclusively on reinforced soil systems and gabions) able to preserve the non-urbanized soil and therefore the draining and stability functions of the soil itself.

As regards the erosion risk, besides being due to natural causes, it is also determined by anthropogenic causes due to the increase of urbanization in the coastal strip and the reduction/destruction of dune systems to make room for seaside resorts and marinas. To cope with this risk, the plan envisages a regulation scheme to rehabilitate the existing green areas by means of felling (where necessary) and a retreat of the seaside resorts and restaurants in order to gain unbuilt soil. The plan also entails the construction of new green areas that could lead to an increase in the rate of permeable soil -2.70% of the entire municipal area in 2012 (Copernicus, 2012)- and a reduction in the rate of the paved, built and therefore impermeable ones -which occupy 21.56% of the municipal area-, with the aim of adapting the urban system to the risk of floods and heat waves.

3.2 BOLOGNA

Bologna, the capital of the Emilia Romagna Region, has been seriously affected by the impacts of climate change in recent years, registering an increasing number of landslides, floods and heat waves: "The City has felt the need not only to avoid the intensification of meteoric events that damage the territory but also to preserve the resources linked to local climatic characteristics, first of all the water resource "(City of Bologna, 2015).

Under the influence of the Italian National Strategy, the city of Bologna drew up the adaptation plan in 2015 with a view to identifying the strategies pursued to improve the territory response to climate change and to coordinating the action of the City with the other local authorities involved in the management and protection of the territory. Bologna adaptation plan was drawn up after an accurate cognitive phase from which all the vulnerabilities of the urban system to climate change have arisen, associating each one of them with one or more strategies accompanied by specific measurable objectives.

The greatest risks to which Bologna is exposed, in relation to soil consumption –which in 2012 involved 56.46% of municipal area (Copernicus, 2012)- are flood, hydrogeological risks and heat waves. The adaptation plan, in an attempt to limit the rising temperatures in urban areas, provides the widespread increase of green areas in such a way that the temperature gradient between built-up areas and vegetated areas determines an important air flow which allows to eliminate heat but also air pollutants from the city. The plan refers to other urban planning tools, the quantification of urban redevelopment projects and the enhancement of public space, which can be pursued through sealing reduction.

In fact, as regards the green areas, to which only 5.16% of the municipal district in allocated (Copernicus, 2012), the widespread qualification interventions will lead to an increase of about 15,000 square metres between public and private green areas, in addition to the realization of private green roofs as well as semi-permeable floors. Furthermore, the green spaces allow to reduce the vulnerability of the system to the other two risks: floods and the hydrogeological one. In this regard, the plan emphasizes the need to reduce soil sealing because it causes a significant increase in the Navile and the Savena Abbandonato flows, thus increasing the hydrogeological risk in the municipalities downstream. To this end, numerous actions are envisaged to make previously sealed surfaces, such as flooring, and areas of rainwater storage permeable once again, so as to slowly return it to the surface circulation or directly to the atmosphere through evapotranspiration.

3.3 PADUA

Padua, the capital of the Veneto Region, drafted an adaptation plan in 2016 and was the only Italian city to use a methodology built from those already existing at the international level. The methodology is articulated in 6 fundamental phases through which the city has identified the vulnerable areas in order to adapt urban areas to the effects of climate change, with the aim of studying the kind of vulnerability and then increase the capacity of reaction to the shocks generated by the ongoing climate change. Identifying vulnerable areas in the urban sector has helped to determine the risk generated by the impacts themselves and therefore the definition of adaptation actions.

The most detected effects due to climate changes in Padua are the floods and heat islands, and actions are planned to adapt to these risks, in order to mitigate and compensate the effects of land consumption, considering that the percentage of the area concerned was 77.27% in 2012, while only 0.59% of the municipal area was allocated to greenery (Copernicus, 2012).

The plan emphasizes the importance of soil protection, promoting actions able to lead to urban growth without sealing new natural soil but reusing already urbanized soils, thus redeveloping existing urban fabric and selectively "densifying" the most accessible urban places. Among the actions scheduled for the city in the plan, there are the new areas of reconversion and urban redevelopment, the new urban axes to be redeveloped both morphologically and functionally and the creation of many multifunctional green areas which, in addition to absorbing large amounts of CO_2, allow greater water absorption compared to sealed paved areas, as well as urban heat absorption, and if properly designed and built they can become areas for water storage in case of extreme weather events.

The plan also includes a map of impermeability (figure 1) with the objective of identifying the percentage of impermeable surfaces opposed to the permeable ones, showing the soil ability to infiltrate and absorb rainfall, thus avoiding water flow downstream and cause flooding. In this way the portions of soil to be kept free in order to reduce water and hydrogeological risk have been identified.

Finally, a plan of solar irradiation is presented in the plan where the areas that register a high level of irradiation are those where most of the solar radiation is absorbed and stored by the streets with consequent urban heat island phenomena. Adaptation actions to reduce risks such as floods and urban overheating mainly involve actions that reduce soil consumption, such as respecting and increasing existing green areas and replacing floors (e.g. parking lots) with materials/techniques that make them permeable.

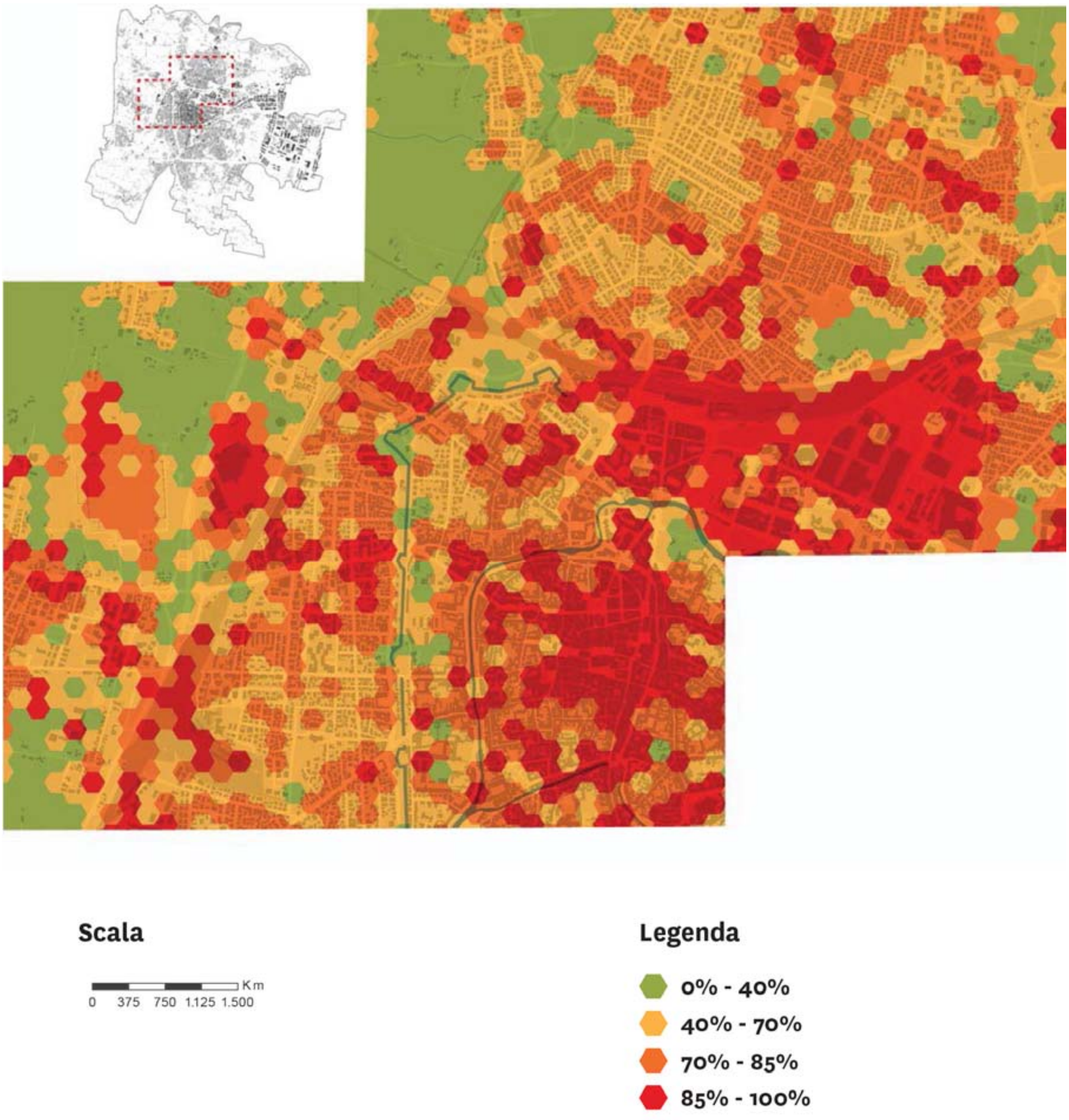

Fig. 1 Graphical representation of soil permeability percentage (Padua)

3.4 HELSINKI

Helsinki adopted a policy of adaptation in 2012 following some natural disasters, such as the storms of Summer 2010 and the Winter storm of December 2011, which showed the vulnerability of the Finnish city to climate change, in particular to the flood risk. Among the different actions proposed by the city, for flood risk there are also indications regarding soil consumption. In this respect, the plan proposes the construction of new

green areas, 6.74% of the municipal area (Copernicus, 2012), and the conservation of large forest areas able to withstand events such as storms. Green areas are also essential to improve water management.
If, on the one hand, the plan aims to safeguard the use of natural soil, in order not to increase the percentage of the sealed area, 17.25% in 2012, on the other hand the housing demand must be met, as the Helsinki urban plan foresees a population growth of around 600,000 residents in 2050, hence, to adapt the city to the risks of climate change with actions that meet the demand for housing without sealing other soil, the administration should suggest redevelopment of unused buildings, also providing for changes of intended use. In fact, increasing sealed areas means increasing the risk of flooding, a risk that the city is particularly vulnerable to. However, this aspect within the Helsinki city adaptation plan is not addressed because the authorities can only suggest the protection of green and forest areas, instead it would be appropriate to define adaptation actions in a systemic perspective, starting to identify risks and considering the different subsystems that make up the entire city system.

3.5 BELGRADE

Belgrade drew up the adaptation plan in 2015 following extreme weather events which, according to data from the hydro-meteorological service of Serbia, occurred with increasing intensity: in the Summer of 1998, 2000, 2012 and 2013 heat waves caused a huge increase in temperatures (exceeding 39°C), carrying as a main consequence a great drought; in 2006 there were repeated floods caused by the melting of snow and heavy rains; in May 2014, heavy rainfall caused a large flood. Furthermore, in recent years the floods have increased significantly in intensity and severity.
With regard to these risks, the administration underlined all the main vulnerabilities within the adaptation plan (Figure 2) with the aim of identifying the most efficient actions to be taken. Green spaces, that in 2012 only covered 2.77% of the entire municipal district (Copernicus, 2012), have a high level of vulnerability to almost all the effects of climate change: extreme cold and drought can in fact cause a slowdown in the fundamental physiological processes of plants (such as photosynthesis, metabolism, transpiration and growth); heat waves slow down the growth of plants or even their drying; heavy rainfall leads to the physical destruction of plant tissues and green infrastructure.
There are a number of actions proposed by the administration in the adaptation plan which aim at adapting the city to these risks and do not directly refer to soil consumption, a phenomenon that until 2012 involved 13.34% of the entire municipal district (Copernicus, 2012).
It is possible to identify in the plan a series of indirect actions, transversal to the various types of risks identified, such as the creation of green infrastructures connected to blue structures (fountains, rivers, aqueducts), parks, gardens, forests connected to waterways, so as to encourage the infiltration and outflow of abundant rainfall, as well as the improvement of existing green areas. Creating green spaces means obtaining ventilation routes, which reduce the risk of heat waves that have proved to be very dangerous both for the ecosystem and for the health of local residents.

3.6 BERLIN

Berlin drafted the plan to adapt to climate change in 2016 to reduce environmental-related damage. In the city of Berlin the most recorded effects were the increase in temperatures, registered especially in the Summer of 2014 and 2015 when the heat waves phenomenon arose. Another phenomenon related to climate change detected in the German capital is the rainfall that has increased over the last decade; in fact, it is foreseen that "Berlin will experience an increase in the average annual precipitation of about 3 - 10% in the near future and 7.5 - 18% in the distant future" (City of Berlin, 2016). According to the forecasts performed, the strongest increase in rainfall should occur in Spring and Winter while it will be less relevant in Autumn and Summer

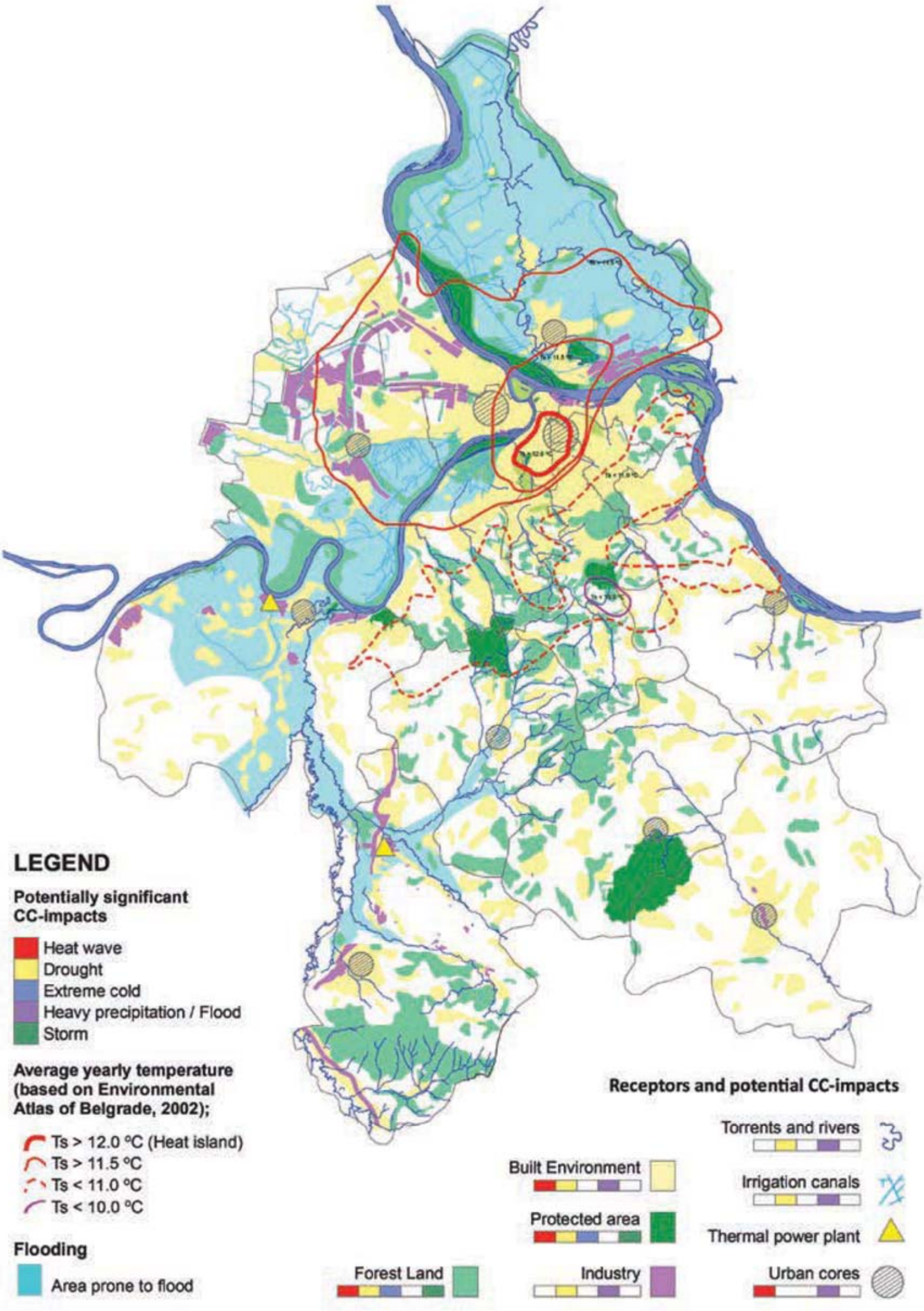

Fig. 2 Spatial distribution of potential climate change impacts related to the highly vulnerable receptors within the administrative territory of Belgrade

seasons, but the events of heavy rainfall will alternate, according to the City of Berlin forecasts, with drier periods. As temperatures rise above all during the winter, Berlin will have less snow in the future. Because of these two types of events, the municipal administration of Berlin has become aware of the fact that soil sealing, a process that in 2012 involved more than half (59.6%) of the entire municipal area (Copernicus, 2012), means increasing the built area and, as a consequence, also the health risks for the inhabitants linked to the higher temperatures. Furthermore, the increase in heavy rainfall will lead to more flooding, especially in the most urbanized areas. In this perspective, the adaptation plan recognizes, on the one hand, the need to build new residential housing units - a demand that arises from the huge flow of immigrants towards this urban area -, on the other it proposes strategies for adapting to climate change by means of recovery of already existing structures and infrastructures and planning of green areas that are "strategically important", in order to benefit from them in terms of temperatures and evaporation cooling processes. The plan also suggests intensifying the permeability of the city surface to rainwater to adapt it to the increase in heavy rainfall so as not to exacerbate the sewage system. These interventions envisaged in the plan are aimed at adapting the city to the risks due to climate change by transforming the city of Berlin into a "Sponge City", increasing that 13.88% of the already present green area (Copernicus, 2012).

3.7 PARIS

Paris adopted the climate change adaptation plan in 2007, then updated in 2012 following an increase in existing risks and the emergence of new risks for both human and natural systems.
"Climate in Paris is changing and will continue to do so throughout the 21st century" (City of Paris, 2012) and among the most recorded effects of climate change on the Paris metropolitan area it is possible to identify: heat waves increasingly frequent and intense; floods due to heavy rains; the gradual loss of biodiversity; drought. Changes in temperature as well as alternating drought with heavy rains can also have an impact on the stability of the ground, with the risk of collapses or possible landslips.
Because of these effects, the administration proposes actions to protect citizens and the city, preserving existing services and resources. As regards the heat waves, aggravated by the phenomenon of urban heat island, the plan suggests the protection of green areas - which in 2012 covered 19.09% of the entire municipal area (Copernicus, 2012)-, as well as the opening times H24 all year round of municipal parks so that citizens can benefit from the freshness of these areas ideally connected by waterways or through green corridors such as hedges, gardens and escarpments, since water and the greenery help to cool the city and limit the effect of the heat island. Evaporation and plant evapotranspiration consume heat and contribute to reducing the surrounding temperatures. Moreover, other advantages could be the biodiversity conservation, the increase in permeable areas, the consequent mitigation of the sealing process that affects a whopping 78.58% of the municipal area (Copernicus 2012), and therefore a better flood risk management. In order to adapt the city to this type of risk, the plan also suggests other types of interventions on which this paper has not focused since they didn't take soil use into account.

3.8 LONDON

London, the capital of England, adopted the climate change adaptation plan in October 2011. London is very vulnerable to phenomena such as floods, droughts and heat waves, which are gradually increasing in intensity and frequency due to climate change. In the last decade, London experienced significant floods in 2002, 2004, 2005, 2007, 2008, 2009 and 2010, heat waves in 2003 and 2006, a severe drought in 2006 and unusually cold winters in 2009 and 2010. Each of these events affected residents' health and quality of life apart from having a negative impact on the economy. London is the engine of UK economy and an integral part of the world's economy, through providing workforce, energy, water and other consumables, thus any impact on London can have serious repercussions at the international level.
Among the various actions suggested by the plan, the one that takes soil use into account is related to the risk of flooding. In this regard, the plan identifies as possible actions the increase of green areas to absorb the flood water, in addition to cooling temperatures, and refers to the flood management plans (CFMPs) that identify actions to be taken for each London river. Another risk, as mentioned above, for London territory are

the heat waves. The plan, in this case too, suggests an implementation of the green areas -which in 2012 covered 1.42% of the entire municipal area (Copernicus, 2012)- in order to reduce the temperatures with a consequent reduction of overheating. Although the London City adaptation plan does not indicate direct actions to protect soil use, Britain was the first country to tackle the problems related to urban sprawl; in fact, the English land law is regulated by the "Town and Country Act "of 1947 which favored the creation of 14 green belts around the main cities, including London.

Among the various actions included in the plan, the increase of green areas to absorb the flood water is one of the most relevant too, but the plan doesn't provide other indications (from the point of view of soil consumption) to mitigate the other effects of climate change occurred in London territory.

	Landslide	Flood	Erosion	Heat waves
Ancona	x	x	x	X
Belgrade		x		X
Berlin		x		X
Bologna	x	x		X
Helsinki		x		
London		x		X
Padua		x		X
Paris		x		X

Tab.1 Risks detected in the cities where actions related to soil consumption are envisaged

	Sealed soil (ha)	Green area (ha)	Sealed soil (%)	Green area (%)
Ancona	2673,3	334,3	21,56	2,70
Belgrade	43582,4	9032,9	13,34	2,77
Berlin	51738,3	12049,6	59,58	13,88
Bologna	7962,9	727,1	56,46	5,16
Helsinki	54275,6	21192,3	17,25	6,74
London	130138,1	24663,5	7,50	1,42
Padua	7271,5	55,9	77,27	0,59
Paris	8244,9	2002,6	78,58	19,09

Tab.2 Sealed soil and green areas measured in 2012 in the examined cities, based on the Corine Land Cover Map

4 CONCLUSIONS

With regard to the risks to which each city is exposed because of climate change, the related adaptation plans include actions to reduce the damage associated with that risk.

In defining these actions aimed at reducing the vulnerability of urban areas to the present and future effects of "global warming", all those non-climatic factors should be also included, whose effects, combined with those of climate change, enhance the final impacts and/or condition the adaptive ability of the population and territory (see sections 1 and 2). Soil transformation processes are among the non-climatic factors that most influence local vulnerability (Cardona et al., 2012). For example, referring to the two effects of climate change Urban Heat Island and Pluvial Flooding, soil sealing increases these two phenomena due to the lower heat absorption and the lower water flow in the subsoil.

This work has been aimed at investigating actions to contain soil consumption included in the adaptation plans of the European cities under investigation, given that soil can play a crucial role to facilitate the adaptation of the urban system to climate change.

From the reading carried out, it is overall recognised that the soil resource plays an important role in the adaptation of urban systems to climate change, albeit indirectly. The limitation of soil consumption is explicitly excluded from the actions to be carried out, but there are widespread interventions such as the implementation of green areas and the mitigation and environmental compensation of impermeable surfaces, to encourage greater carbon storage in the subsoil and thus preserve the ecosystem functions of this natural resource. Only in the Italian plan of Padua, -which, among the three Italian cities currently examined, is the one that up to 2012 consumed a higher percentage of soil and is currently characterized by the lowest amount of greenery compared to all the case studies (tab.2)-, it is possible to find actions aimed at limiting soil use in a direct way, preventing new sealing interventions for the purpose of settlement expansion and aiming, instead, at the reuse of brownfields and reclaimed production areas; on the integrated regeneration of the existing building heritage, "where it does not interfere with the settlement safety, increasing, firstly, its drainage capacity"; on the integration of all urban-scale planning instruments able to guarantee emissions cut (in line with the Covenant of Mayors). As regards the most widespread risks that the eight cities under investigation are called to face, namely heat waves and floods (tab.1), the key actions to be promoted mainly concern the construction of green infrastructures. For example, the Helsinki plan proposes actions to protect green areas and agriculture, in order to preserve biodiversity and soil fertility; in the London adaptation plan green belts represent a fundamental support for cooling and the flowing of surface water, as well as for CO_2 capture. Greening 50% of the entire municipal area is a priority objective for the administration of London to be achieved by 2050 - foreseeing an increase of about 500 hectares in parks and green corridors (City of London, 2017)-, together with the one of a zero soil consumption that seems really feasible, given that in 2012 London showed a significantly reduced sealed area compared to that of the other countries examined (tab.2).

Each plan has also used a different approach for the definition of the system of actions to be implemented, in relation both to the risks and to the physical and environmental characteristics of each urban area. In particular, it is possible to state that except the city plans of Ancona, Padua and Belgrade, all the other plans have been developed on the basis of specific knowledge of the urban system and on the study of the natural disasters linked to climate change occurred in recent years. It is, basically, a qualitative approach which, as such, has led to the definition of adaptation actions "in broad terms" since they seem to be guidelines and strategies rather than concrete and effective actions to be carried out.

For example, the actions developed by the Ancona adaptation plan are defined starting from quantitative analyses related to three variables (temperature, precipitation and sea level), aimed at identifying the key sectors on which risk analysis and urban vulnerability should be focused. In practice, this plan used a quantitative approach to carry out, with a degree of uncertainty, the risk forecasts and define multiple and detailed adaptation actions for each risk. The Padua plan is based on a quantitative analysis too. Thanks to the support of digital tools such as GIS, this plan has conducted an analysis on the new vulnerabilities of the city system, obtaining data that allowed an accurate definition of adaptation actions to be implemented. Lastly, Belgrade performed a quantitative analysis of the vulnerabilities and impacts of climate change affecting the urban system, obtaining an assessment of risks and opportunities. Even in the case of Belgrade, the adaptation actions envisaged in the plan are more specific than those contained in the plans which use a cognitive approach.

Ultimately, it is possible to state that although the reduction of soil use is now a strategic issue in the international scientific debate on the sustainable management of urban systems, its key role in the adaptation actions to climate change is not yet consolidated, as called for more and more frequently by Europe in the steering documents for the Member States. In fact, soil consumption is not one of the factors that requires

direct action to reduce the vulnerability of urban systems to climate change in progress, but rather it is a phenomenon that can be contained by increasing green areas and/or infrastructures and encouraging agricultural and environmental regeneration.
Moreover, the adaptation actions concerning soil almost exclusively refer to the latter in terms of protection and preservation, considering this resource from a mostly ecological and naturalistic perspective.
The attention, in other words, seems to turn to not yet sealed soil, thus leaving out the already anthropized one that, as such, would require, instead, greater adaptation efforts: «if for a correct approach to the limitation of soil consumption it's absolutely essential to safeguard what is outside the urbanized space, it is likewise indispensable to redevelop what is inside the city" (Arcidiacono, et al., 2012). The actions aimed at preserving the natural and biodiversity features of soil not yet built on should be complementary to those aimed at ensuring a more sustainable use of the already transformed soil, that is, of the volumes and the adapted spaces that constitute that heritage of urban resources from which the improvement of urban resilience strictly depends. Measures mitigating and compensating land consumption can also be a lever to implement urban sustainability policies, in full agreement with the European Environmental Sustainability Strategy, and not to undermine the capacity of other natural systems as well as of some social and economic sectors to pursue adaptation (Fregolent, 2014; Filpa & Ombuen, 2014). The innumerable interrelations between «the top layer of the Earth's crust» (surface) (ISPRA, 2015) and all that has been realized and/or modified by man (abovesurface) with the possible negative effects that may derive from the climate and ecosystem point of view require a broader and more integrated approach to issues such as soil consumption, based on the systemic value of this natural resource. In this perspective, the government of urban transformations requires the definition of strategies and instruments capable of adapting to unforeseen phenomena that may occur in the urban system.
This paper can be a starting point for local administrations that have not yet drawn up a plan to adapt to climate change, in order to develop actions that take into account the multiple benefits that soil protection (and especially a more sustainable use of it) can determine in terms of improving urban resilience. Further elements useful to define strategies and measures to mitigate and compensate soil sealing with the consequent negative impacts on climate change, and to measure the effectiveness of existing adaptation plans, can be identified in a future research work based on most up-to-date European land cover data. Indeed, this paper has a limitation due to the fact that the open data used are updated to 2012 (Copernicus project), and consequently, it does not provide recent information on the processes of anthropogenic transformation of the soil and can't help understand if and to what extent the actions contained in adaptation plans examined (drafted mostly in 2012) have produced in terms of increasing the resilience and environmental sustainability of urban systems.

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IMAGE SOURCES

Fig. cover: picture of the authors. Central Park. New York; Fig. 1: adaptation plan of Padua; Fig. 2: Climate change: adaptation action plan and vulnerability assessment; Tab.1 and Tab.2: created by the authors

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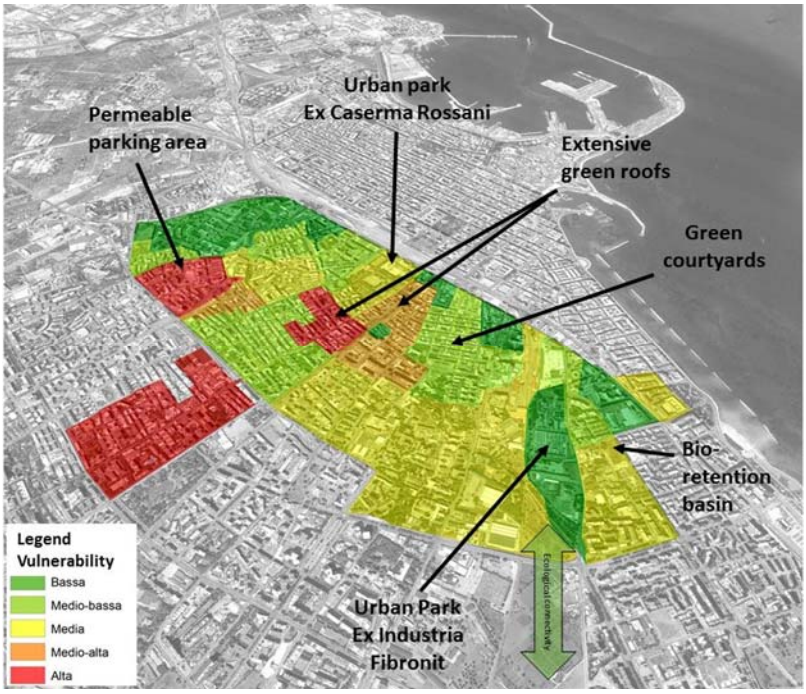

SECOND LAW OF THERMODYNAMICS AND URBAN GREEN INFRASTRUCTURE

A KNOWLEDGE SYNTHESIS TO ADDRESS SPATIAL PLANNING STRATEGIES

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ABSTRACT

Planning strategies driven by the second law of thermodynamics (SLT) are innovative approaches to sustainability but they are still in seminal phase. In this article, a coupled review of SLT within spatial planning is accomplished looking at the main applications in urban green infrastructure (UGI) planning. In particular, a systemic review of UGI planning and thermodynamics has been carried out to identify all the occurrences to date in the scientific literature. Secondly, a scoping review of SLT-related concepts of exergy, entropy and urban metabolism is presented in order to investigate the main applications of, and gaps in, urban spatial planning. Results indicate that UGI and ecosystem service planning based on SLT is a relatively new field of research. Moreover, some general indications are derived for the development of spatial UGI planning strategies based on SLT. The work then aims to contribute to the improvement and/or development of even more solid planning strategies supporting a SLT-conscious green transition of cities.

KEYWORDS:
Entropy; exergy; urban metabolism; urban planning; low-entropy city; ecosystem services

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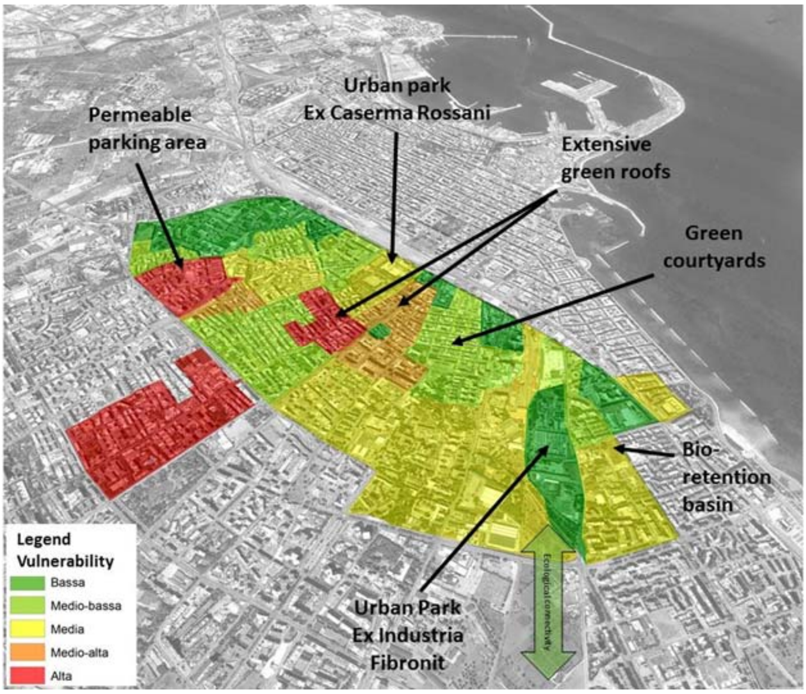

热力学第二定律和城市绿色基础设施

解决空间规划策略的知识综述

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摘要

受热力学第二定律（SLT）启发的计划策略，是实现可持续发展的一种创新方法，尽管目前仍处于开创阶段。在本文中，对空间规划中的 SLT 进行了一次综合评估，并着眼于在城市绿色基础设施（UGI）规划中的主要应用。特别是对 UGI 规划和热力学进行了系统评估，旨在确定科学文献中的所有情况。其次，为了调查城市空间规划的主要应用和差距，对㶲、熵和城市代谢的 SLT 相关概念范围进行了梳理。结果表明，基于 SLT 的 UGI 和生态系统服务规划是一个相对较新的研究领域。此外，基于 SLT 的空间 UGI 规划策略发展取得了一些进展。该工作旨在帮助改善和/或制定更加稳固的规划战略，为城市的 SLT 意识到的绿色过渡提供支持。

关键词:
熵、㶲、城市代谢、城市规划、低熵城市、生态系统服务

1 INTRODUCTION

City sustainability is a multifaceted task that entails non-linear processes and system complexity on different spatial scales and with a long-term view. Moreover looking at sustainable development, the evaluations should involve transdisciplinary research dealing with the interactions between natural and social systems in order to meet the needs of present and future generations while substantially reducing poverty and conserving the planet's life support systems in changing climatic conditions (Kates et al., 2012). Several urban planning and governance strategies have been developed to reach sustainability objectives giving social, economic and environmental aspects different weight. Moreover, designers and architects have embraced different sustainability criteria in their urban projects. The current approaches to sustainable urban development are therefore multiple and complex while the relevant issues are intertwined (Hassan & Lee, 2015). Thus, we should select the proper direction for future city development, but also define strong grounds on which to base our moves to avoid expensive and/or late re-thinking. The thermodynamics of open systems, with the Second Law of Thermodynamics (SLT) in particular, is one of the most solid disciplines for the study of complex systems and several applications of it have emerged in social, ecological and economic disciplines (see Pelorosso, Gobattoni, and Leone 2017).

Following the SLT, cities are metabolic far-from equilibrium systems, which utilize energy and matter flows to maintain levels of complexity, organization, and functionality releasing entropy (disorder or waste) into the environment (Fath, 2017). In pursuit of diverse objectives, humans modify land use and the socio-ecological and technical infrastructures which regulate urban energy and matter metabolisms. In a sustainable and systemic SLT view of the urban metabolism processes, exergy (or work capacity) should be maximised and entropy discharges reduced (Pelorosso, Gobattoni, & Leone, 2017). The concepts of entropy, exergy and urban metabolism (UM) are therefore strictly linked to the SLT and several applications of them are present in scientific literature as well as in sustainable urban planning and design (Bristow & Kennedy, 2015; Leone, Gobattoni, & Pelorosso, 2016).

Urban sustainability can be augmented integrating Nature and ecosystems with the urban metabolism and the socio-economic activities. The fundamental functions of natural systems that support citizen life are mainly provided by the Urban Green Infrastructure (UGI). Indeed, UGI is defined as an interconnected network of natural systems and Nature-Based Solutions (NBSs), localised at landscape scale and fully integrated with the built environment, which provides a diversified array of Urban Ecosystem Services (UESs) to the urban socio-ecological system, thus increasing its resilience. NBSs are engineered green/ecological systems inspired or supported by, or copied from, Nature (EU, 2015). UESs are benefits that people derive directly or indirectly from natural and managed ecosystems (Pelorosso, Gobattoni, & Leone, 2017). Thus, UGI planning aims to enhance the sustainability and resilience of urban systems. Recently, Pelorosso, Gobattoni, and Leone (2017) have presented a seminal low-entropy UGI strategy which incorporates social and ecological aspects and new operational entropy indicators into an adaptive SLT planning framework (see fig. 1). The low-entropy city concept at the basis of the UGI planning strategy calls for innovation and more efficient urban systems, from compacted to sprawled, with a stronger nature integration, able to use local and renewable resources, to reuse wastes and to institute closed productive cycles. These new urban socio-ecological systems, by maximizing cyclic, non-dissipative flows while minimizing dissipative flows, would release less entropy out of the system and, like a complex living organism that tends to minimum entropy production (e.g. the more healthy, mature forests at later stages of succession), they would persist and even grow in an even more sustainable manner. The low-entropy city concept represents a first contribute to the development of a new systemic urban planning paradigm in which nature of, for and in the city converges together under a thermodynamics vision of which social domain can be considered a part (Pelorosso, Gobattoni, & Leone, 2017). In the low-entropy view, NBS will be then studied, planned and designed looking at their localisation and spatial distribution, the increased internal socio-ecological complexity (e.g. creation of a network of people, new enterprises, added biodiversity), the importation of external sources of energy (e.g. for cooling systems as well as for crime control) and exportation/creation of entropy outside the urban system by wastes (e.g. pollution, runoff), to build Nature-Based Low-Entropy cities. The general low-entropy UGI strategy needs to be translated in real study cases with its embedded SLT principles (related to the concepts of entropy, exergy and urban metabolism) adopted in urban assessment and NBS planning. It is necessary therefore to know the main applications of, and gaps in, SLT planning with particular reference to urban systems and UGI in order to make the low-entropy concept operative. Despite numerous studies on thermodynamics, very little attention has been paid to SLT planning of UGI (Pelorosso, Gobattoni, & Leone, 2017). The objective of this article is then to provide essential information for the improvement/development of sustainable UGI planning strategies based on thermodynamic concepts and the low-entropy view. We adopted a coupled and sequential revision procedure to select the most significant papers and study cases able to inform UGI planning. A first preliminary systemic review has been carried out on scientific databases to select and investigate all the literature having explicit references to UGI and SLT planning within the title, keyword and abstract fields. Secondly, a scoping review was conducted to depth the knowledge on SLT planning even to cases not directly linked to UGI and not reported in scientific database. In particular, we sought for explicit spatial analyses with real study cases, which could facilitate the task of applying the research results to guide practical decision-support within planning processes. Indeed, explicit evidence of spatial anisotropies of land uses and indicators allow scenarios and urban projects to be designed considering the complex relationships among UGI components and urban systems (Pelorosso, Gobattoni, Geri, & Leone, 2017). The paper then provides evidence about the state of art of UGI and SLT indicating the main steps for the inclusion of thermodynamic concepts into UGI planning.

2 MATERIAL AND METHODS

To point out the links between SLT and UGI planning, a preliminary systemic review based on peer-reviewed papers or book chapters on the Scopus (http://scopus.com) and ISI Web of Knowledge (WoK) databases (https://webofknowledge.com) has been performed. A combination of terms was used to capture all the possible scientific products with ongoing research within the title, keyword and abstract fields. In particular, the search engines were used to explore the use of the terms thermodynamics, green, infrastructure, urban and planning (see the queries reported in Table 1). We then verified the relevance of the selected dataset with thermodynamics and real study cases of spatial UGI planning. Additionally, a second review framework, concentrated efforts on the most relevant SLT concepts related with urban planning and the sustainability of cities and landscapes. Thus, the use of exergy, entropy and urban metabolism concepts within planning has been investigated even though UGI were not considered directly. Since the scientific literature on these three research fields is abundant and diversified, a scoping review (Arksey & O'Malley, 2005) was carried out to build a knowledge synthesis regarding the following research question: what are the main applications of, and gaps in, SLT related concepts (exergy, entropy and urban metabolism) within spatial planning with particular reference to urban systems and UGI? The scoping review was carried out by Google Scholar search engine in order to widen the sample even to literature not included in scientific databases. Google Scholar was then used to search for published papers and books following the individual terms exergy, entropy and urban metabolism in an iterative process engaging with each stage in a reflexive way, repeating search steps in order to ensure a comprehensive coverage of the literature (Arksey & O'Malley, 2005). References reported in the papers identified were also checked following the same search engine. We focused in particular on the most recent literature in order to report significant update information.

The majority of the publications found were thus filtered out, taking into account only the most recent scientific products reporting spatially explicit quantifications, prioritizing works with practical applicability for urban planning.

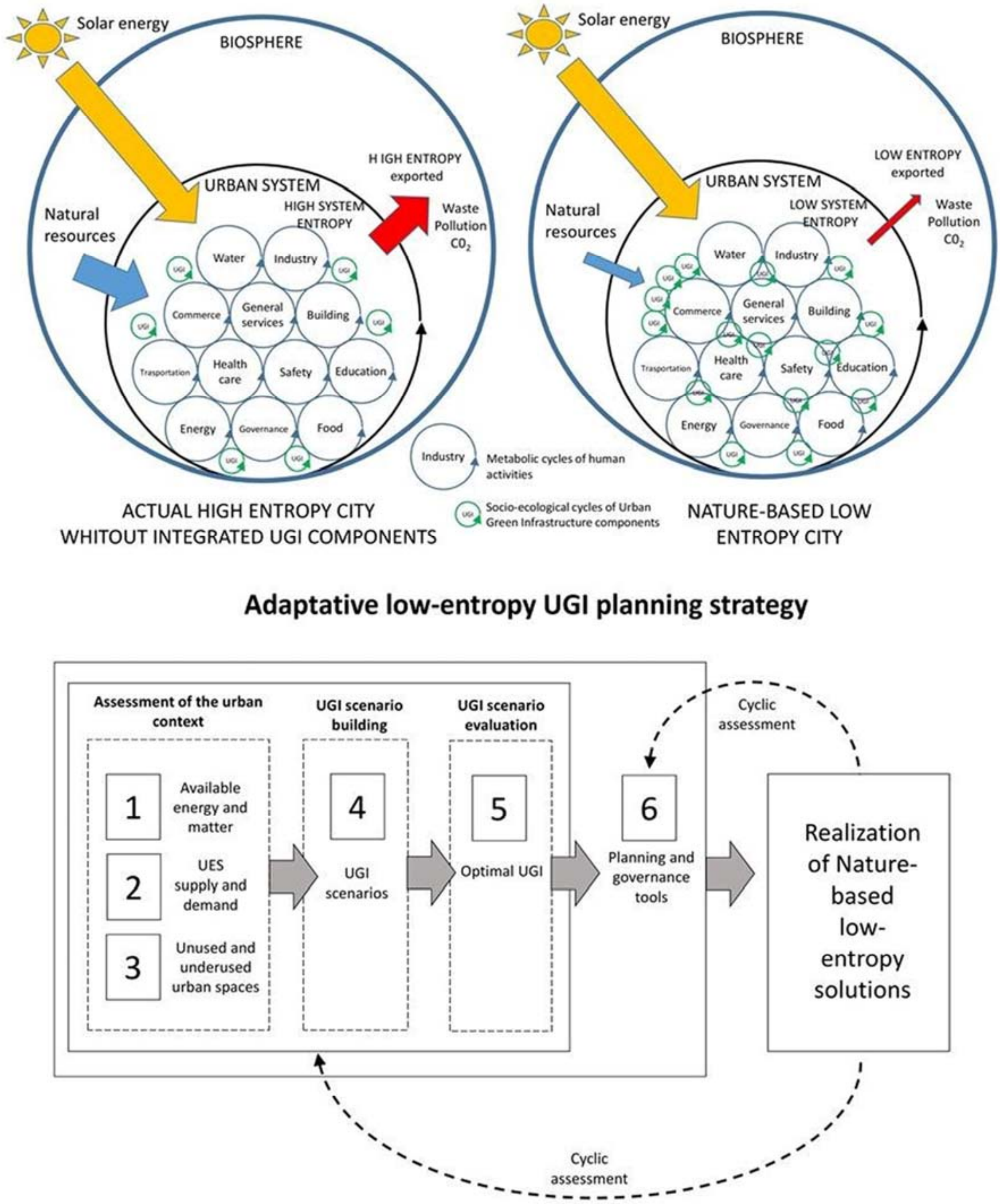

Fig. 1 Actual city without integrated UGI components compared with a theoretical nature-based low-entropy city with multifunctional UGI (top). The Conceptual framework of the adaptive low- entropy UGI planning strategy (bottom)

3 RESULTS AND DISCUSSION

3.1 THE SYSTEMIC REVIEW

The systemic review on UGI planning and SLT has brought to light few occurrences within scientific products for significant terms. In particular, no result was found considering UGI planning in urban contexts related to Thermodynamics (see queries 6 and 7, Table 1). Considering combinations of terms, the search provided a total number of 77 papers. Then, excluding overlaps between the two datasets, we kept 66 papers (see appendix A). Amongst the 66 works selected, only one paper presented an interesting application for spatial urban planning, though it does not explicitly consider SLT (He, Shen, Miao, Dou, & Zhang, 2015). The work deals with the urban climate of Beijing and proposes to use the synergy between the urban-induced heat island circulation and green-wedge planning to deliver cool/fresh air from the suburbs to downtown Beijing (He et al., 2015). In particular, the paper proposes a novel numerical-simulation-based method for detecting fresh-air ventilation paths quantitatively by taking into account both dynamic and thermodynamic aspects. The work analyses mountain-valley breezes using hourly weather station observations and puts them in relation with the built environment and the green infrastructure. Finally, a series of key planning recommendations (i.e. mitigation measures and climatic spatial planning guidelines) are presented for improving the urban climatic conditions of five planning zones proposed with reference to the Beijing city master plan. The final product of the analyses is then an urban climatic map which includes essential spatial information for planning land uses and UGI from the urban climatic perspective (Fig. 2). The final urban climatic map represents an eloquent visual tool, able to translate complex modelling studies in information useful for planners and practitioners. However, it should be noted that explicit references to ecosystem services (even climate regulation services) provided by UGI are not present in the paper, demonstrating that a full integration among urban ecology concepts and physical urban planning is still lacking. Moreover, entropy, exergy, urban metabolism and SLT are concepts not included in the study.

Although explicit references between UGI planning and SLT are not present in large part of literature, many urban ecology and design studies are founded on physically-based methods and models that rely on physical laws such as Thermodynamics (e.g. climate or energy modelling studies) (e.g. Ambrosini et al. 2014 and Fig. 3). These works deal with the simulation of green scenarios aimed at mitigating the urban heat island effect or heat waves and, in general, to enhance the thermal comfort of urban environments, reducing the energy demands of buildings and, consequently, carbon emissions. The simulations are conducted at different scales but usually they pursue design objectives while large spatial planning applications are rare and conducted at a coarse resolution. Indeed, these modelling approaches still have the drawback of high computational cost and complexity, so their use is often limited to research purposes or/and transdisciplinary collaborations among experts and planners. However, from a technical point of view, the evolution of the modelling approach is ineluctable considering also the increasing pc calculation power and availability of free (and open) software as well as digital information (i.e. big data, spatial data). The main issue appears to be the difficulty of adopting these modelling approaches within urban planning practice, considering the complexity of the model simulations (i.e. cost-effectiveness) with respect to the planning process needs (Gobattoni, Pelorosso, Galli, Ripa, & Leone, 2017).

Searched terms	Occurrences	
	Scopus	ISI
Q1:"green" AND "thermodynamic/s" AND "urban"	39	9
Q2: "green" AND "thermodynamic/s" AND "planning"	25	8
Q3: "green" AND "infrastructure/s" AND "thermodynamic/s"	7	3
Q4: "green" AND "thermodynamic/s" AND "urban" AND "planning"	9	0
Q5: "green" AND "infrastructure/s" AND "thermodynamic/s" AND "urban	3	0
Q6: "green" AND "infrastructure/s" AND "thermodynamic/s" AND "planning"	0	0
Q7: "green" AND "infrastructure/s" AND "thermodynamic/s" AND "urban" AND "planning"	0	0
Total occurrences	59	18

Tab.1 Results from queries on SCOPUS and ISI Web of Knowledge (ISI WoK) (period: up to 25/01/2017)

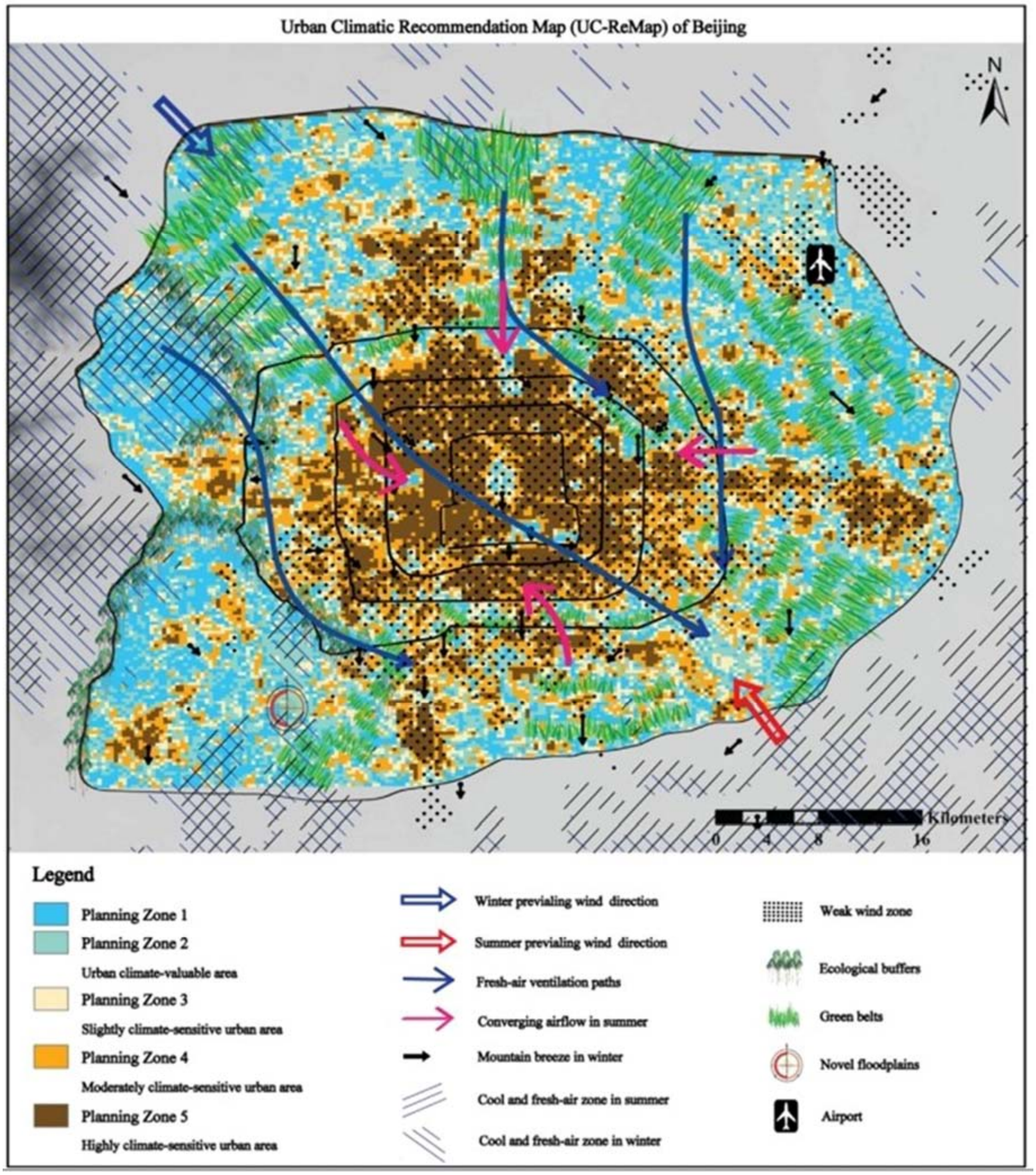

Fig. 2. Urban climatic map of Beijing

3.1 THE SCOPING REVIEW

Since few occurrences within scientific products emerged from the preliminary systemic review on UGI and SLT, a second review has been conducted in order to deep the knowledge relatively to SLT applications within spatial planning. This second review was then focused on three fundamental SLT concepts, namely exergy, entropy and urban metabolism highlighting, when possible, the planning implication for the urban systems and UGI. Table 2 reports a summary of the selected papers on SLT concepts and their field of application within spatial planning. The selected planning examples of Table 2 thus represent the state-of-art for further research developments and their applications in real case study are instances of SLT spatial planning.

	Definition	References	Field of application
Exergy	The maximum amount of work a system can perform when it is brought to the thermodynamic equilibrium with its environment. It represents the useful energy or work capacity embodied in the system (Stremke & Koh, 2011).	(Stremke & Koh, 2011; Stremke & Van den Dobbelsteen, 2013)	Renewable resources and sustainable energy landscapes. Several study cases of exergetic optimization in The Netherlands.
		(Leone, Gobattoni, & Pelorosso, 2016)	Exergetic optimization of a Mediterranean rural area. Foggia, Apulia Region, Italy.
		(Leduc & Van Kann, 2013)	Sustainable urban energy planning. Kerkrade-West neighbourhood, The Netherlands.
		(Balocco, Papeschi, Grazzini, & Basosi, 2004)	Sustainability of built up areas. Castel-nuovo Berardenga, Siena Province, Italy.
Entropy	A measure of the state of disorder of a system (Stremke & Koh, 2011). It is related to the dissipated energy (waste) during natural irreversible processes that trasform energy, move mass and drive the global biogeo-chemical cycles (Kleidon, 2009).	(Balocco & Grazzini, 2000)	Sustainability of urban areas in terms of energy. Florence, Italy.
		(Fistola & La Rocca, 2014)	Urban entropy assessment. Benevento, Italy.
Urban metabolism	The sum total of the technical and socio-economic processes that occur in cities, resulting in growth, production of energy, and elimination of waste (Kennedy, Cuddihy, & Engel-yan, 2007)	(Chrysoulakis et al., 2013)	Sustainability of urban planning interventions. Helsinki, Athens, London, Florence and Gliwice.
		(Codoban & Kennedy, 2008)	Design of sustainable neighbourhoods. Toronto, Canada.
		(Pincetl et al., 2014)	Urban environmental sustainability. Los Angeles, California

Tab.2 Spatial planning and second law of Thermodynamics: relevant applications of SLT concepts and study cases from scoping review

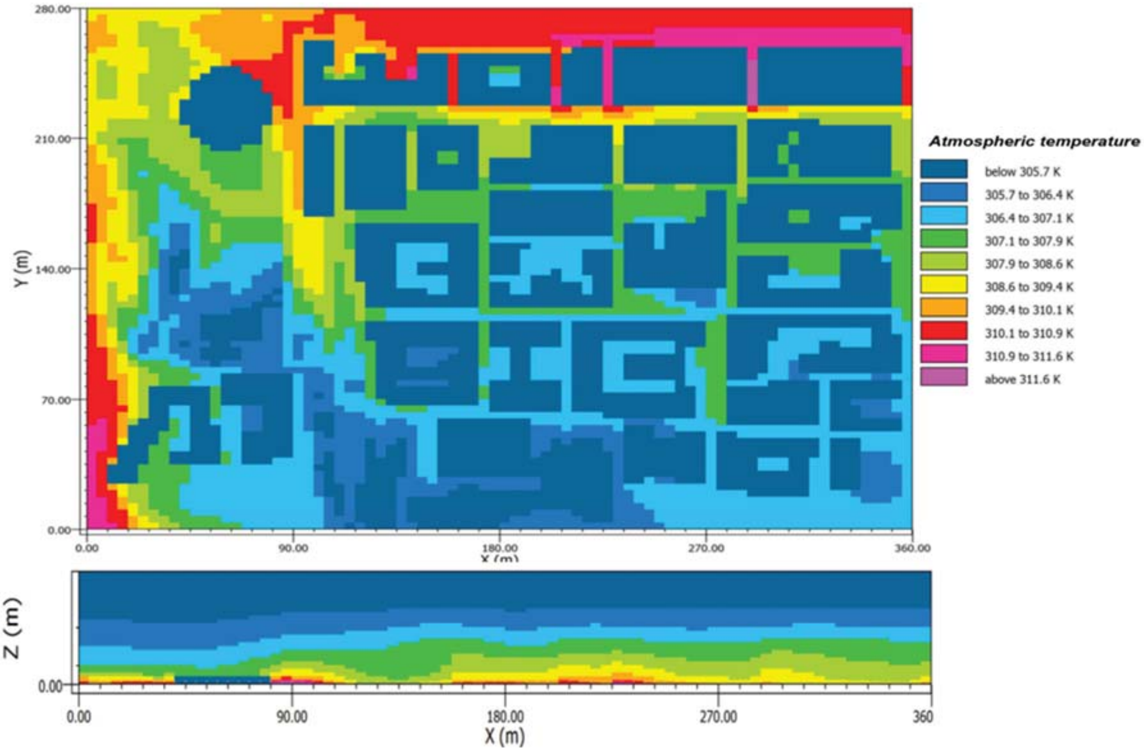

Fig. 3. Atmospheric temperature in a green scenario simulated with ENVI-met model, historical city center of Teramo, Italy

Exergy and urban spatial planning

From the consulted literature it emerged that exergy studies analyse mainly the energy aspect of cities and landscapes without specific interest in UGI spatial planning. The exergy assessment and SLT planning approach have been presented in the context of renewable resources and sustainable energy landscapes (Stremke & Koh, 2011; Stremke & Van den Dobbelsteen, 2013; Stremke, Van den Dobbelsteen, & Koh, 2011). The SLT planning approach aims to increase the exergy component of any process and, consequently, to reduce the production of pollutants (entropy) responsible for the alteration of ecosystem ecological functionality (e.g. climate change, freshwater degradation etc.). In general, the study cases on SLT planning based on exergy evaluations demonstrate how it is possible to evaluate the energy incidental to each land-use, obtaining significant productions, and increasing system resilience. Indeed, a conscious spatio-temporal organisation of the landscape based on the SLT, local renewable resources and smart energy systems increases the ratio of energy self-sufficiency and the resilience of the socio-ecological system. It allows local populations to have a greater capacity to persist and develop in the territory to which they belong through the mitigation of the negative effects derived from the fluctuations of the energy availabilities external to the system both on the productive processes and on the essential vital activities. SLT landscape planning studies have been conducted mainly in North Europe where SLT was firstly developed but the approach is attracting even more international interest. Worthy of note is the exemplificative SLT application in a Mediterranean rural area of Apulia Region (Italy) aimed at respecting landscape identity integrating traditional agricultural productions with a local industrial district and a residential area (Fig. 4) (Leone, Gobattoni, & Pelorosso, 2016).

Exergy analysis is also proposed in urban contexts. Two papers have been selected as exemplificative exergy applications because they aim to evaluate the sustainability of urban areas (Balocco et al., 2004) and guide spatial urban planning (Leduc & Van Kann, 2013).

Balocco et al. (2004) report an extended exergy analysis method in a small municipality of Central Italy, taking into account the mean life time cycle of building, to evaluate the sustainability of an urban area in terms of gas emissions. Two thermodynamic indexes, η_I and η_{II} showing, respectively, the first and second law efficiency of buildings, have been proposed as thermodynamic indexes. The applied methodology provides a single thermodynamics environmental criterion for the selection of technological alternatives, strategies and designs that produce lower environmental impacts connected to higher exergy indexes η_{II} . The method appears innovative, but difficult to apply to spatial urban planning in practice, due to its high data requirements at local scale. Moreover, it needs to be further developed for other urban issues and specific green area assessments have not been considered.

The work of Leduc & Van Kann (2013) proposes using the Urban Harvest Approach (UHA) to reach a circular urban metabolism in terms of exergy. The UHA can be defined as a strategy to investigate possible options for harvesting local resources, such as materials, water, space, energy, and for transforming these resources so that they can be used efficiently and effectively, limiting waste or output both into and out of urban regions. The proposed UHA is based on the integration of different urban functions, multifunctionality, harvesting of local renewable and residual resources at regional scale (see Fig. 5). The method described in this paper combines exergy analysis with spatial planning to test the sustainability of urban areas, including industrial areas, and proposes new productive functions. The UHA method is tested in Kerkrade-West, a neighbourhood of the municipality of Kerkrade in the province of Limburg, in the south of The Netherlands. The municipality of Kerkrade is part of a region where coal mining took place for centuries. Kerkrade-West has almost 16,000 inhabitants in an area of around 1000 ha. The proposed final strategy aims to increase the multi-functionality and resilience of Kerkrade-West, by filling exergetic gaps and by creating additional energetic synergies: e.g., adding a brewery to make good use of remaining energy potentials, and to create new jobs. Thus, the proposed spatial strategy constitutes the base for successive urban design aimed at building a multifunctional urban fabric with short connections between functions to make optimal use of the remaining residual energy flows and to apply heat cascading. The UHA proposed by the authors shows interesting aspects for spatial planning, but further application to study cases considering different contexts (e.g. compact cities), green scenarios and characteristics (e.g. water and matter fluxes, ecosystem services) should be realised. Indeed, specific gaps and constrictions (also at governance level) need to be identified to make the proposed UHA fully operative in UGI spatial planning.

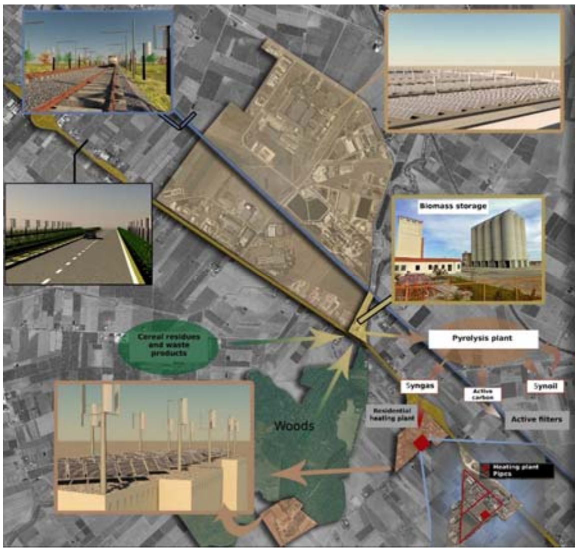

Fig.4 Scenario of exergetic landscape optimization by local renewable energies

Entropy and urban spatial planning

Despite numerous studies, only a limited number of papers present useful methods based on urban entropy aimed at supporting practical urban planning (Pelorosso, Gobattoni, & Leone, 2017). Indeed, entropy is a complex task that needs to be studied at different scales of analysis taking into consideration various urban system components such as energy, water, social aspects, waste cycles, etc. Few applications of the entropy concept have been presented in a context of spatial urban planning. The two most noteworthy ones are described below.

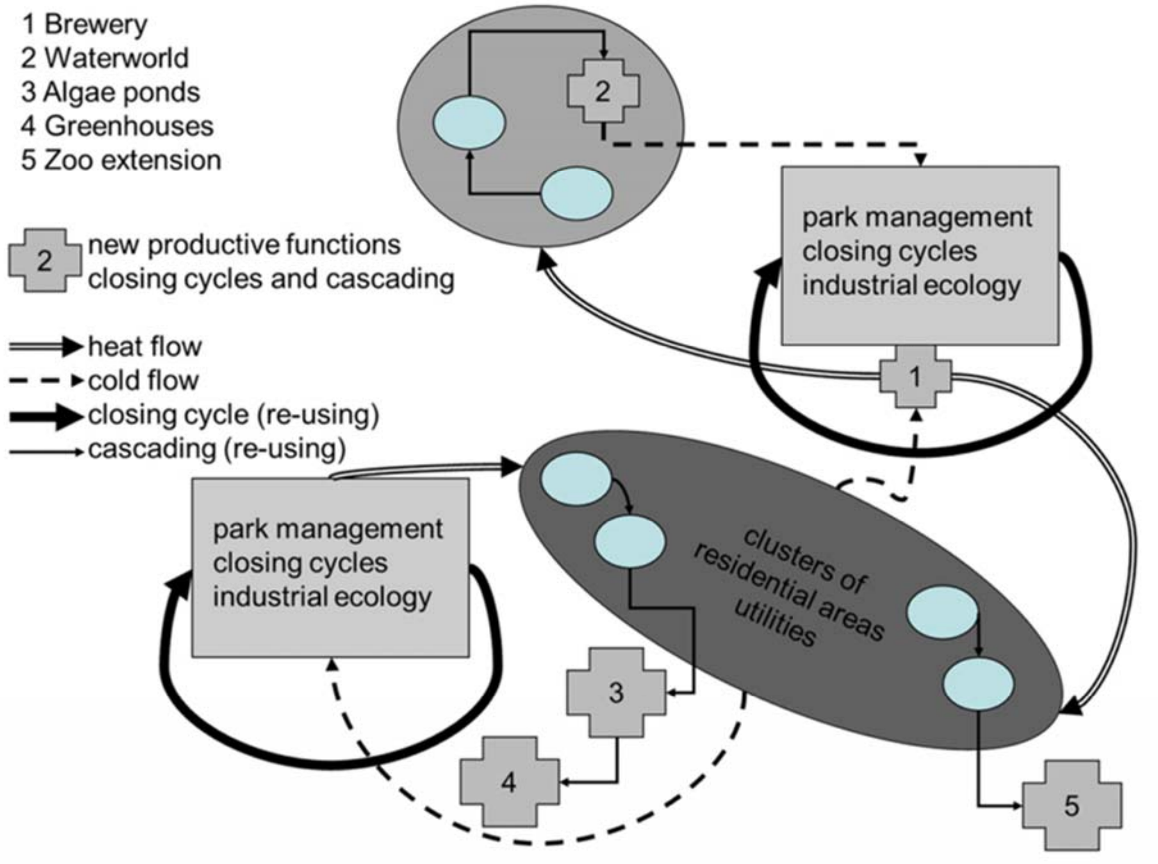

Fig. 5 Spatial energy strategy for productive urban regions

Balocco and Grazzini (2000) propose GIS and entropy indicators to study the sustainability of urban areas in terms of energy. The paper provides some indicators useful for measuring the energy sustainability of urban areas and defining planning criteria starting from an energy balance of a reference volume obtained in GIS by superimposing a grid mesh (200m x 200 m) on the built-up area under study. The work is based on the concept that real sustainability can only be obtained if total irreversible entropy is lower than the negentropy flux from the sun. A first entropy indicator is presented as the ratio between the entropy variation due to the total energy losses of buildings and the entropy variation due to the solar energy gain. The authors assert that a reduction of this indicator is necessary to reach sustainability. Moreover, another thermodynamic indicator is presented to take into account the entropy generated by building heating which considers the different sources of energy (i.e. fossil fuels or renewable sources). Even if not directly applicable to planning and evaluating the impacts and effects of green urban areas, the two thermodynamic parameters, expressed using the second law of thermodynamics, can be useful to analyse and design different sustainable urban energy scenarios. The proposed indicators are not closely connected to energy quality; nonetheless, they could be useful for analysing different energy efficiency scenarios at a defined reference scale. The definition of the assessment scale is a relevant issue for this entropy evaluation method. Indeed, urban planning requires high spatial resolution of information and reducing the mesh size of grid, the proposed entropy assessment could be not cost-effective in supporting localised interventions planning.

Fistola and La Rocca (2014) propose a different approach to urban entropy assessment within system theory and urban planning, by applying reversed sustainability indices as proxies of urban entropy. The research thesis speculates on the possibility of defining indicators of urban entropy acting in reverse: sustainability is a positive state and it is evaluated by "positive indicators" while entropy is measured by parameters describing negative states or having negative impacts on urban systems. The assessment method has been applied to the ancient part of the city of Benevento, subdivided into 59 census tracts and 572 buildings. Thematic maps and analyses were carried out by using GIS technology considering five main urban subsystems: anthropic, functional, physical, psycho-perceptive and geomorphologic sub-systems. The five sub-systems are described by a static and a dynamic component (see tab. 3) that when properly balanced indicate that a city is in a sustainable dynamic state. For each sub-system several indicators of sustainability have been identified as proxies of entropy and a composite entropy indicator has been mapped to guide urban planning (Fig. 6). The map of the composite urban entropy indicator showing the spatial distribution of critical areas was developed to support planning choices aimed at reducing specific and local sources of urban entropy. Thus the work of Fistola and La Rocca (2014), developed for urban planning aims, appears operative in the spatial planning of cities, but needs further research to confirm the usefulness of the proposed indicators in relation to thermodynamic principles which would allow a stronger theoretical foundation to be developed.

Sub-system	Static component	Dynamic component
Physical	Adapted spaces	Physical channels of communication (streets, networks, mains, etc.)
Functional	Urban activities	Communications
Anthropic	Players	Interactions
Psycho-perceptive	Images	Interpretations
Geomorphologic	Territorial areas	Connections (physical networks of interconnection)

Tab.3 Static and dynamic characters of urban sub-systems

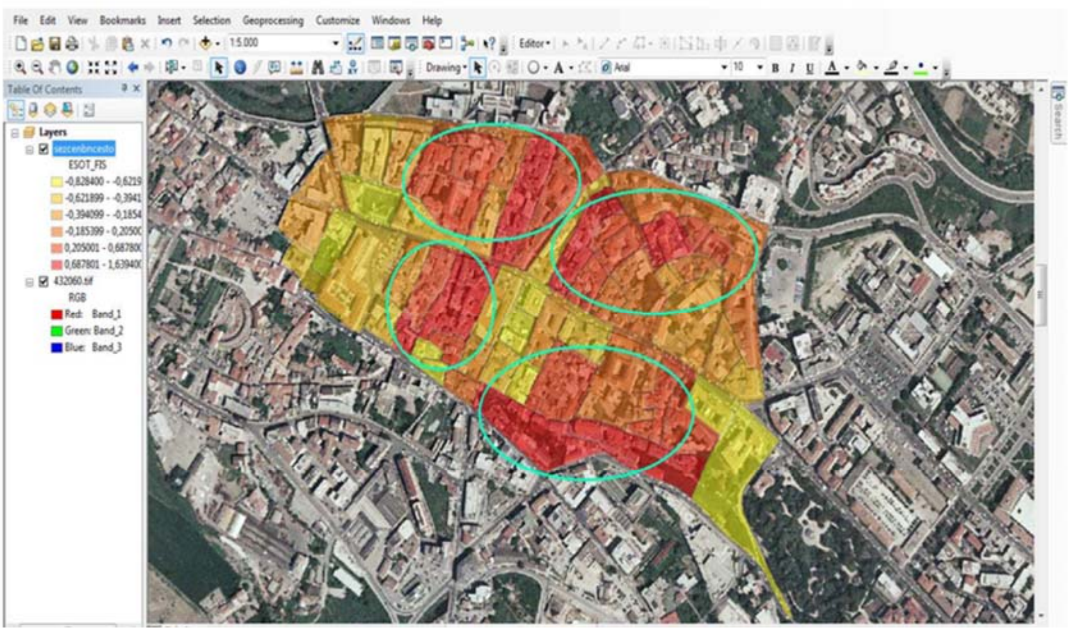

Fig. 6 Urban entropy for the physical urban sub-system

Urban metabolism and urban spatial planning

A City, like any other ecosystem, cannot be a self-sufficient system: it always requires an exchange of matter and energy to grow and evolve, and depending on its metabolism, it needs different amounts of energy, materials, water and nutrients to provide sustenance and shelter to its citizens, to produce goods and services, to grow and to eliminate waste and pollution.The regulation of the UM is therefore a priority to increase the sustainability of a city (Beloin-Saint-Pierre et al., 2017).

Two main schools of UM exist: one describes metabolism through energy equivalents (emergy), while the second studies the flows of water, materials and nutrients in terms of mass fluxes (C. Kennedy, Pincetl, & Bunje, 2011). The scoping review conducted did not reveal emergy assessment studies aimed at supporting practical spatial planning in urban contexts. In general, most UM studies use a top-down approach and coarse or highly aggregated data which cannot be correlated with specific locations, activities, or people (Chrysoulakis et al., 2013). Indeed, obtaining and managing huge amounts of data at a sufficiently downscaled level for planning purposes is often difficult (Pincetl et al., 2014). Only a few studies have presented UM as the baseline for effective designing and planning aimed at optimizing urban flows (Chrysoulakis et al., 2013; Codoban & Kennedy, 2008; Pincetl et al., 2014) and they do not specifically address UGI.

Chrysoulakis et al. (2013) report the results of the FP7 BRIDGE project aimed at defining sustainable urban planning decisions accounting for urban metabolism. The project developed a Decision Support System (DSS) based on a Multi-Criteria Analysis approach and GIS interface that aids the evaluation of the sustainability of urban planning interventions coping with the complexity of urban metabolism. Targeted end-users were involved to define planning objectives and future development scenarios were assessed in relation to the interactions between the environmental elements (fluxes of energy, water, carbon and pollutants) and socioeconomic components (investment costs, housing, employment, etc.) of urban sustainability. Five different case study cities participated in the BRIDGE project: Helsinki, Athens, London, Florence and Gliwice. For each city, several scenarios of development were defined (Fig. 7).

The evaluation of each scenario in the city study case was carried out in a participatory way in order to allow end-users to recognize the relative importance of sustainability objectives and indicators. Finally, planning alternatives in each case study were ranked in order of performance (environmental and socioeconomic components) and user preferences. Project results highlight a general positive effect of green spaces on many aspects of urban sustainability: cooling, CO_2 sequestration, water buffering and air quality. On the other hand, the develop of buildings and roads had the opposite effect. The innovation of the BRIDGE project is that these evaluations are quantified and related to urban sustainability targets and physical flows (see Fig. 8). The BRIDGE DSS thus represents a first example of a pragmatic tool for the sustainable land use decision making process at local scale based on urban metabolism. Another application of urban metabolism assessment for urban planning/design purposes is reported by Codoban & Kennedy (2008).

The study provides an analysis of the metabolism of four representative Toronto neighbourhoods, focusing specifically on the flows of energy, water, and food. Three particular metabolic processes within neighbourhoods are studied: operation of buildings, preparation and consumption of meals and beverages and transportation. The inflows to neighbourhoods include water, food, electrical, and fossil fuel energy; the outflows are solid waste and wastewater (see fig. 9). The authors report some general suggestions for the design of sustainable neighbourhoods.

These include the construction of energy-efficient buildings, development of public transit, replacement of inefficient water fixtures, the conversion of solar energy to building operational energy, the closure of waste-cycle growing urban forests and recycling grey water. The work shows a high detail of analysis, but it was not translated to specific and spatially defined actions within neighbourhoods. Thus, despite the considerable assessment efforts, the use of the information produced for practice urban planning appears is still limited to general considerations. The causes of the reduced employment of UM studies in practice urban planning have recently been investigated by Voskamp et al. (2018). The authors present an application of SIRUP tool – "Space-time Information analysis for Resource-conscious Urban Planning" in a case study of Amsterdam, focused on the investigation of energy and water flows. The purpose of SIRUP is the identification on the optimal spatiotemporal resolution of information on resource flows that stakeholders need for assessing urban interventions. In other words, the paper examined at which spatial and temporal resolution urban metabolism should be analysed to generate results that are useful for the implementation of urban planning and design interventions aiming at the optimization of resource flows.

Moreover, an investigation was performed to find out whether a lack of data currently hampers analysing resource flows at this desired level of detail. The urban planning and design measures considered were chosen among a number of interventions aimed at urban climate adaptation, climate mitigation and/or resource efficiency. The measures selected range from the conversion of cellulose in waste into power, to the realisation of PV on roofs, from parking garage as battery, to a regional smart grid. Specific water-related measures consider dike reinforcement, the concentration of sewerage flows, cooling capacity, water infrastructure improvement and the realisation of water squares.

The selected green/NBS measures are the creation of a park on a brownfield site, phytoremediation, rainwater buffering and infiltration and small scale parks. Results show that most urban planning and design interventions envisioned in Amsterdam require information on a higher spatiotemporal resolution than the resolution of current urban metabolism analyses, i.e., more detailed than the city level and at time steps smaller than a year. Energy-related measures generally require information on a higher resolution than water-related measures. Moreover, for the majority of measures, information is needed on a higher resolution than currently available. For energy, the temporal resolution of existing data proved inadequate, for water, data with both a higher spatial and temporal resolution is required.

Finally, the authors claim that for urban planning and design, the development of new types of UM analysis is necessary, rather than performing a conventional one on a finer spatiotemporal scale. The new UM analysis should thus be based on modelling and monitoring techniques that can provide a systemic understanding of urban resource flows and that are tailored to urban planning and design objectives. In particular, the use of modelling approaches, even if they are not fully accurate and simplify reality, may produce accurate enough data to inform the assessment and planning of interventions. We report the work of Pincetl et al. (2014) as the state of art in UM studies for spatial land use planning in line with the approach and issues pointed out by Voskamp et al. (2018).

The article presents an UM study using mixed methods and multiple sources of data for Los Angeles, California. In particular, electric energy use in buildings and greenhouse gas emissions from electricity are examined calculating infrastructure life cycle effects, water use and solid waste streams. The assessment is being conducted to help policy-makers better target energy conservation and efficiency programs, detect the best locations for distributed solar generation, and support environmental sustainability policies. Fig. 10 shows an example of UM spatial assessment for water use conducted at parcel level.

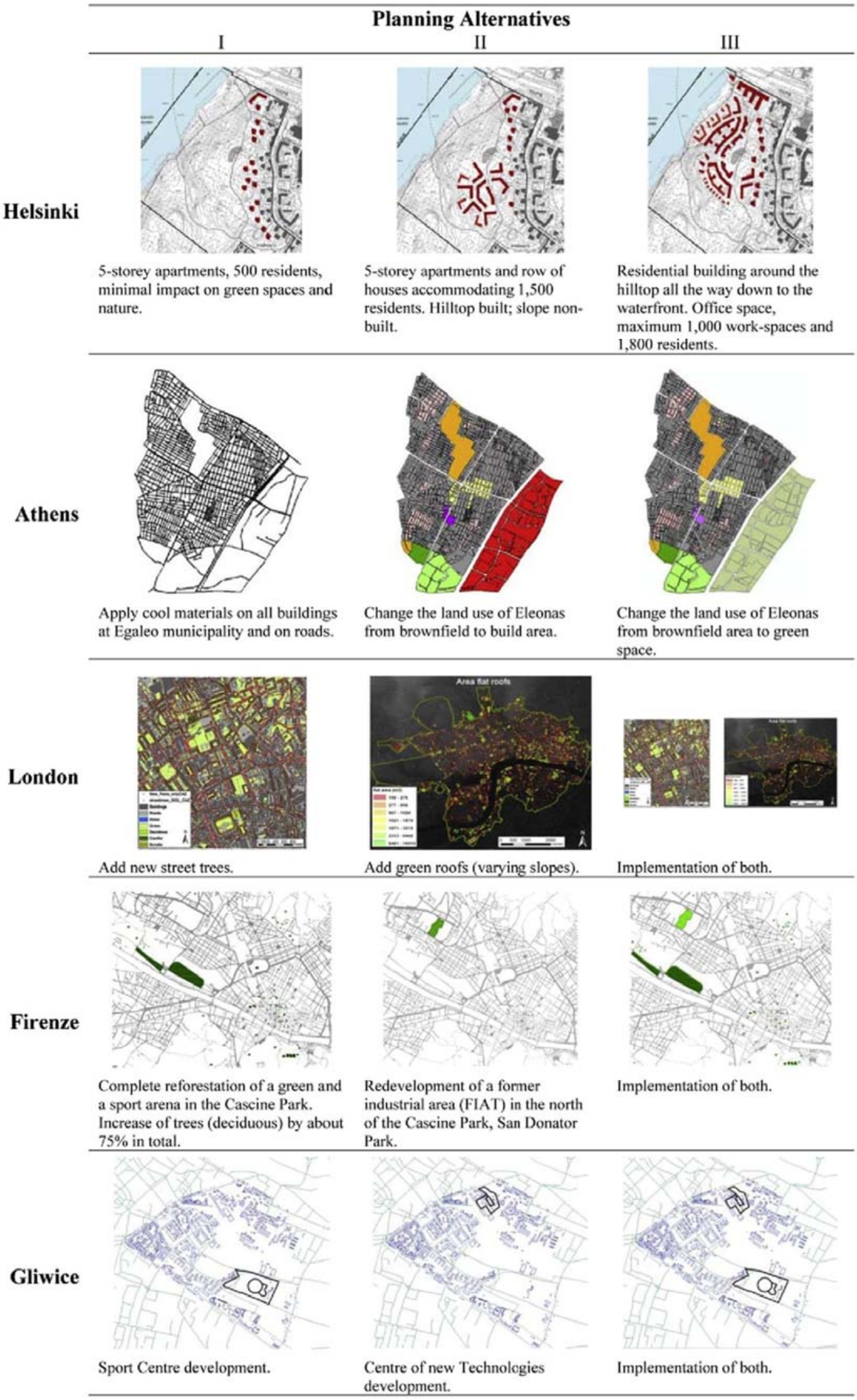

Fig. 7. The urban planning scenarios evaluated within the BRIDGE project for the five city study cases

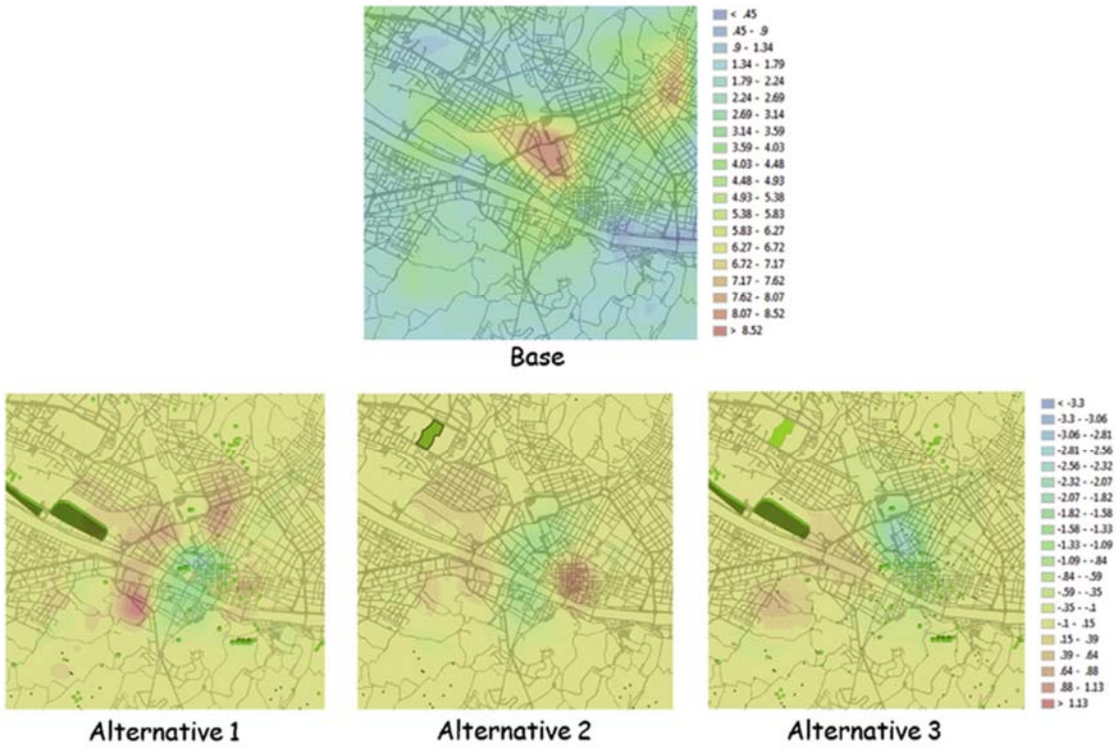

Fig. 8. Example of urban metabolism analysis conducted in the BRIDGE project. Mean surface runoff (mm h^{-1}) for summertime for the Firenze study case. The alternative scenarios (bottom) are evaluated as runoff difference with respect to the base case (top)

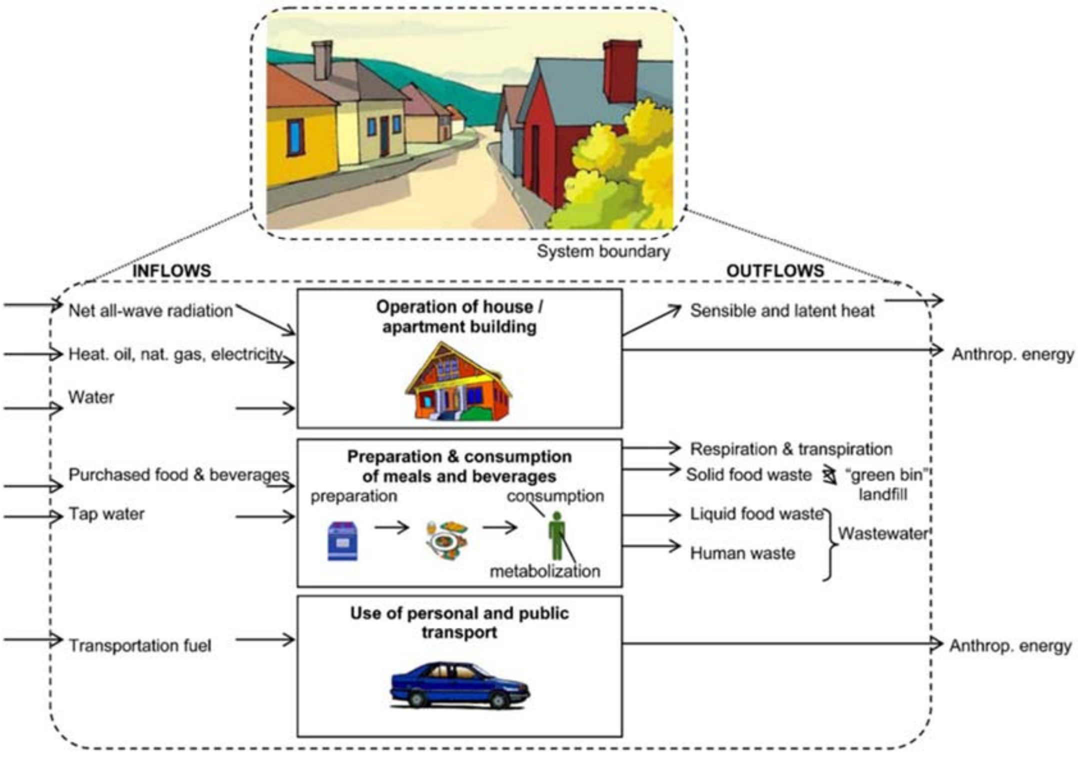

Fig. 9 Key metabolic processes analysed within the four Toronto neighbourhoods

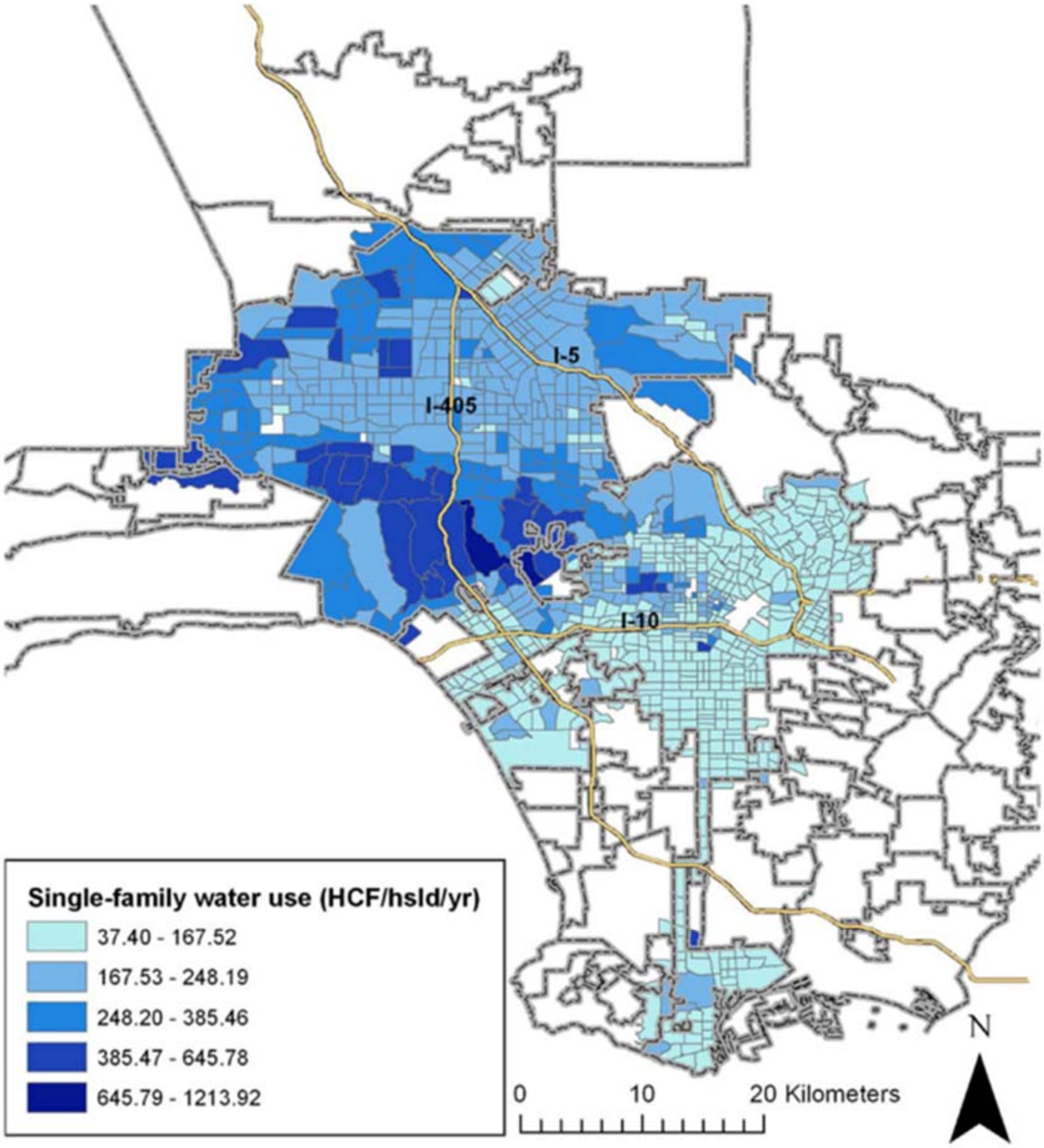

Fig. 10 Ten-year average single-family water use by census tract for Los Angeles

4 DISCLOSING SLT KNOWLEDGE FOR UGI PLANNING

From the literature review conducted, it emerges that beside technical issues, the integration of SLT into UGI planning requires a different systemic approach able to deal with different analysis scales and socio-ecological processes. As Voskamp et al. (2018) well highlighted, each UM assessment to be useful in spatial urban planning should aim to describe the urban system by linking the physical, quantitative knowledge of resource flows to its interaction with (current and historic) environmental, social and economic conditions. We think that this concept for UM can be translated for the general SLT approach. Indeed, human regulating and governing mechanisms play a critical role in urban ecosystems where policy, planning, and management decisions influence both anthropogenic and ecological processes within and beyond the city (Bai, 2016). A systemic understanding of urban resource flows must therefore be reached in order to provide insight both into the social and ecological processes affecting resource flows and into the interlinkages between processes and resource flows (Voskamp et al., 2018). Chrysoulakis et al. (2013) have shown that the choice among interventions on urban systems is not easy, even with the most accurate spatial assessments. Indeed, the dimensions of the urban sustainability are multiple, and each project has complex outcomes and trade-offs: such trade-offs are contingent to end-users' preferences and they are not fixed over time. SLT planning, especially at local scale, should then include stakeholder participation and cyclic assessment phases to adapt it to the changing socio-ecological system, allowing the best solutions (in our case NBS) to be selected and realised. Thus, two intertwined paths might be followed by researchers for the inclusion of SLT in UGI planning: a technical and a strategic path. The former consists in the further development of methodological frameworks (e.g. considering ecosystem services assessment, the integration of different SLT concepts, the proper spatiotemporal assessment scale), new applicable cost-effective indicators (in particular for entropy), the implementation of modelling approaches and the assessment of social domain related with ecological and physical processes. Among the several study cases reported, the spatial representation of the assessments has demonstrated to be a valuable support for planning. Mapping significant indicators of entropy, exergy or energy and matter fluxes at the proper scale and resolution can then represent a key aspect to facilitate SLT inclusion into UGI planning. The second path should aim to study how these technical aspects have to be considered in governing mechanisms, transforming the quantitative information produced by SLT assessment into effective and lasting urban interventions capable of increasing the quality of citizen life and the resilience of socio-ecological systems. Within this second path we should consider, for example, innovative policy and regulating approaches (e.g. compensatory measures) to encourage private owners to adopts NBS following performance-based criteria instead of conformance and prescriptivism norms (Frew, Baker, & Donehue, 2016). Finally, during recent years, several SLT planning approaches have emerged from scientific literature within different research fields such as, energy landscape planning, sustainable urbanism and urban metabolism studies. Since different field objectives, exergy, entropy and UM concepts have been applied, they have evolved separately. Even though some possible research pathways for a unifying thermodynamic-based urban planning have been suggested (Bristow & Kennedy, 2015; Filchakova, Robinson, & Scartezzini, 2007), more efforts are required to define solid spatial planning strategies able to embrace different SLT approaches above all for UGI.In this intertwined view, the low-entropy city concept and the proposed UGI planning strategy (Pelorosso, Gobattoni, & Leone, 2017) appears to be a promising cross-boundary tool which could provide a flexible integration of assessment methods taking into consideration ecosystem service frameworks, urban metabolism, social impacts and SLT-based planning. In particular, the proposed low-entropy UGI planning strategy emphasizes the role of modelling in the assessment phase and identifies several entropy indicators able to be easily applied by planners. Recently, the low-entropy approach has been applied in a exemplificative study case within the context of sustainable urban storm water management in Bari city, South Italy (Pelorosso, Gobattoni, & Leone, 2018). This research paper demonstrates the potential operativity of the low-entropy concept within the indicated technical path representing a first case of low-entropy UGI planning integrating modelling approach and entropy evaluation.

5 CONCLUSIONS

Although several scholars have investigated the role of Nature and SLT in making cities more sustainable, UGI planning based on SLT is a relatively new field of research with few real applications to urban systems. The paper, through a coupled review (scoping and systemic) of scientific literature, reports the main applications of thermodynamic concepts and approaches in urban planning. In particular, we searched for significant applications of SLT on study cases and we focussed on three key concepts related to SLT, namely exergy, entropy and urban metabolism (UM), to highlight gaps, constrictions and applicability for UGI planning. Finally, from the analysis of the selected contributions, some essential considerations have been derived with the aim of addressing and supporting future spatial planning. Exergy is an indicator of sustainability employed mainly for energy planning and several real study cases of exergetic landscape optimization exist at different planning scales. However, more efforts are required to investigate how exergy assessment can be used within specific

UGI planning, considering also the provision of ESs. Entropy appears a promising indicator of urban sustainability, but its operative application has still to be realised as well as the definition of proper and cost-effective entropy indicators able to spatially evaluate the effectiveness of green interventions at different urban scales. UM is recognised by many urban planners as the frontier for innovative land use decision making. Several issues hampering UM integration in urban planning have been highlighted by literature (e.g. demand of high resolution data) but a consolidated UM-based UGI planning is not present yet. Moreover, from the literature review, some general indications summarized in two levels of intervention (i.e. technical and strategic research paths) can be derived for the development of spatial UGI planning strategies based on SLT. From a technical point of view, practical UGI planning requires operative and integrated exergy, entropy and UM assessments with accurate descriptions of the urban socio-ecological complexity at the temporal and spatial scale at which practitioners work. In addition, modelling and mapping of SLT processes appear pivotal approaches for the inclusion of SLT in UGI planning. Strategical actions should instead look at defining adaptable governing mechanisms (e.g. compensatory measures) enabling SLT and performance-based planning criteria to be accepted and widely used among citizens in order to operationalise effective and shared interventions on UGI. The knowledge synthesis on SLT and urban planning thus confirms the innovative character of the low-entropy city concept and the proposed seminal UGI planning strategy (Pelorosso, Gobattoni, & Leone, 2017). In addition to further theoretical developments, practical implementations on exemplificative study cases or the creation of *ad hoc* urban living labs are welcomed to provide useful information to test the low-entropy strategy, and in general the SLT approach, in UGI planning. Several efforts are thus required to build theoretically sound but also operative thermodynamic-based UGI planning strategies able to integrate different approaches and to translate them into real UGI study cases. In conclusion, planning strategies driven by SLT are innovative approaches to sustainability, but they appear to be still in a seminal phase. The presented knowledge synthesis of actual SLT implementation in urban contexts and the proposed paths of action aim to address future spatial planning strategies and to support a SLT-conscious green transition of cities.

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APPENDIX A- SUPPLEMENTARY MATERIAL

List of the papers selected through ISI Web of Science and Scopus databases (period: up to 25/01/2017)

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IMAGE SOURCES

Fig. 1: Pelorosso, Gobattoni, & Leone, 2017; Fig.2: He et al., 2015; Fig.3: Ambrosini et al., 2014; Fig.4: Leone, Gobattoni, & Pelorosso, 2016; Fig.5: Leduc & Van Kann, 2013; Fig.6: Fistola and La Rocca, 2014; Fig.7: Chrysoulakis et al., 2013; Fig.8: Chrysoulakis et al., 2013; Fig.9: Codoban & Kennedy, 2008; Fig.10: Pincetl et al., 2014.

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THE ADAPTING CITY

RESILIENCE THROUGH WATER DESIGN IN ROTTERDAM

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ABSTRACT

The Netherlands is a fragile and vulnerable land; spatial planning is very important, just as important is the resilience of the system and its adaptation to climate change. Rotterdam is a delta city and, in a period of heavy climate change, it will experiment more extreme weather conditions, such as heavier rainstorms, longer periods of drought and more heat waves, as well as higher water levels in the river Meuse; so is important to know that it is a deep vulnerable city and need right strategies to overcome the problem and to be adapted to conseguences of climate change. The results presented in these manuscript were developed through some academic course at TUDelft; the main aim is to arrive at shared ambitions for climate proof urban development and to make specific concrete agreements about this defining a strategy able to enforce urban beauty and absorb excess rainwater and improve urban resilience through the implementation of some adaptive measures linking this strategy to the whole urban governante of the city. There is the need to implement a conscious and smart urban governance and to undertake urban awareness actions that aim at the awareness of the communities, which becomes an active part in promoting urban resilience policies and in creating the sustainable city. The strategy is characterized by some main innovation that could be recreated in other countries, such as the inclusion of resilience's theme in all levels of government and in all urban planning instruments and in spatial and strategic development policies; the deep cooperation between all stakeholders and public administrations; and the role of urban design that is able to create a waterproof city, enhancing the quality of public space.

KEYWORDS:
Resilience; water management; waterproof city.

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适应城市

通过鹿特丹的水设计提高城市复原力

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摘要

荷兰是一个土地脆弱的国家，空间规划非常重要；但同时，系统的复原力及对气候变化的适应也非常重要。鹿特丹是一座三角洲城市，在气候变化严重的时期，它将经历更加极端的气候条件，如暴风雨加剧、干旱时间更长、热浪更多以及默兹河水位更高等情况；因此需要了解这座城市的脆弱性并需要制定正确的战略来解决这些问题，适应气候变化的影响。本文中的结果是通过 TUDelft 的学术课程获得的，主要目标是达成城市发展中对气候变化的共识并就这一战略达成具体协议，通过采取适应性措施美化城市并吸收多余的雨水，提高城市抗灾能力，将这一战略应用到整个城市管理中。有必要采取意识明确的智能城市治理，开展旨在提高意识的城市行动，这将成为促进城市复原力政策及打造持续发展城市的重要环节。该战略中的创新特点也可以实践应用到其它国家，如在各级政府和所有城市规划工具及空间和战略发展政策中纳入抵御能力的主题；在所有利益相关者和公共行政部门之间展开深入合作；以及城市设计的作用，打造防水城市，提升公共空间的质量。

关键词：
复原力、水管理、防水城市.

1 INTRODUCTION

Water has always played a key role in the dynamics of growth and in the development of a territory; the waters have always been at the center of the history of civilizations; the territories furrowed by the great "water infrastructures" were the first to be urbanized by man and marked the first human settlements; water has been at the center of the classical mythology of the gods and has been at the center of religious rituals that have exalted its sacred nature linked to its recognized healing abilities. The water space is a place of intense vitality, a space of relationships, of exchange, a connective tissue, a fluid environment in which flows of people, of goods and of knowledge are realized; the water space, the limit between land and water, is a strategic space, often protected, where a strong landscape and environmental value are recognized; but it is also a strategic space for the transformation of the city. Often this space is a place of comparisons; the water spaces are public spaces characterized by high recognizability and identity; they are places defined in a very clear way by the cognitive approach of mindscape; places of relationship in which social well-being is not only dictated by the urban project but also by its fluidity, by its becoming, by its being a territory in rapid and continuos evolution and transformation. The water, in its countless garments, is the center of the city and of the urban project and it is often precisely the element that qualifies it, making it sustainable and resilient; water has to be used but it is also the main component of a series of hydrogeological risks from which we need to protect ourselves. Climate change is taking place in a changing world; in the water cities, urban projects that are aware of the fragility and vulnerability of the territory must be promoted (Galderisi, 2012). It is necessary to implement urban resilience actions able to mitigate natural risks by converting territorial problems into territorial resources and opportunities. There is a need to implement a conscious and smart urban governance and to undertake urban awareness actions aimed at the awareness of the community; a community which becomes an active part in promoting urban resilience policies and in creating a sustainable city (Moraci & Fazia, 2013). The global population has grown exponentially over recent centuries (Eger, 2009); more than half of all people now live in towns and cities, most of which are vulnerable to climate change (Newman, Beatley & Boyer, 2009). In particular, the densely populated and economically prosperous cities in the large river deltas that open out into the sea will be directly affected by the consequences of climate change. It is necessary to promote the development of a sustainable city, a resilient city, able to adapt to climate change and to face its effects, trying to mitigate its risks and to develop its potential for development and urban use. Concerning climate change and resilient city (Sennet, 2014), flood safety is just one of the tasks confronting the city. Major effects of climate change will develop on water cities where is important the theme of flooding; but climate change will also lead to more frequent periods of high temperature with effetcs on citizens' health, on Energy consumption, on air quality, water quality and problems on biodiversity. The Netherlands is a fragile and vulnerable land because it is located at the delta of three european rivers: the Rhine that flows from Holland to the Alps, the Meuse, which arrives in France, and the belgian Scheldt; from the geological point of view the area is shaped by the presence of sandy banks that were deposited about twelve thousand years ago and have allowed the first human settlements that are currently the historical centers of the cities; the outskirts of the contemporary city rise on peat or heavy clay soils. The dutch landscape consists of a dense network of polders characterized by key elements such as dams, windmills and farms; it is a unique landscape but, at the same time, is very fragile and constantly changing, been characterized by a deep relationship between man and nature; the polders are in sharp contrast with the massive urbanization of recent years.

The city-water relationship in the Netherlands is particularly important and strategic because 20% of the country is made up of water, whose presence affects every urban and architectural project; Netherland is, among the countries with the highest population density in the world, ranked 14th according to WorldAtlas[1], with a population of just over 17 million inhabitants on an area of 41.543 square kilometers and an average

1 www.worldatlas.com/aatlas/populations/ctypopls.htm

density of about 412 inh/sqkm. Spatial planning is very important, just as important is the resilience of the system and its adaptation to climate change; the relationship with water, as mentioned, is strategic and at the center of the policies of VROM, the Ministry of Home, Spatial Planning and the Environment. Aware of the fact that the existence and the survival of the territory itself depend on the infrastructures that determine it, dutch planners and designers have developed, especially in the twentieth century, policies and strategies to develop and maintain a "sustainable" balance between urbanization, landscape and infrastructures that have guaranteed the recognized leadership in the field of water management and defense, with a system of dams that is the largest in the world[2].

At the end of the eighteenth century, the dutch Parliament decided to introduce a more effective central organization for flood defense; on March 27th, 1798, an agency for public works and water management was established, which took the name of *Rijkswaterstaat*, which currently manages 3.260 kilometers of national roads and 1.686 kilometers of national waterways. On the whole of the national defense works, all the most important dunes and dams constitute the "primary water defenses", since they protect the country from the floods of the Ijsselmeer and Markermeer rivers, lakes and rivers. The "secondary" defenses are also important but if a dam of this system collapses no dramatic consequences will occur. In order to cope with the current climate change, in 2007 the national Government issued its "Vision" on the water policy entitled "Reclaiming the Netherlands from the future" (City of Rotterdam, 2008), which underlines the need for a sustainable management of the water resource in relation, above all, to climate change; in 2008 the Second Report of the Delta Commitee entitled "Working with water" was published (Delta Commissie, 2008), it contains twelve recommendations to guarantee national defense and security; in 2009 the "National Water Plan" (Ministry of Infrastructure and the Environment and Ministry of Economic Affairs, 2014), came into force whose slogan is "Move in accordance with natural processes where it is possible, offer resistance where necessary and seize opportunities to promote prosperity and well-being". To achieve these aims the theme of water will have a central importance in spatial planning.

Fig. 1: Water in the Netherlands

The Netherlands is getting wetter, dryer and saltier. The sea level is rising. While rainfall is getting heavier at times, it may also at other times hold off much longer. Soil subsidence continues, due to both geological influences and human activities. Land use is changing as well, the economic sectors are continuously changing and, societally speaking, new demands are made on water. All this can hardly indicate anything else than the necessity for a change in water management and water use.

Adaptation involves solutions being found in all aspects of the urban environment that make it possible to alleviate the system and make it more resilient. Adaptation means that we must also focus on adapting the

[2] In the Netherlands the dams are extended for 16.500 kilometers and panels about 300 structures.

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city to make it less vulnerable and more resilient. Through the different experiences described in this manuscript, the authors want to contribute to the construction of an urban methodology that can allow the construction of a resilient urban system. This strategy also aims to contain storm water runoff in case of extreme rainfall, if possible in combination with measures to improve and enhance the green quality of open spaces in the city. The strategy combines sustainability efforts with resilience and urban transformations. The theme of resilience is included in all levels of government, in municipal plans and in spatial and strategic development policies, such as in some projects concerning public and private space.

Climate adaptation assumes the role of a real urban strategy that can innovate the city, making it more fascinating and modern. The approach pursued throughout the manuscript aims at fostering resilience and flood protection by means of the architectural and urban projects. Moreover, it considers the use of the public areas as strategic spaces where the resilient city can be developed, employing engineering technical climate defences as new public zones for citizens and communities. Urban governance (Deakin, 2013) is the best place to establish goals and objectives that must be pursued for the creation of a resilient city (Hollands, 2008); the city must be a unique, resilient project and every part of it, both public and private, must be seen as a potential space in which to pursue climate adaptation policies. To make smart planning implementable and equip it with the new paradigm of urban resilience, all levels of government and all the stakeholders must be involved. The resilient city is an urban challenge, but it is also a political and economic challenge. It is also important to link defense design with other spatial planning tools, to allow the better integration and implementation, a right cost reduction and an increased innovation. The challenge is to link climate adaptation to other urban measures, projects and initiatives such as the management and maintenance of roads and public spaces. It is also important to develop appropriate strategies to improve awareness within the population, to promote the active collaboration of the smallest "backyard actions." To engage the community, it is necessary to ensure people are aware of the benefits they will have if they contribute to the pursuit of climate adaptation. It is necessary to implement urban resilience actions that are able to mitigate natural risks by converting territorial problems into territorial resources and opportunities. Implementing a conscious and smart urban governance and undertaking urban awareness actions are fundamental. The aim is to create a community actively participating in promoting urban resilience policies and in creating a sustainable city.

2 WATER MANAGEMENT IN THE NETHERLANDS

Water management in the Netherlands is a complicated issue (Rijkswaterstaat, 2011); the Netherlands could be considered as a gateway for water; all the water that is carried across its borders by streams and rivers must be discharged into the sea. The same applies for rainwater, which makes its way to the sea overland or underground. The Dutch model of water services management is entirely public; the tasks related to the integrated water service are not the responsibility of a single entity, but the aqueduct service is managed by water companies, companies with entirely public capital. The sewerage service is managed by the municipalities while the wastewater treatment is entrusted to waterschappen, functional public bodies that deal, on a regional scale, also with the management of water control works, fundamental for the very existence of the country. These subjects interact closely with each other and with other organizations that deal with the planning and management of the territory, given that the management of all water services (and not only that connected to civil and industrial uses) is strongly integrated in the Netherlands and, for historical and morphological reasons, it is also integrated with the planning and management of the territory. Responsibility for water management in the Netherlands is entrusted to the Rijkswaterstaat (the executive branch of the Ministry of Infrastructure and the Environment) and to the water control Committees; the Rijkswaterstaat (RWS) is responsible for the management of the main waters, such as the sea and rivers, and ensures that the responsible authorities are promptly warned in the event of floods or stormy seas.

Furthermore, RWS maintains dams, dunes, cages and overvoltage barriers and protects the coast by regimenting and expanding the floodplains and building secondary canals.
Dutch have started to use modern wastewater treatment techniques since the 1970s; currently all homes have access to drinking and chlorine-free water, while 99.4% are connected to the sewage system; moreover, the level of recycling of industrial wastewater is high and the water is of sufficient quality to be used in the food and beverage industry. The regulatory framework of the Dutch water management legislation consists of a 2011 law ("Drinkwaterwet") which prevents the private sector from directly managing water resources. In relation to current climate change, the national government, since the early years of the 21st century, is trying to promote the formation of a resilient city, able to cope with the ongoing natural transformations and to create a less vulnerable and more resilient city. For dutch people is possible to link the adaptive measures to other spatial development projects in the city and to intelligently combine them with existing management and maintenance programmes with an intensive cooperation with other partners who are active in the city. The general aim is to promote the creation of a waterproof city through joint responsibilities and smart management and urban governance. In 2007, the government published its vision on water policy, entitled 'Reclaiming the Netherlands from the Future', a document in which the government wanted to operate in the field of National water policy, encouraging the formation of sustainable water management. The Water Vision specifies five spearheads for which the cabinet would like to intensive its policies. One is resilience to climate change. The Delta Committee, in 2008 published its report 'Working with Water' (Delta Commissie, 2008) containing twelve raccomendations to help to face the threat of an excess of sea and river water and to safeguard freshwater supply in the long term; this study anticipated the National Water Plan that was published in 2009 (Ministry of Infrastructure and the Environment and Ministry of Economic Affairs, 2014); with the aim to enforce the National Water Policy stressing the importance of the pursuing of sustainable water management and giving to the water greater significance in spatial development; for this reason this plan is considered as a frame work vision based on the Spatial Planning Act. This Water Plan has integrated eight previous sectorial water acts of the Netherlands, addressing all relationships within water systems. For example, the relationship between the quality and quantity of water, between surface water and groundwater, but also the relationship between water, land use and water users. Integrated water management is also characterised by its relationship with other policy areas such as nature, environment and spatial planning.

3 A RESILIENT PROJECT: THE DELTA METROPOLIS

As we have already highlighted, the territory of the Netherlands is very fragile and vulnerable, placed on average 5 meters below sea level; for this reason about 75% of the Dutch coast is protected by sandy dunes that vary their length from 100 meters to several kilometers; 15% of the coast is made up of "hard" man-made constructions such as dams and artificial reefs, while the remaining 10% is characterized by flat and very wide beaches. Dikes and dunes ensure that Netherlands and its inhabitants could feel safe. All the dunes and the most important dikes are called primary water defences, because they protect mainly from flooding by the sea, the main rivers or Lake IJsselmeer and Lake Markermeer. The secondary defences are also important, but if a dike in this category collapses, the consequences are not as dramatic. If the primary water defences were breached, the consequences would be considerably greater. The Flood Defences Act indicates the safety standards for every dike ring area. The standard is higher if more economic activities take place within the ring and if the number of inhabitants is high. Other important factors are the size of the area liable to flooding; the height to which the water may rise and whether the flood water will be fresh or saline. Flooding occurs when water levels are so high that the streams, lakes or waterways bursts their banks. In the main water system, floods are deemed to occur if national waterways are not sufficiently capable of storing or discharging regional water discharges. In the field of hydraulic works and hydrogeological management, the most famous flood protection projects are the Afsluitdijk dam and the Delta Works, a system of dams, sluices and mobile barriers in the two Zeeland and Zuid-Holland provinces. The two most important works of the Deltaworks are the Oosterscheldekering dam, inaugurated in 1986 between two islands, in the Zeeland Province, and the Afsluitdijk dam, a 32-kilometer dam, designed as early as the seventeenth century, but completed only in 1932, which separates the inland sea from the North Sea and connects the Friesland and Noord-Holland provinces. This dam protects the coasts of four provinces from maritime floods, and creates the large inland lake IJsselmeer, a freshwater basin that is used in periods of drought. The Delta Project is impressive and was designed and built in response to the catastrophe that struck the Western Netherlands in 1953. The area devastated by the storm was that on the southern coast, called Zeeland, affected by the mouths of three major European rivers, the Rhine, the Scheldt and the Meuse; the project, which involved the construction of eleven dams that blocked the main estuaries of the Delta, had the ambition to increase the safety of the topographically most depressed areas of the delta of the Rhine, the Meuse and the Scheldt, defending them from the most violent storms and floods. This impressive project, also considered one of the seven wonders of the world, demonstrates the ability of the Dutch to dominate the immense power of water. The main element of the Delta Plan is the Oosterscheldekering dam, a unique 8-kilometer-long storm barrier that isolates the entire Eastern Scheldt in just 75 minutes; this ingenious system consists of 62 huge sliding gates that can close quickly protecting the Netherlands from flooding. Given that more than a third of the country is below sea level, the goal was very complex; to achieve the goal of hydraulic protection, the coastal dunes were raised more than 5 meters and the islands of Zeeland were connected by dams and other masterpieces of high engineering. Under normal circumstances, dutch water system works well. Problems such as safety, water shortages, flooding, waterlogging and salinisation usually only occur under extreme circumstances.

4 ROTTERDAM RESILIENT CITY: STRATEGIE AND ACTIONS FOR A WATERPROOF CITY

Rotterdam has been protecting itself from the threat of the water from the rivers and especially from the sea for centuries. The dams and dikes, belonging to primary and secondary defenses, have managed the risk of flooding and have helped the drainage of urban land. For this reason Rotterdam is considered one of the safest delta cities in the world altought Rotterdam iso ne of the most vulnerable city in the world (Meyer, 2003). Rotterdam is located in the delta of the rivers Rhine and Meuse; the city, for the resilience strategy, is divided in different zone but the main importance is to be in the inner city or in the outer-dike areas; The outer-dike areas of Rotterdam are not protected by dikes while the inner part is protected by dikes and is less vulnerable. Within the dikes, the inner-dike city of Rotterdam is mostly well below sea level, with the lowest point being as much as 6.67 metres below NAP[3]. The Rotterdam Programme on Sustainability and Climate Change (City of Rotterdam, 2014) focus on some priority, on some urban topic such as enhancing sustainability, producing a greener and more Energy saving environment, reducing CO2 emissions and working with polpe and communities to promote awareness for the best management of natural hazards and resources. Rotterdam is a delta city and in a period of heavy climate change is will experiment more extreme weather conditions, such as heavier rainstorms, longer periods of drought and more heat waves, as well as higher water levels in the river Meuse; so is important to know that it is a deep vulnerable city and need right strategies to overcome the problem and to be adapted to conseguences of climate change *Rotterdammer*[4] have been adapting their city to the ever-changing delta for centuries. Rotterdam has a strong relationship with water, the whole city is surrounded by water that comes from the sea, from the river, from precipitation and from groundwater.

[3]!!!!!!!!NAP, the National Amsterdam Level, is an agreed ordnance measurement that is almost equal to mean sea level.

[4] Rotterdam's citizens.!

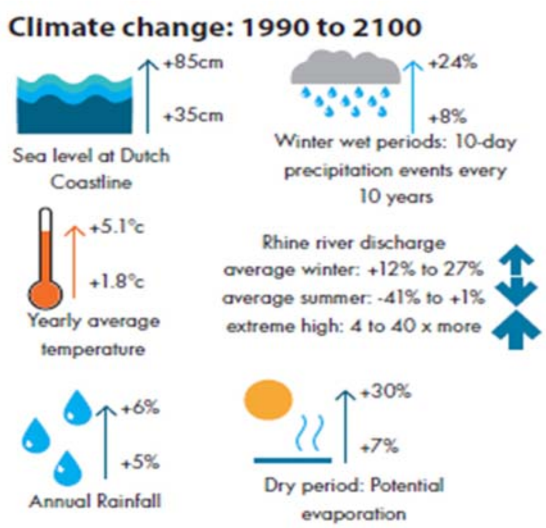

Fig. 2: Climate Change 1990-2100

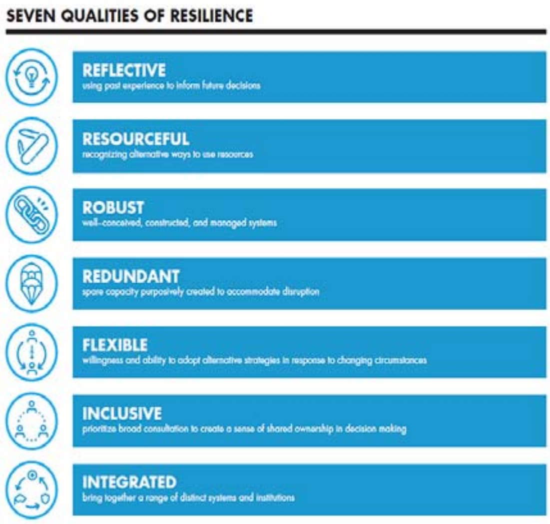

Fig. 3: Quality of resilience

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This is the main reason because the city is one of the more vulnerable to the consequences of climate change. The rise in sea levels and increase in water levels directly influence the city's flood risks. During periods of estreme rainfall, it is very difficult for the water to drain away. Drought manifests itself for example by low water tables and low river levels. Furthermore, the negative effects of a heat wave are more apparent in a highly populated, compact city such as Rotterdam than in the surrounding countryside.

Rotterdam is an example of resilience and adaptation to climate change; the theme of urban resilience has been under the attention of the municipality for about fifteen years and Legambiente has included the Dutch city as one of the examples to follow in the 2017 "Cities to the challenge of climate" dossier (Legambiente, 2016); moreover, in the central districts of Rotterdam, urban retrofitting actions are experimented through new technologies and new functions applied to existing structures, and in line with the climatic changes taking place. Rotterdam is also experimenting with some innovative building technologies; for example, is adopting architectural technology solutions that adapt to the fluctuation of water levels with the introduction of the obligation, by 2025, to create sustainable constructions with floating quarters, in areas outside the banks; the urban water system is also being resilient with the creation of tanks for the storage of excess rainwater. Through some programs, including the "Rotterdam Climate Initiative" (City of Rotterdam, 2013), Rotterdam is seeking, with the help of the government and organizations, research centers and citizens (van Oostrom, 2001), to reduce pollutant emissions by 50% by 2025, trying to adapt the city to climate change in progress and promoting five main initiatives focusing on the concept of resilience: 1) floating houses; 2) the water squares; 3) enhanced water collection systems; 4) green roofs; 5) the sustainable port. Rotterdam is the inspiring example to other delta cities around the world going through a sustainability approach; as a green city is an attractive and resilient city where people love to live, work and relax; sustainability is an integral part of all area development projects in Rotterdam; sustainable areas are future-proof areas with good living conditions. The Rotterdam City Council is committed to making Rotterdam a leader in sustainable urban living. The original core of Rotterdam was along the Rotte river (now largely reduced to an underground but navigable canal); in the expansion of 1626 the city assumed the shape of a triangle with the river Maas as a southern limit and limited by Goudsche Singel and Coolsingel and Schiedamsche Singel. Rotterdam is formed by some district: the *Oude Binnenstad*, the most ancient urban nucleus, almost entirely razed to the ground in 1940 by bombing and rebuilt with a new, extensive urban and functional structure; from the *buitenstad*, the predominantly commercial suburbs; from the *polderstad*, the most modern residential district, and finally, on the left of the river, from the *port* and *industrial quarters*, where economic life is thriving and one third of the population. Refering to the city form, concerning climate change there is a clear distinction between the outer-dike and the inner-dike areas of Rotterdam; the outer-dike regions are not protected by dikes and are directly affected by the water levels of the river and by the tide so they are more likely to flood than the inner-dike areas. The outer-dike areas are protected by the Maeslant storm surge barrier. This barrier closes when water levels reach 3 metres above NAP; it is expected that by 2080 the barrier will have to close once a year on average, rather than the current average of once every twelve years. Inner-dike Rotterdam is extremely well-protected from flooding; prevention is the key factor in the flood protection of inner-dike Rotterdam. Outer-dike Rotterdam is the least vulnerable area. The 19th century urban districts are the most vulnerable areas. These are densely built-up, generally paved over, have relatively little open water and green. The inner-city centre of Rotterdam is especially vulnerable to extreme rainfall because it is densely built-up, the public areas are used intensively and there is very little vegetation The main difference between these six zones is if they are defended by the dykes (inner dyke) or if, on the contrary, they are lacking (outer dyke); in other areas the main difference is in the presence and availability of potential public spaces or, on the contrary, in the compactness of the fabric that precludes or limits the sustainable project of public space.

5 RESILIENT STRATEGY AND CLIMATE URBAN ADAPTATION

A definition of urban climate resilience is 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.

Resilience thinking has attracted attention since the Katrina disaster in 2005. Indeed, it is the ability to function, survive and thrive to any stress, according to the Disaster Risk Reduction Hyogo Protocol in 2005 (International Strategy for Disaster Reduction, 2007) and to the UN conference on Disaster Risk Reduction.

The European Commission has adopted the *European Adaptation Strategy* with the obligation for all the Member States to implement national plans to cope with the inevitable Climate Change impacts by 2017. Many EU members have already developed national strategies, among those: The Netherlands, Denmark, Finland, Spain and United Kingdom (Swart; Singh, 2013). Additionally, in 2012, the European Commission presented *The EU Approach to Resilience: Learning from food crises*, which provided policy principles for action to help vulnerable communities in areas facing crisis. Some countries, such as the UK, developed separate national resilience plans, whereas others, as The Netherlands and Denmark, included resilience in their national adaptation strategies. Rotterdam is considered one of the lowest-lying cities in Europe; a city safe and well protected but still vulnerable to flooding, in estreme weather conditions. For this reason, in the last yeas, a lot of urban and enviromental strategies were adepte to face climate change and environmental hazards; in 2014 the national Delta Programme was adepte and become part of the Rotterdam Adaptation Strategy (Ministry of Infrastructure and Environment, 2017).

The aim of the Rotterdam Adaptation Strategy (City of Rotterdam, 2016) is to maintain and optimise the existing strong defence system, to improve urban resilience through the implementation of some adaptive measures, to involve citizens and community, and to link this strategy to the whole urban governance of the city. The final aim is to take advantage of the opportunities that climate change adaptation provides making city more attractive and forming new multifunctional public space. This strategy also aims to contain storm water runoff in case of extreme rainfall, if possible in combination with measures to improve and enhance the green quality of open spaces in the city. It includes measures at neighbourhood, street and building level to minimise the consequences of extreme precipitation that will, at the same time, result in a more beautiful, green city for the people of Rotterdam. The strategy combines sustainability efforts with resilience and urban transformations, making Rotterdam more able to clear the panorama of the different hazards that could interest it; and in this way the right action to face the situation could be undertaken, a smart and comprehensive solutions able to realize a waterproof and resilient city. Rotterdam has joined also the Resilient City programme for the best 100's city promoted by the Rockefeller Foundation (Rockefeller Foundation, 2015); this programme can provide very useful support for the other pillars and ambitions of the Rotterdam Programme on Sustainability and Climate Change, not least by linking the various themes and intelligently anticipating future trends (Kimmelmann, 2017). The Rotterdam Climate Change Adaptation Strategy indicates which measures can be implemented in the various parts of the city in order to face the effects of climate change. The main priority in outer dyke areas is based on prevention and adaptation; the main defense system based on the storm surge barrier will continue to be the first strong measure for flood protection but, according to this, the protection will be augmented with adaptive measures aimed at increasing resilience and evolving with climate change; for example with the creation of adaptive building, with the construction of floating buildings and the adaptive design of outdoor areas including roadways, utility infrastructure, wilderness areas and parks.

In the area within the dykes will be promoted urban design action able to reinforce the sponge function of this part of the city; will be implemented actions able to store rainwater and to delay drainage, will be realized green roofs and sustainable green infrastructure and will be promoted the permeability of private and public space. In the highly populate areas, with little open space, will be developed measures on existing buildings while, in those part of the city where there is more space, robust measures such as increasing the water storage capacity of canals and lakes and constructing green-blue corridors will significantly contribute to making the city climate proof. The activities promoted in the strategy, and that has to be achieved within 2018 regarding the planting of trees, plants and flowers in the district of Oude Noorden, Nieuwe Westen/Middelland, Tarwewijk, Bloemhof and Hillesluis, combining, where is possible, this with measures to contain storm water runoff in incidences of extreme rainfall; encouraging the residents to plant more flowers, shrubs and trees near their homes removing tiles from the garden enforcing the private space's permeability; encouraging the introduction of lush greenery and a healthy cover of vegetation along the river banks of the New Meuse River, along the New Waterway, the River Rotte and the River Schie, creating an attractive and pleasant green corridor; encouraging the addition of green alements to existing facilities, such as green car parking sites; stressing the importance to develop Wall gardens, or vertical gardens, not only brighten up the streets but also prevent the wall from warming up too much during extremely hot days. Making green roofs has a double meaning: enforcing urban beauty and absorb excess rainwater, they are necessary especially in this district dominated by brick, such as the city center and the old urban districts. Green roofs save energy (keeping homes cooler in summertime) and double the life of the roof. Furthermore, they enhance the city's biodiversity. The target is to install 40.000 sq of green roofs every year. Private initiatives include measures such as green roofs and façades and green inner courtyards and gardens. In public areas there are a wide range of potential measures, from incorporating more green in the streets and along the infrastructure (boulevards, quays, cycle and walking routes) to good management and extension of parks and greenbelts. The 'waterproof city' is robust and resilient (grey and green-blue) with a mix of paving and vegetation. The focus is on adaptive measures whereby the rainwater is captured and drainage is delayed. Public areas become a strategical space where store the rainwater; this could be realized along the infrastructures (through the street profile) and along the surface of the square, realizing multilevel public space that, in case of particular weather, could be used as a store for rainwater. Additional areas of water storage are included in the projects currently being implemented in Rotterdam, for example in Centraal Station or in Kruisplein and also in urban vision in 2030 or 2050 as "Rotterdam child friendly city" (City of Rotterdam, 2010) or "Wilderness school playgrounds" . The group of architects "De Urbanisten" has defined several projects (Bokern, 2014) concerning the management of urban water in Rotterdam and in neighboring polders, realizing many water squares. Is interesting, for example, the project for the

Benthemplein water square, a large multifunctional water square that combines rainwater collection with the creation of an outdoor public area; the project was defined after three preparatory workshops in which the natural elements and the form of public space were discussed. Green and blue roofs, removing paving and planting trees and bushes in the streets and open areas and waterproof design all contribute to increased resilience. The core of the strategy is to incorporate more flora in the city, especially in its paved, densely built-up areas. This is being done at all levels in the city, from pavements to city parks.

6 CONCLUSION

In the manuscript is underlined the Rotterdam strategy for the creation of a resilient city; the whole strategy is developed promoting an intensive cooperation between the water boards, urban developers, the City of Rotterdam and spatial administrators; other parties such as housing corporations, project developers and the inhabitants has an active role in trasforming the city.

Creating a waterproof city, as Rotterdam best practice shows, requires intensive cooperation, public awareness and citizens involvement; everyone is deeply involved in making the city waterproof.

The Rotterdam Adaptation Strategy (City of Rotterdam, 2013) charts the course by which Rotterdam plans to adapt to the consequences of climate change and shows how residents, businesses and the city can gain maximum benefit. This strategy offers the framework and the guiding principles for a future-proof development of Rotterdam and ensures that every future (spatial) development will include subjects such as flood management, accessibility and robustness of the city as basic principles from the very outset of the process. It is also important to link defense design with other spatial planning tools, to allow the better integration and implementation, a right cost reduction and an increased innovation.

These actions will not only contribute to making Rotterdam more resilient but will contribute to the creation of a more pleasant and attractive urban environment¸rotterdam's climate adaptation strategy provided opportunities for reinforcing its image as an attractive city; resilient urban design experimented in Rotterdam was well integrated and multifunctional, making space for water storage gave to the city the opportunity to create an high quality and pleasant public space. The main added value for the city is the creation of an attractive and green-blue environment with sustainable solutions for coping with rainwater. Experiments with 'water in the city' reinforce the Rotterdam's international image as a progressive, ambitious delta city. Rotterdam's water squares are exemplary.

Rotterdam, in its adaptation strategy, wants to anticipate climate change; the main innovations are that:

- the strategy encourages flood protection through the architectural and urban project;
- resilience theme are included in all levels of government and in all urban planning instruments and spatial and strategic development policies;
- additional areas of water storage are included in the projects currently being implemented in Rotterdam, for example in Centraal Station or in Kruisplein and also in urban vision 2030 or 2050 as "Rotterdam child friendly city" or "Wilderness school playgrounds";
- as *waterproof city*, Rotterdam has involved in its strategy*,* individual actions and cooperation between water boards, ministreries and municipalities, urban developers and private firms, the housing corporations and, over all, the citizens;
- the defense works become spaces for the city and new high quality public space because "blue and green" strategy which will also contribute to making the urban environment more attractive and enjoyable.

In Rotterdam, Architects and urban designers are finally responding to the threats of rising sea levels by "welcoming the water" into city, so the waterscape is becoming a new paradigm of spatial planning; Rotterdam is striving to become a climate proof city that will be safe and attractive to inhabitants, visitors and businesses, and will remain so in the future. A healthy delta city in which it is pleasant to live, work and spend leisure time.

Fig. 4: Water squares in Rotterdam. (City of Rotterdam, 2013)

The approach devised in the Rotterdam water plan will be extended to all areas that are important in a climate proof city. The adaptation strategy provides the framework and basis for discussions. The aim is to arrive at shared ambitions for climate proof urban development and to make specific concrete agreements about this. The Rotterdam's experience shows that there is the need to implement a conscious and smart urban governance and to undertake urban awareness actions that aim at the awareness of the communities, which becomes an active part in promoting urban resilience policies and in creating the sustainable city. The involvement of private is also crucial, taking place in two ways: firstly, individuals are involved in the thematic awareness process and become aware of the environmental risks associated with climate change; secondly, precisely because of this mature awareness, they become an active part of the adaptation policy by implementing some strategic actions in the areas they own or by encouraging participation in the case of interventions in public areas through forms of associationism and smart communities. Spaces and resources are shared and the strategy becomes more implementable and successful (EU, 2011). In addition, the Dutch are deeply aware of the environmental problems, because at school, from an early age, training courses are provided that update them on the risks and the main techniques to preserve their nation, as for example, that of the polders. The education system, in this case, is one of the best in the world and aims to raise children's awareness so that they can refine their behavior with growth and be examples of best practices and smart communities. Furthermore, there is a strong convergence of interests between the central government and the individual municipalities, a union that is difficult to implement, but desirable, in countries such as Italy due to the excessive size and the normative and administrative organization. Rotterdam is becoming resilient not just by fortifying its defences to a changing climate and rising seas, but also by building a more cohesive and inclusive society. Resilience thinking is being incorporated in the policymaking and initiatives across all domains of city government, including across social, physical and economic programmes.

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Fig. 1: Rijkswaterstaat (2011). Water Management in The Netherlands, Den Haag, February 2011. Available at https://staticresources.rijkswaterstaat.nl.

Fig. 2 - Fig. 3: City of Rotterdam (2016). Rotterdam resilient strategy. Ready for the 21st Century. Available at www.100resilientcities.org/wp.../strategy-resilient-rotterdam.pdf.

Fig. 4: City of Rotterdam (2013). Rotterdam Climate Change Adaptation Strategy, 2013. Available at www.rotterdamclimateinitiative.nl.

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GEOGRAFICH DETERMINISM VS URBAN RESILENCE: AN ITALIAN SCENARIO ANALYSIS

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ABSTRACT

It has been for many years that the analysis of the resilience concept has transversally enriched the scientific debate, both from the technical-scientific view to the socio-humanistic one.
In urban areas, particularly, scientific literature offers a consolidated panorama of theories and applications.
The present work is animated by the objective of complementing this background with a geographic approach in which the characteristics of urban resilience, synthesized by a wide review of scientific articles, are associated with determinants of geographic type (urban dimension, latitude, and prevalent urban attribute).
The proposed analysis introduces methodological elements of evaluation useful for this topic, as well as demonstrates, based on the stratification of real data regarding some main urban variables (Living, Environment, Mobility and Legality), the scenario of Italian cities characterized by high, medium and low resilience actions as a function of their geographical characteristics. It will try to make clearer the question regarding the geographic determinism paradigm respecting the urban frame, analyzing the eventual geographical influence on the processes of urban resilience

KEYWORDS:
Resilience; geography determinism

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地理决定论与城市复原力:

意大利情景分

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摘要

多年来，对“复原力”概念的分析横向地丰富了从科学技术观点到社会人文主义科学观点的科学讨论。
特别是在城市地区，科学文献提供了理论和应用的综合概述。
本文从地理方法这一补充角度切入，通过对科学文献的广泛梳理和整合，研究城市复原力特征与地理类型决定因素（城市维度、纬度及城市普遍属性）的关联。
本文提出的分析引入了对这一主题有用的评估方法要素，并基于对一些主要城市变量（生活、环境、流动性和合法性）实际数据的分层，将意大利城市高、中、低复原力作为其地理特征的功能。本文将试图提出有关尊重城市框架的地理决定论范式问题，分析地理因素最终影响城市复原力的过程

关键词:
复原力、地理

1 CONCEPTUAL FRAMEWORK

The topic of geographical influence on anthropic, as well as other, processes finds remote origins, but its most scientific formulation can be traced back to the end of the 1800s with the geographer Ratzel who identified the territory and defined it as a tangible material item made up of elements connected to each other in a Cartesian vision in which it is possible to analyze causal relationships and their effects.

Therefore, by inserting itself into all those sciences founded upon the scientific rigor of the cause-effect relationship, scientific debate began to speak about geographic determinism: cause function for the territory, and the way of inhabiting and using the terrestrial surface for the relative effect.

According to an approach of this type, therefore, the specific ability to react from man, in the specific topic of urban areas, to phenomena of shock, for example the urban resilience, could change according to the territorial or more generally geographical features.

The objective of this study is to evaluate, through some real data on Italian cities, how this correlation could be true and possibly for which variables. For over fifty years scientific literature has suggested an interpretation of the city as a system; in the last twenty years, the evolution of the complexity paradigm has awarded a central role to a dynamic reading of urban systems (Batty, 2008), more and more widely interpreted as complex systems, non-linear, capable of self-organization, which constantly change themselves by the action of perturbing factors, owned to internal processes or owned to exogenous factors.

Climate change, resource scarcity, individual or concatenated risks, and environmental degradation are just some of the many and varied factors that threaten contemporary cities and are now the pressure factors capable of triggering processes and modifications of urban systems, altering or changing their status. These factors are characterized by different natures and impacts: some may induce long-term changes (lack of resources); others cause immediate shock (risks). Faced with the various factors mentioned above, cities seem to play a dual role: on the one hand, they constitute systems that are highly vulnerable to the potential impacts of such factors, while on the other hand, in many cases, the characteristics and evolution modes of urban systems are themselves able to generate or amplify these factors.

The complexity of the various pressure factors, their close interactions and the characteristics of the urban systems, seem to suggest the need to analyze and manage the response of urban systems to potential impacts of these factors through a systemic approach, able to grasp the complexity and interactions between factors and better understand the ways in which the various elements of the urban system react to each factor and react to their interactions, at different scales and in the course of time.

Unfortunately, despite an awareness that cities are complex systems to manage, and considering that connections come even before the individual parts (Kanter & Litow, 2009), the different pressure factors are almost always treated separately, both by researchers as well as technicians with the result of an increasing fragmentation, and subsequent ineffectiveness, of urban policies.

Against this, a growing number of researchers and international organizations seem to agree on the key-role relative to the concept of resilience, which it can play in order to increase the capacity of social and territorial systems in order to adapt or to change themselves as an effect of heterogeneous pressures (Folke, 2006; Bahadur et al. 2010). This concerns both slower ones, related to climate change, as well as those such as instant risks (De Falco, 2014, 2015a, b, c).

2 LITERATURE REVIEW OF RESILIENCE ATTRIBUTES

The concept of resilience is well known in a number of scientific fields, including physics (applied in engineering and construction, for instance) and ecological studies. Although there is not only one definition, in an intuitive way resilience is basically understood as the buffer capacity or the ability of an element (for example, a material or an ecosystem) to absorb perturbations (for example, by deforming elastically), or the magnitude of disturbance that can be absorbed before a radical change in its structure (for example before reaching deformation, in the case of a material, or collapse, in the case of a building). In the last two decades, the idea of resilience has been translated into a number of human and social sciences, including psychology, organizational studies and network studies (Vanolo, 2015).

The centrality of the concept of resilience in the scientific debate of recent years in various fields requires a deeper analysis: it is, in fact, a controversial concept, characterized by many definitions and approaches, which risks becoming an empty shell, difficult to translate in operative terms (Rose, 2007; Grünewald & Warner 2012). The concept of resilience has deep roots and a complex evolutionary path. Born in physics to describe the resistance of the materials in presence of external disturbances, the concept of resilience has its main developments during the late sixties and early seventies in the field of ecology. Holling (1973) is one of the first to use the term to describe the behavior of natural systems in presence of external disturbances. And it was still Holling who proposed, in the mid-nineties, an interesting distinction between "engineering resilience" and "green resilience". The first one, strictly connected to the concept of stability, was based on characteristics such as efficiency, return to an earlier time condition and, and above all, on the uniqueness of the equilibrium state. The second one, was defined as "magnitude of the disturbance that can be absorbed before the system changes its structure (Holling, 1996), was based on the possible plurality of equilibrium states and allows for a dual possibility for a system to absorb adverse disturbances within a certain threshold, while maintaining its own characteristics and structure, or change, when the level of pressure exceeds this threshold, in a different system, not necessarily better than the previous one.

The interpretation from the ecological point of view concerning resilience is strengthened further when the concept began to be used in the study of socio-ecological systems characterized by the close interrelationship between anthropogenic components and natural components and their further correlations with studies on adaptive capabilities of complex systems, based on learning by experience, and the ability to adapt to changes (Holling, 2001; Walker, Holling et al. 2004; Bankoff et al. 2004). Analysis of ecosystems using the resilience model allows one to consider nature not only as a system that constantly seeks equilibrium, but also as a system able to evolve, depending on specific inner conditions and on the contest that surrounds it. There are four crucial aspects of resilience (Walker et al., 2004, 2-3). The transposition of the concept of resilience to complex adaptive systems is closely linked to the concept of "Panarchy", introduced by Gunderson and Holling (2001) to explain the evolutionary and dynamic nature, in time and in space, of such systems: the term describes the evolution of the systems according to evolutionary cycles as characterized by different phases. These cycles are developed in a domain of reality in three dimensions: the potential, i.e. the availability of accumulated resources (and for the socio-ecological systems which can be understood as natural capital and socially available); the connection, which is the system's ability to control its own destiny or, conversely, its vulnerability to unexpected changes that exceed the system's control capabilities; the resilience, that decreases when the system settles down in a stable condition and increases in reorganization phases and in growth, allowing the system to start a new cycle. The most recent developments of studies on resilience, strongly linked to the metaphor of panarchy, have further expanded the concept by proposing an interpretation as a result of three dynamically interacting components: persistence, adaptability, and transformability (Folke et al. 2010). Persistence, nearest to the concept of engineering resilience, expresses the ability of the system to resist impact, while preserving its own characteristics and structure, subject to a temporary removal from ordinary operating conditions. Adaptability expresses its capacity for social-ecological systems of learning, combining experience and knowledge, in order to regulate the response to internal or external disruptive pressures, changing the system in order to keep it within its domain of stability. Convertibility expresses the system's ability to modify its own characteristics and its own structure, entering a different stability domain. This interpretation of resilience, thereby inspired by an evolutionary vision (Davoudi, 2012), seems to be the one most responsive to the nature of urban systems considered as complex systems: finally overcoming resilience's idea as recovery of a previous equilibrium condition, it seems far more adapted to the dynamic nature of urban systems that constantly change themselves under the influence of endogenous and/or external factors. As described above, in scientific literature there are different approaches to the concept of resilience applications on different systems (from the social to the economic and infrastructural). The main features of a resilient system are thus: persistence, adaptability and transformability as identified by Folke et al. in 2010. These traits are recurrent in scientific literature, although terms such as robustness or strength are often preferred to the term persistence. These terms, referring however to the ability of a system to face an event without undergoing alterations, can be easily interpreted as specifications of the persistence concept. Regarding sustainability, according to Folke et al. (2002), Chelleri (2012) and Colucci (2012), the target of sustainability can be achieved by enhancing urban resilience, especially "optimizing available resources, making a rational use of them, and contributing to increasing the amount of available resources" (Galderisi & Ferrara, 2012). Cities, in fact, are key players in energy and climate challenges, as they are responsible for the most energy consumption, and at the same time they are vulnerable to the effects of climate change (Gargiulo & Zucaro, 2015). Some capabilities are recurring regardless of the approaches and systems considered: diversity, for example, crucial in ecological systems, has been recognized as essential in the economic and social fields; learning ability, the feature of adaptive systems and the central purpose of their self-organization, interpreted as the capacity to learn from past events in order to confront the future. Table 1 provides a broad overview of scientific literature identifying the skills that, in different disciplines, are most used to describe a resilient system (Galderisi, 2016).

Field	Representative Author	Characteristics of Resilient Systems
Complex adaptive systems	Folke et al. (2002)	Diversity; redundancy; adaptability; self-organization; innovation; storage; experience; knowledge; learning ability; convertibility.
Systems thinking	Fiksel (2003); Bahadur et al. (2010).	Adaptability; cohesion; diversity; effectiveness and reliability of institutions; efficiency; control mechanisms; participation; knowledge; preparation; equity; networks; learning ability; multi-scale perspective.
Urban systems	Godshalk (2003); Ahern (2011); Desouza & Flanery (2013); Papa R., Gargiulo C. & Galderisi A., (2013).	Diversity; redundancy; resistance; adaptability/flexibility; collaboration; interdependence; autonomy; efficiency.
Communities	Bruneau et al. (2003); Chang & Shinozuka (2004); Davis (2005); Tierney & Bruneau (2007); Norris et al. (2008).	Redundancy; strength; availability of resources (resourcefulness); rapidity/capacity for mobilization.
Socio-ecological systems	Walker et al. (2004); Folke et al. (2010).	Resistance; latitude; precariousness; panarchy, persistence; adaptability; convertibility.
Ecosystems	Adger et al. (2005); Gargiulo C., Zucaro F. (2015); R. Papa, A. Galderisi, M. Vigo Majello, E. Saretta (2015); Colucci (2012).	Sustainability; diversity; redundancy; space organizations
Economic systems	Van der Veen et al. (2005); Briguglio et al. (2008).	Redundancy; sustainability; transferability; efficiency; rapidity; flexibility.
Urban communities	Chuvarajan et al. (2006).	Diversity; redundancy; self-organization; storage; networks; innovation; individual capacity; spatial interactions; temporal

		interactions; self-confidence; feedback.
Social systems	Maguire & Hagan (2007)	Resistance; resilience; creativity.
Social-ecological and economic systems	UNESCAP (2008)	Redundancy; strength; availability of resources.
Infrastructural systems	McDaniels et al. (2008)	Strength; rapidity.
Organizational theory	Gibson & Tarrant (2010)	Resistance; reliability; flexibility; redundancy.

Tab.1 Synthesis of literature for tge capacity of resilience

In table 2, after data sorting (figure 1), terms characterized by major occurrences in scientific literature can be deduced.

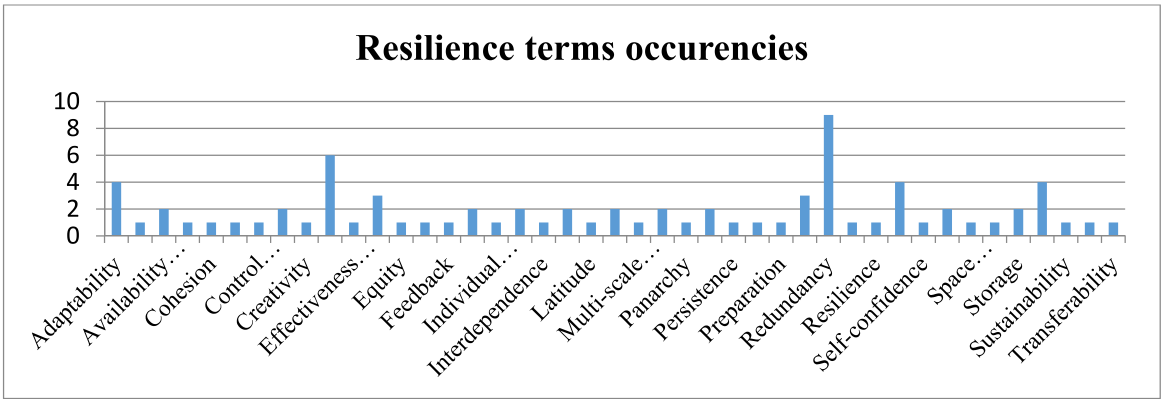

Fig. 1 Major resilience term occurrences in scientific literature

3 METHODOLOGY

The proposed methodological approach is based on some sequential phases. First of all, the resilience attributes, considered as prevalent inside the data set identified from literature review, have been defined starting from figure 1. The second step was the definition of the geographical features, in terms of the reference variables and relative levels of their respective variations, according to which stratify the data of the analysis to be conducted. In the present work, three urban geographical variables have been considered: size, latitude and type. Three levels of variability have been considered as well, as shown in table 2.

	Level 1	Level 2	Level 3
Size	Small	Medium	Metropolis
Latitude	South (S)	Middle (M)	North (N)
Type	University City (UC)	Cultural and Tourustic City (CC)	Industry City (IC)

Tab.2 Variables and level of geographical characterizations

Through appropriate filters related to the different levels of table 2, set in the processing software, the data were stratified according to their different geographical determinants.

In the following discussion, the main characteristics of the "type" characterizations of geographical determinants are chosen:

- *University City,* University cities are characterized by a young and lively context, innovative but with a long academic history. In fact, the element that unites the Italian university cities, similar to European ones, is represented by an almost oxymoronic union between rooted tradition and a propensity to the future. In the described context of these university cities, access to knowledge resources is potentially favored;

- *Cultural and Touristic City,* the touristic and cultural cities are those characterized by large tourist flows, as they are rich in monuments, churches, castles, museums, and historic houses. All preserve a historical, artistic, and architectural heritage that relate centuries of history. Often characterized by an urban fabric that preserves its original structure, whether it is a castrum or a medieval village, Italian cities of art represent vestiges of the times, frozen in their transformations. Marked by the activity of great artists and patrons, these cities are not only the container of relevant artistic expressions but are themselves works of art, characterized by festivals and theaters that combine traditions, culture, and entertainment;
- *Industry City,* Industrial cities are those cities polarized as an organizational and life model, mainly, to the presence of industries. Typical Italian industrial cities are Turin, a Fordist city par excellence thanks to FIAT, and Taranto which has the ILVA plant.

Next a correspondences matrix between resilience attributes and main urban characteristics is defined. These characteristics are Living, Environment, Mobility and Legality as shown in table 3, while sub-variables and metrics of these four variables are reported in the Appendix.

To assess the resilience of Italian cities with respect to these four identified urban variables, and for which data are available concerning both 2015 and 2016 through the source of the Icityrace report, two conditions have been considered in the analysis, in compliance with the pure definition of the concept of urban resilience:

- the first condition is the presence of low values of urban indicators;
- the second condition is the presence of a detected variation delta Δ for the variables of the first condition.

In this way, resilient cities can be characterized as those that, starting from a negative situation, reacted positively.

For those cases in which the data of the analysis will show a great intensity for this resilience action, the municipality policy and programmatic guidelines of those cities will be also analyzed to confirm the deterministic and non-random will of a municipality regarding the positive variation detected concerning these specific urban variables.

The results of the analysis shown in the next section will highlight, in the first case, a geographical dependence on urban variables and, in the second case, a possible relationship between some resilience attributes and geographical features, thus satisfying the objectives of the work.

4 DATA ANALYSIS

The analysis was conducted by considering the last 50 Italian cities from a total of 106, in the Icityrace 2015 ranking for each of the four urban variables: Living, Environment, Mobility, and Legality. These samples, each of them consisting of 50 units, represented cities with the worst values for the four variables considered. Then, for the same cities from each of the four samples, the respective values for the year 2016 were evaluated and the change, positive, null, or negative was used as a resilience metric.

Figures 2, 6, 10 and 14 show the variations of each city for each urban variable in decreasing order, while figures 3-5, 7-9, and 11-13 show the stratifications of data relative to figures 2, 6, 10 and 14 according to the three geographic variables chosen by size, type, and latitude, and according to their three variation levels (as shown in table 2).

Resilience Attribute	*Urban Variables*			
	Living	*Environment*	*Mobility*	*Legality*
Adaptability	▲	▲	▲	▲
Autonomy				
Availability of resources				
Capacity for mobilization			▲	
Cohesion	▲			▲
Collaboration			▲	▲
Control mechanisms		▲		
Convertibility	▲	▲		
Creativity	▲	▲		
Diversity				
Effectiveness and reliability of institutions				▲
Efficiency		▲	▲	
Equity				▲
Experience				▲
Feedback	▲	▲	▲	▲
Flexibility	▲			▲

Tab.3 Corresponding matrix

4.1 LIVING

The living dimension measures the livability of a city in terms of basic services and personal security as well as social cohesion, cultural offering and job opportunities. Therefore, in reality, the overall rating summarizes variables for which the distribution is extremely heterogeneous.

Global data shown in figure 2 reveals an almost univariate distribution more shifted towards positive variations rather than negative ones. The data stratifications in terms of geographical characterizations are reported in figures 3, 4 and 5.

From stratification data in figure 3 it emerges that the small and medium cities are characterized by better changes than the metropolis cities. Some sub-variables (see Appendix) such as school dropouts, infancy care, and elderly assistance have a very positive effect on the medium-sized size of cities, compared to other sub-variables such as amenities and entertainment, and the offer of cultural internationalization that are better for big cities. But the data clearly reveals a predominance of the medium-small size for the living variable.

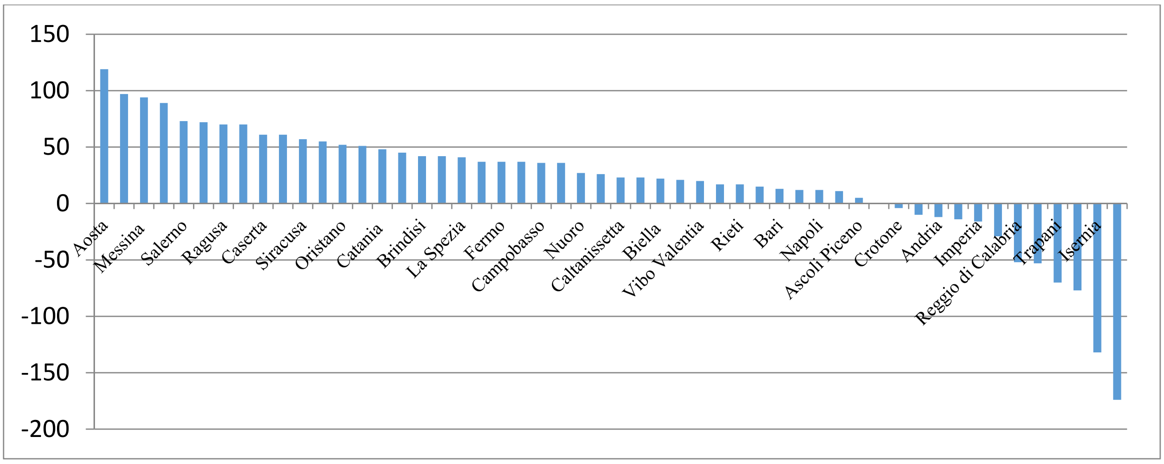

Fig. 2 Δ Living

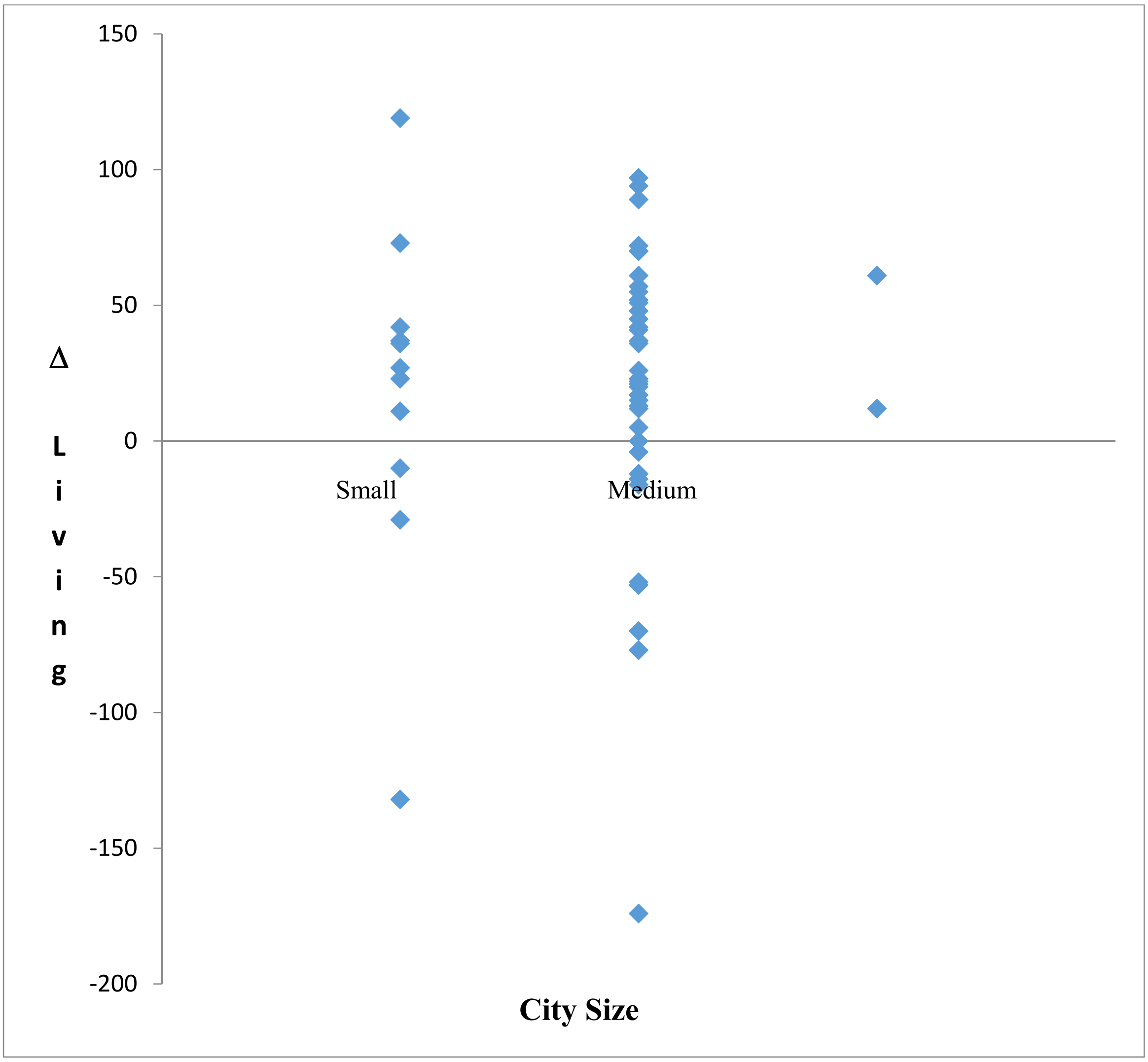

Fig. 3 Δ Living – size stratification

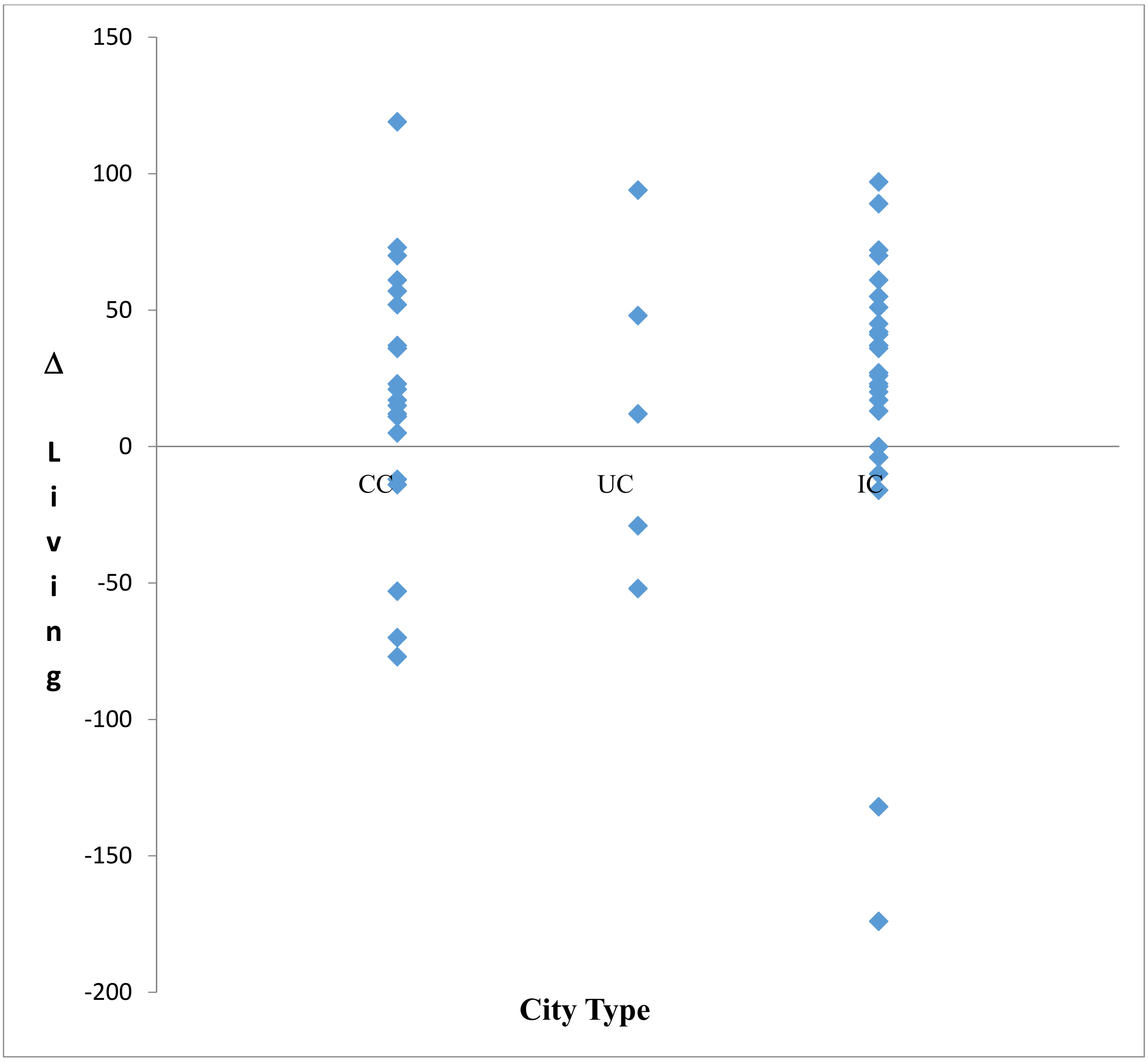

Fig. 4 Δ Living – type stratification

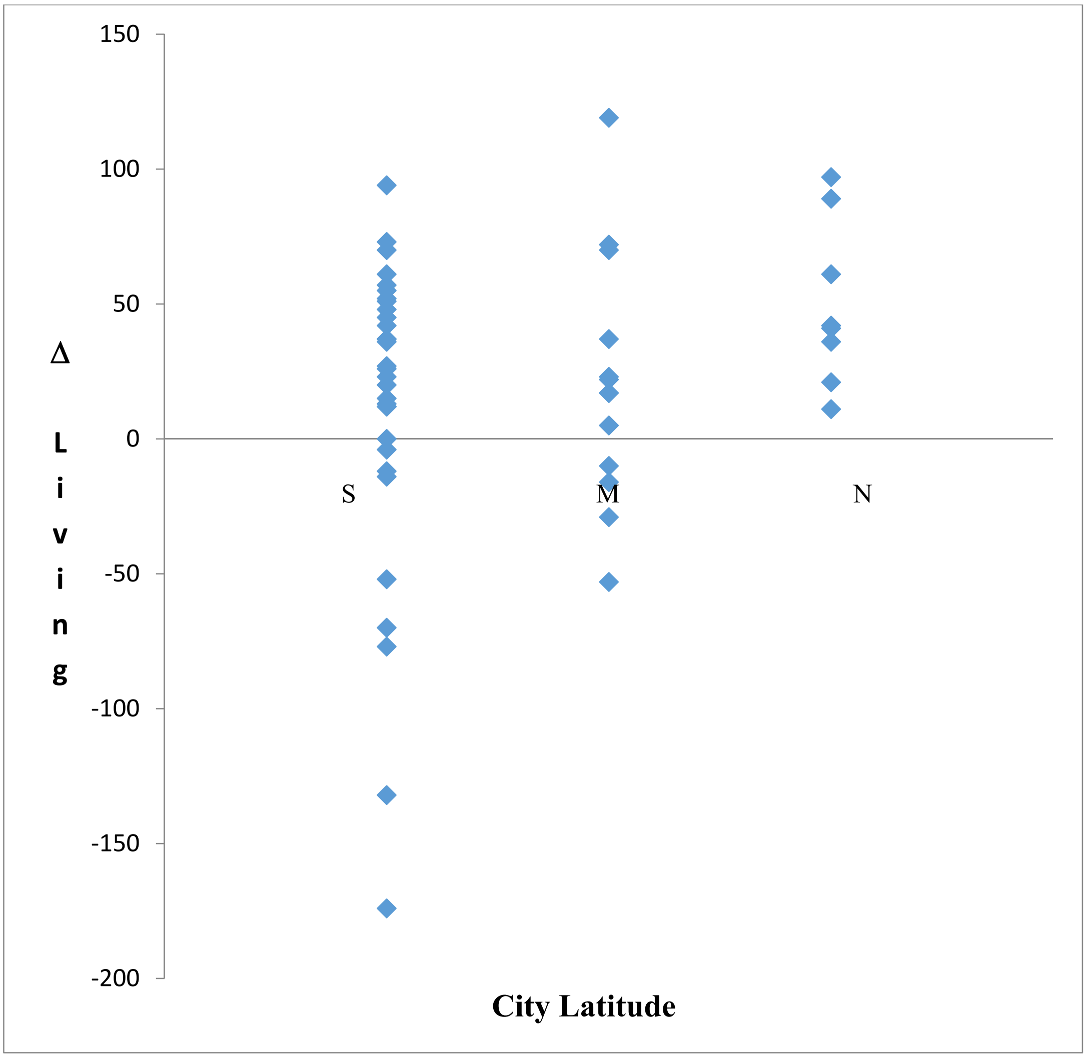

Fig. 5 Δ Living – latitude stratification

As shown in the graph stratification of figure 4, cities, regardless of their type, are in most cases prone to positive variations in regard to living. Thus the distribution of resilient actions can be considered uniform.

The stratification of data by latitude confirms an intense resilient action on urban livability in the cities of middle and northern Italy, while for the southern cities, even there is some positive data, it still shows many negative deviations, indicators of a degradation process that has not stopped.

4.2 ENVIRONMENT

The environment dimension describes the environmental sustainability of cities. The metrics, as shown in the Appendix, are oriented towards quality environmental protection measurement and public protection policies. Global data shown in figure 6 reveals a symmetric balanced bi-variate distribution. The data stratifications in terms of geographical characterizations are reported in figures 7, 8 and 9.

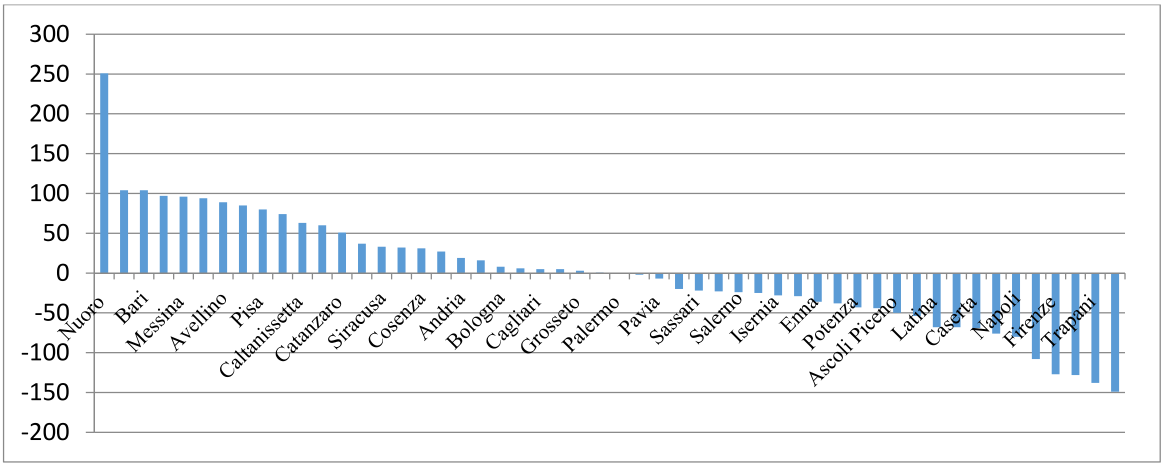

Fig. 6 Δ Environment

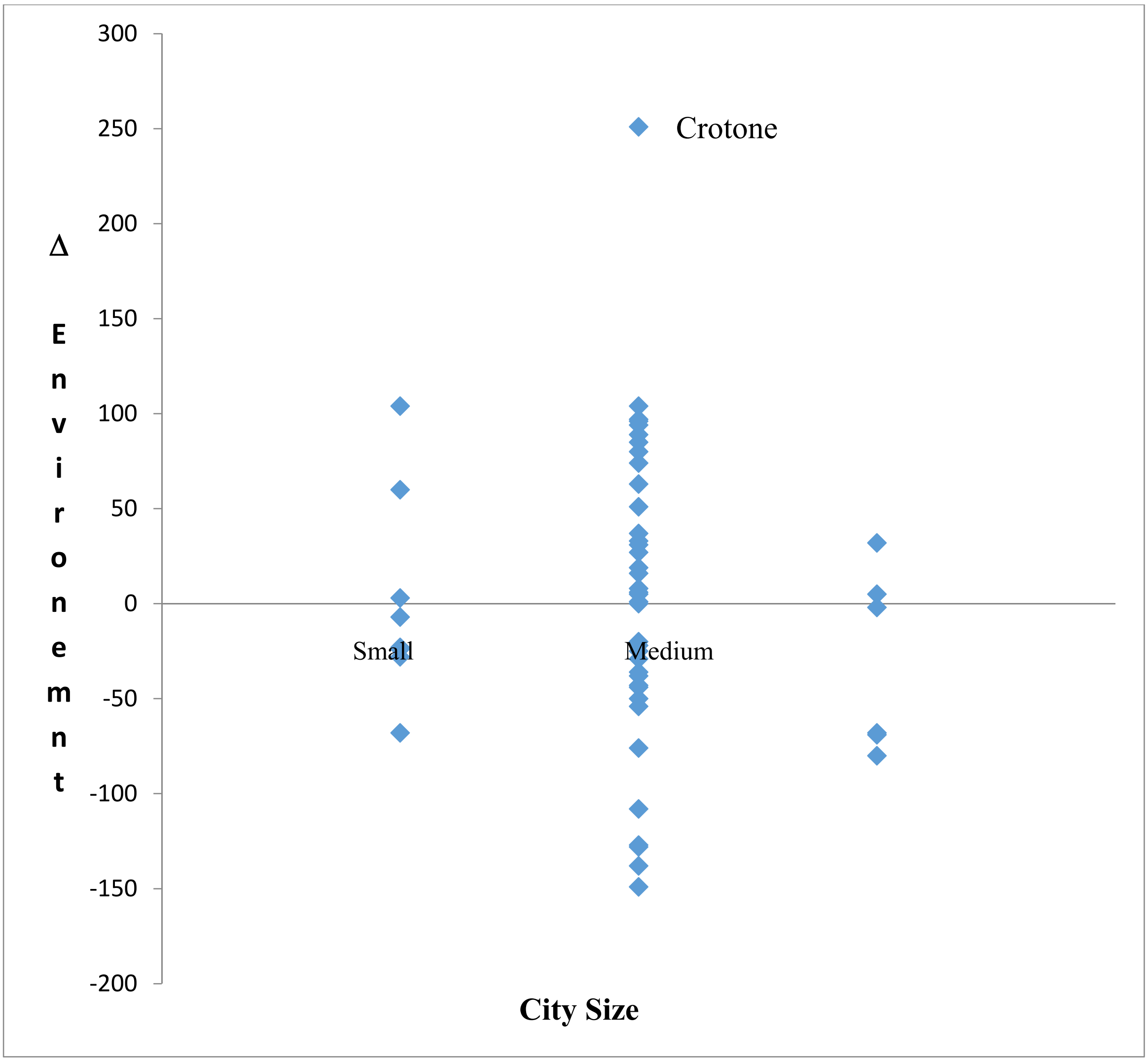

Fig. 7 Δ Environment – size stratification

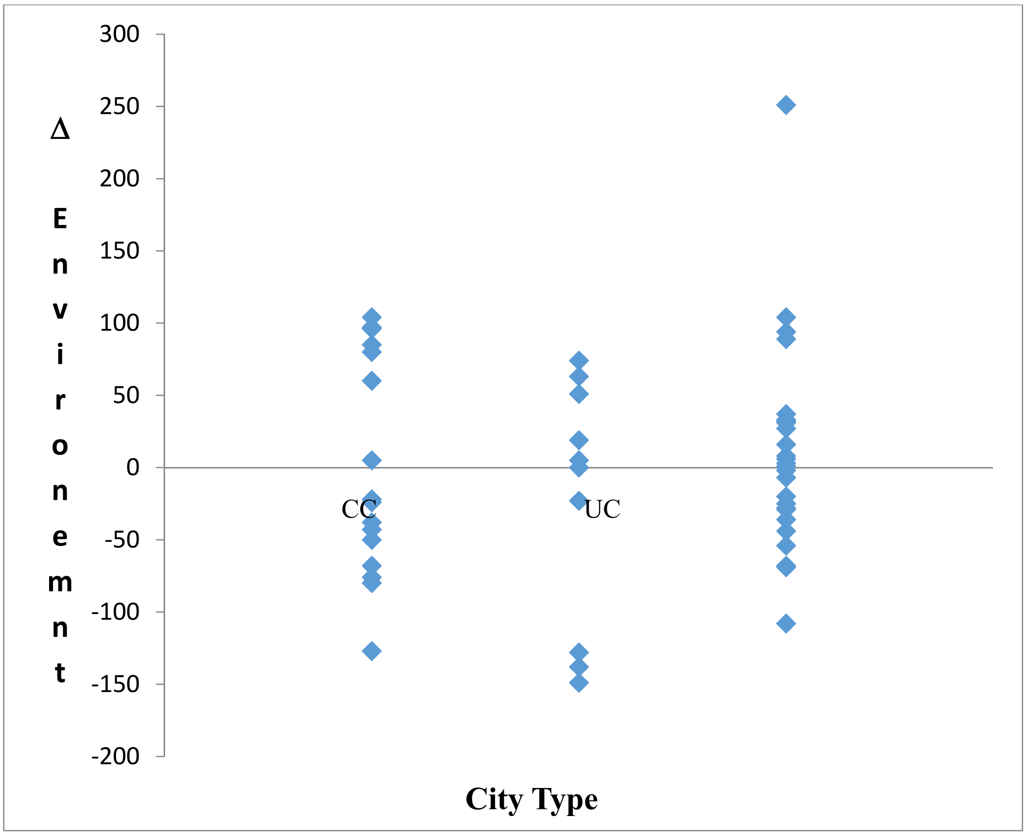

Fig. 8 Δ Environment – type stratification

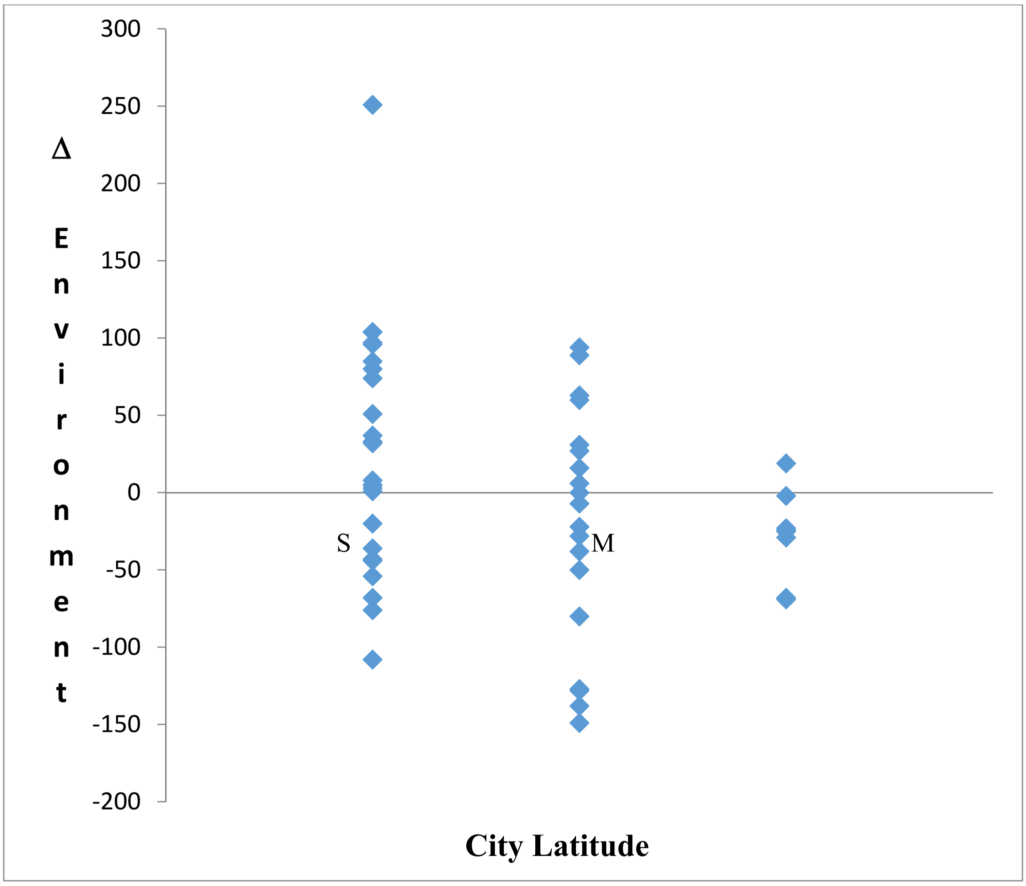

Fig. 9 Δ Environment – latitude stratification

In all cases, the stratifications both in urban size, type, and latitude as shown in figures 7,8 and 9, reveal an almost uniform bi-variate distribution, as global data profiles, representative of an Italian scenario in which both small and medium-sized cities are equally divided between those that have implemented the SEAP (Sustainability Environment Actions Plan) with innovative solutions for the use of renewable energy sources in their territories with the European objective of reducing carbon emissions by 20% by 2020, and those still unable to adopt solutions for the implementation of policies in the field of sustainable energy.
The geography of the resilience on the environment of Italian cities attenuates, at least partially, the ancient North-South difference.

4.3 MOBILITY

The mobility dimension measures the capacity of cities to promote models of sustainable mobility. The variables considered in the field of mobility synthesize the external accessibility and the internal fluidity of cities and their commitment to improvement.
Global data shown in figure 10 reveals an imbalanced bi-variate distribution almost shifted on the side of negative variations. In terms of geographical characterizations the data stratifications are reported in figures 11, 12 and 13.

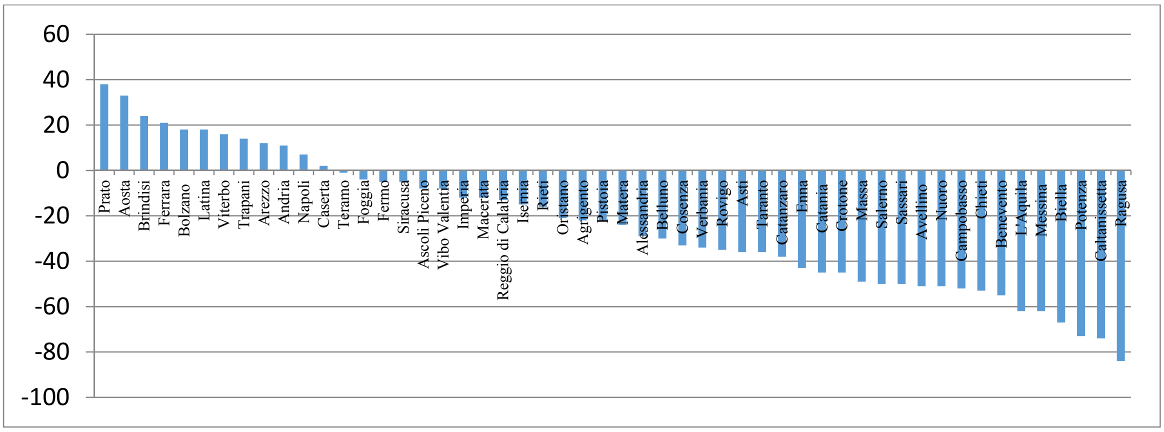

Fig. 10 Δ Mobility

With the exception of only two big cities that have shown an increase in the value of the variable compared to the low values from which they started the previous year, most cities, both small and medium, show signs of deterioration in mobility. Considering the indicators taken in analysis for mobility, shown in the appendix, the scenario highlighted by the stratifications is in compliance with a phenomenon, unfortunately, known for the Italian cities concerning distance compared to the target mobility parameters of European cities: cycle paths, shared transport, as well as green and efficient transport services.
The phenomenon of low resilience in the field of mobility does not show exception, even for the university cities, where it seems easy to imagine a relevant contribution of technologies to improve the efficiency of transport and, above all, to make them greener and sustainable.

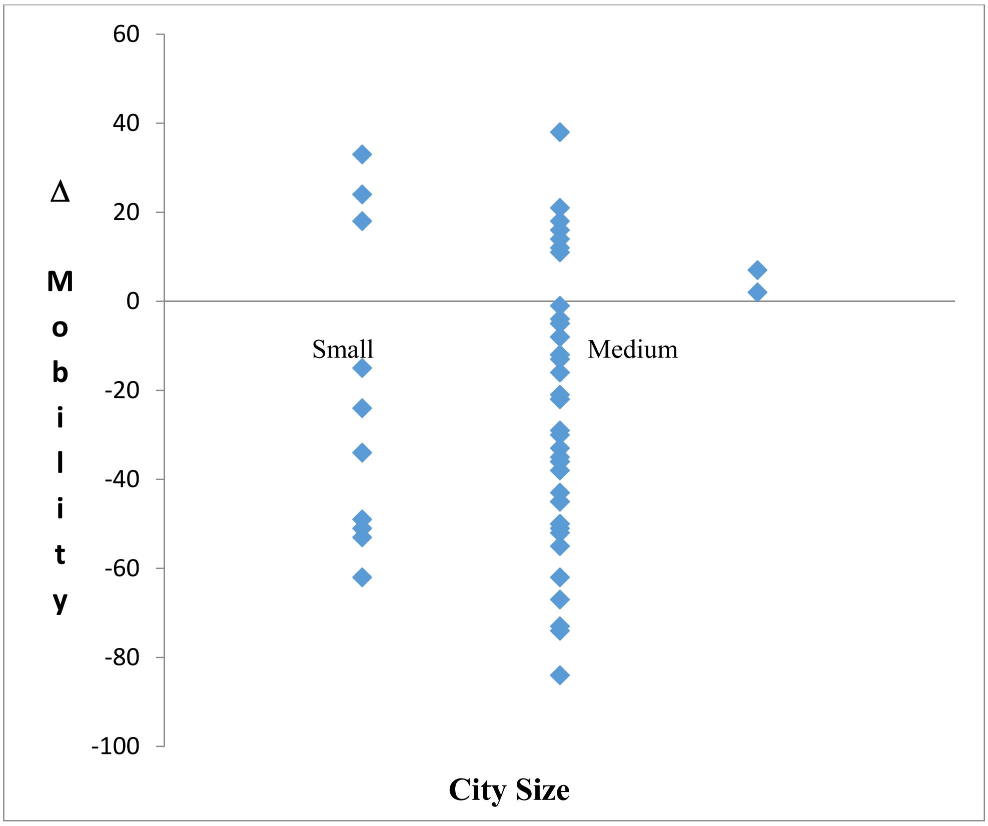

Fig. 11 Δ Mobility – size stratification

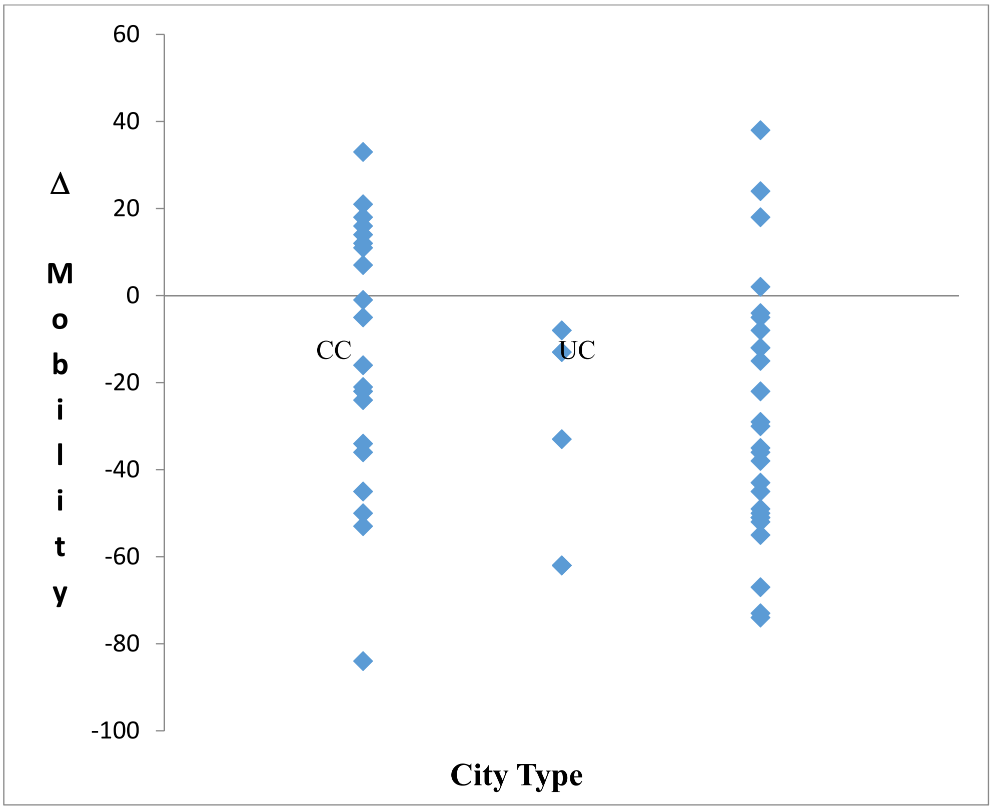

Fig. 11 Δ Mobility – tstratification

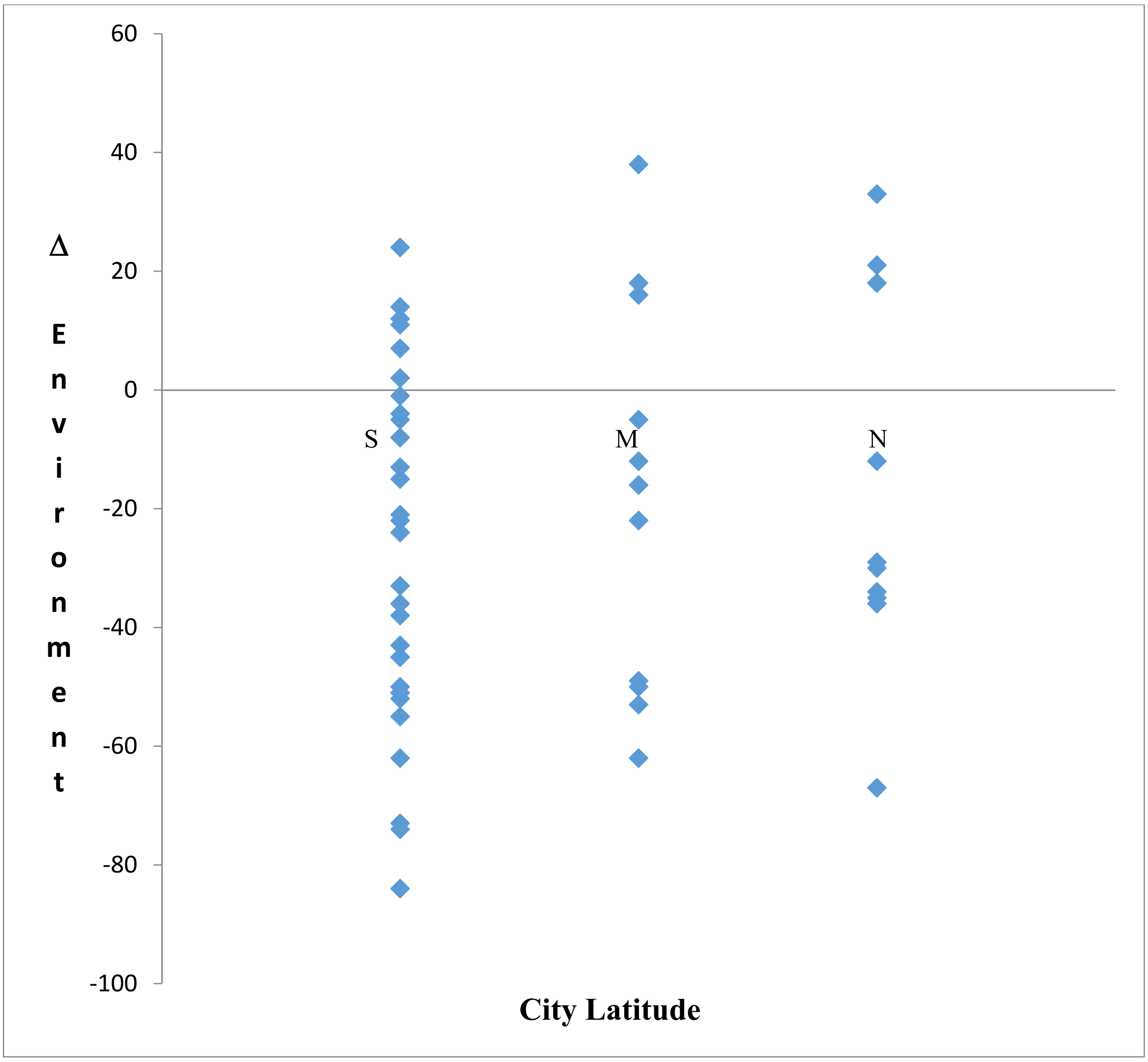

Fig. 13 Δ Mobility – latitude stratification

4.4 LEGALITY

The legality dimension describes the secure social network of cities and administration efficiency.

Global data shown in figure 14 reveals almost a positive (and very positive) distribution with only a few cities as outliers (Isernia, Latina, Catania, Nuoro and Naples), therefore also the data stratifications in terms of geographical characterizations as reported in figures 15, 16, and 17 show the same profile for each of the geographical determinants.

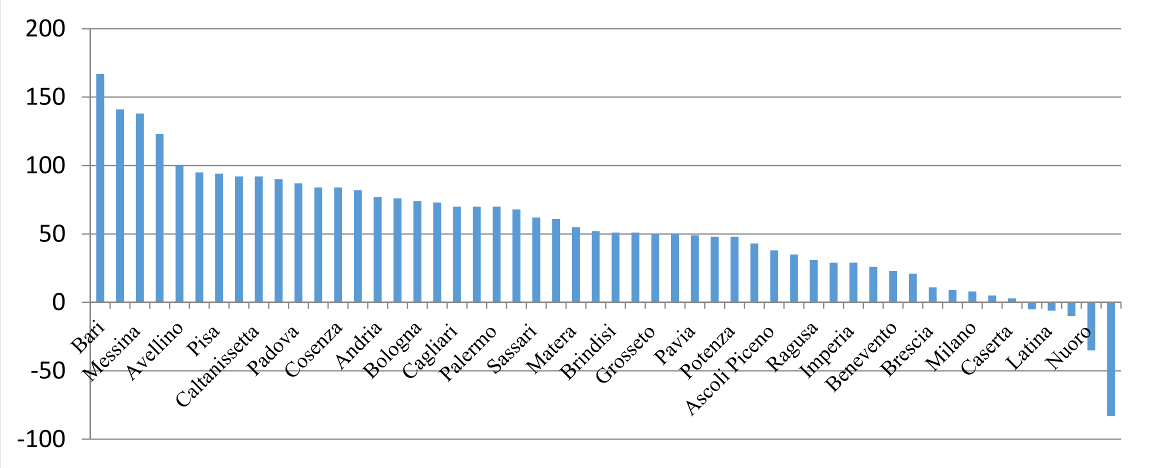

Fig. 14 Δ Legality

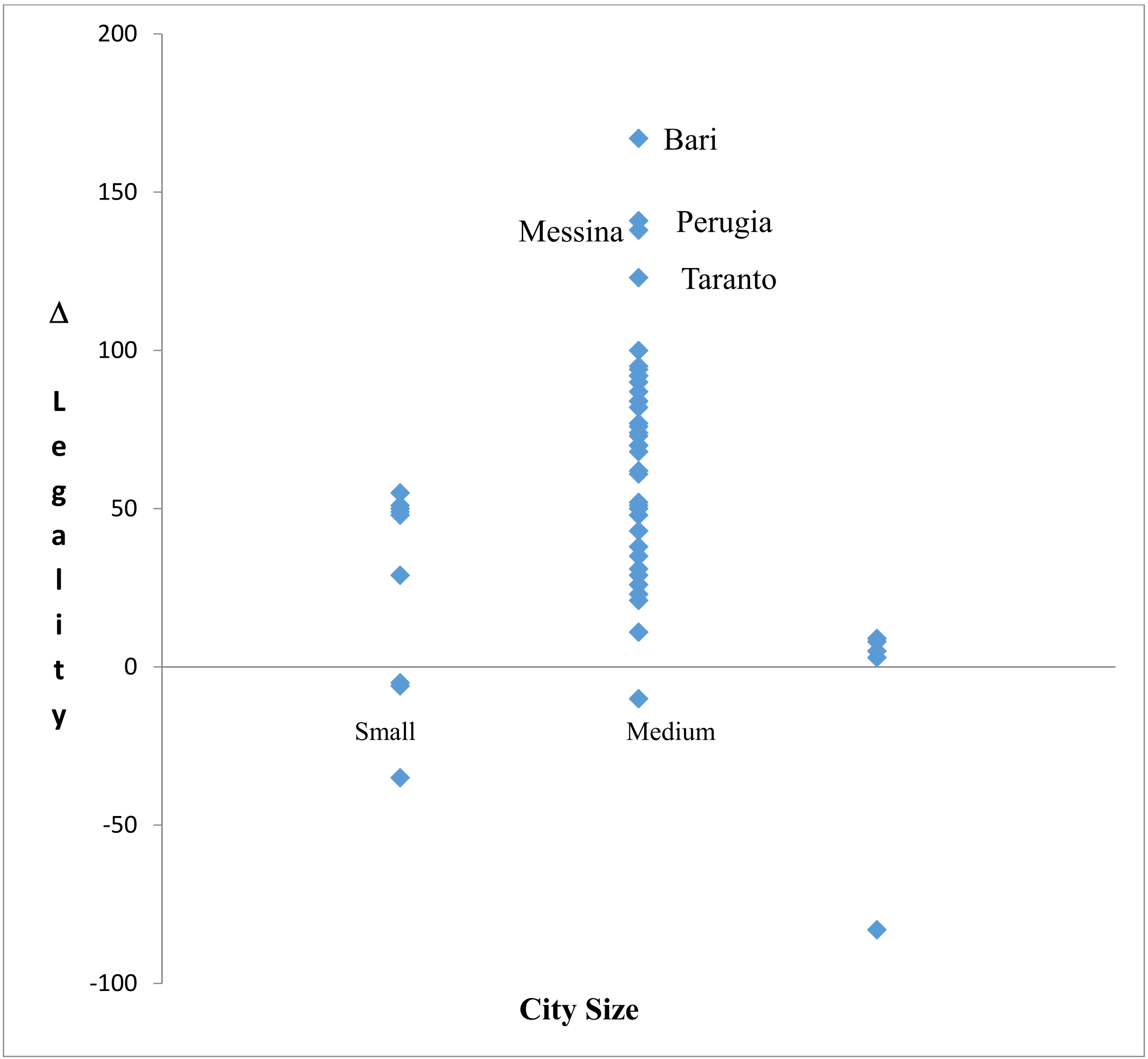

Fig. 15 Δ Legality – size stratification

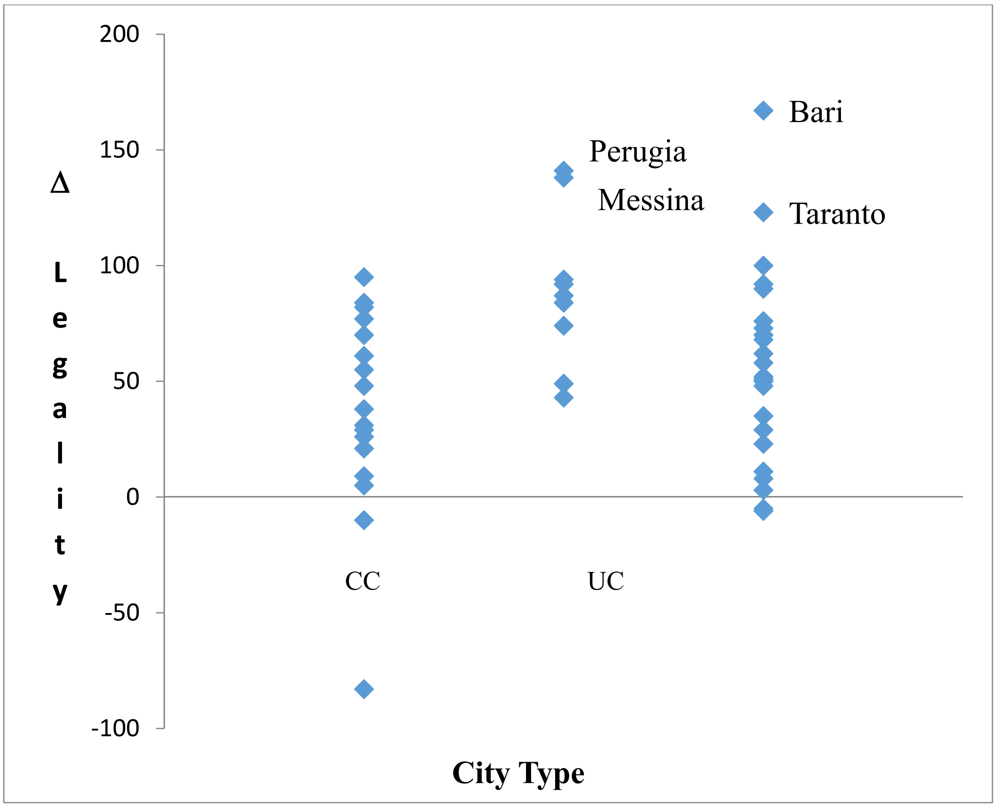

Fig. 16 Δ Legality – type stratification

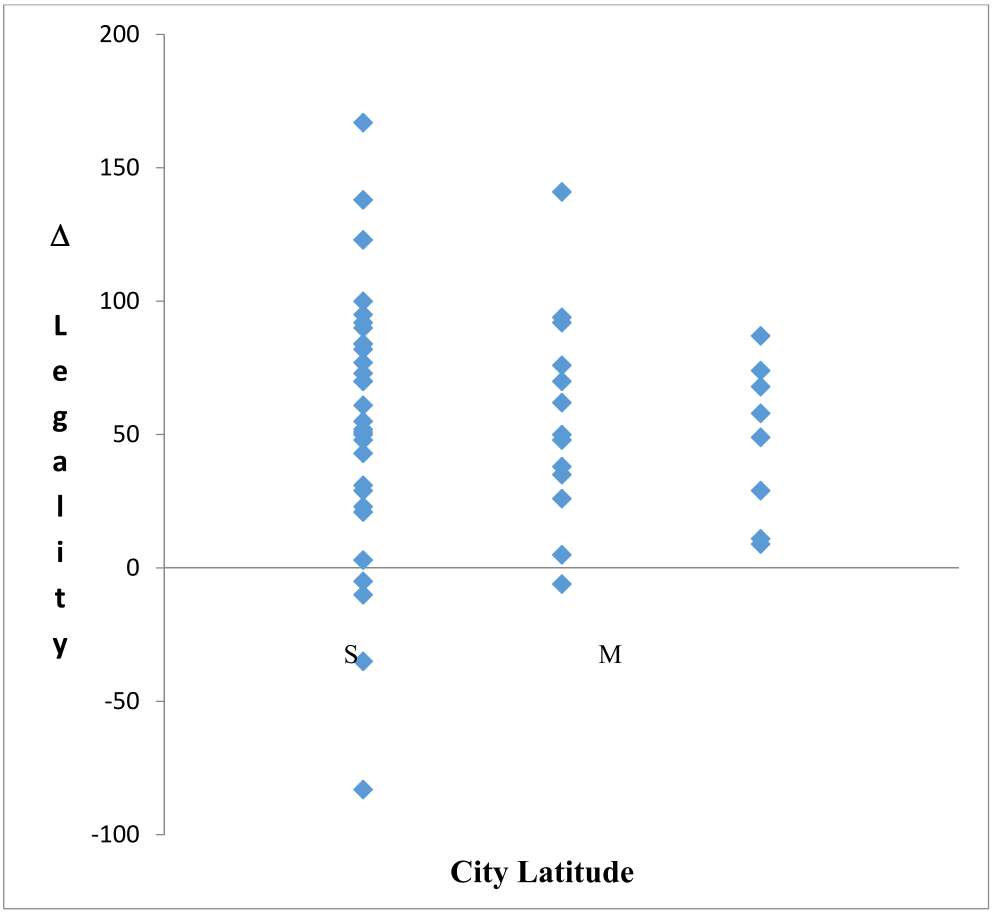

Fig. 17 Δ Legality – latitude stratification

5 CONCLUSIONS AND FINDINGS

The present work has proposed a geographic approach to the theme of urban resilience in order to verify the eventual relationship between some geographical and some urban variables involved in urban resilience actions. From the analysis carried out on data related to the scenario of Italian cities, the following paradigms emerged. Both the medium-sized cultural and industrial cities of the South are those characterized by a medium to high increase in the Living variable. Unlike the medium-sized cities, both small and large cities and northern cities have not been sensitive to the theme of the environment and there are no significant differences between cities of different types (as data are uniformly distributed). Only the medium and southern cities have proved sensitive to the issue of mobility and, as shown in figure 10, the deviations for this variable were generally quite negative. Finally, the southern medium-sized cultural and industrial cities are those characterized by a medium to high increase in the Legality variable.

Among the geographical variables, the one that seems to have the greatest influence on the processes of variation in urban variables is size; in fact, the middle cities have proved to be the most sensitive (both positive and negative) to the detected deviations. Understanding the phenomena of influences between geographical variables and urban variables can be a strategic element for all local stakeholders in terms of choosing appropriate assets, specific to that city or territory, through which to express the best resilience actions.

In fact, the principles and abilities related to the resilience approach can support a general framework and strategic visioning which is able to move and activate different interests and stakeholders (citizens, institutions, private sectors, professionals, academics and educators) towards integrated multi-issue projects. Existing trends and initiatives, and new polices and projects need to be integrated with a strategic vision (on a regional, metropolitan, or territorial scale, and at the local level), in order to be supported by technical and methodological innovative instruments that are able to orient the decision-making process and lead to the implementation of innovative governance solutions (Colucci, 2015).

Therefore, a geographic determinism can be considered in the phenomena of urban resilience and through the correspondence in table 3 it is possible to obtain a further correspondence between geographical characteristics and resilience's attributes as shown in table 4.

Geographical Characteristics	Resilence's Attributes
Medium-sized Cultural and Industrial Cities (E.g.: Aosta, Novara, Messina, Rovigo, Salerno, Cagliari, Ragusa, Sassari, Caserta, Pordenone, Siracusa, Benevento, Oristano, Enna)	Adaptability Cohesion Convertibility Creativity Feedback Flexibility
Medium-sized Cities of Middle and South (E.g.: Bari, Perugia, Messina, Taranto, Avellino, Lecce, Pisa, Siena, Caltanissetta, Catanzaro, Padova, Siracusa)	Adaptability Control mechanisms Convertibility Creativity Efficiency Feedback
Medium Southern Cities (E.g.: Brindisi, Caserta)	Adaptability Capacity for mobilization Collaboration Efficiency Feedback
Southern Medium-sized Cultural and Industrial Cities (E.g.: Bari, Messina, Taranto, Avellino, Crotone, Oristano, Lecce, Cosenza, Caltanissetta, Catanzaro, Siracusa, Agrigento)	Adaptability Cohesion Collaboration Effectiveness and reliability of institutions Equity

Tab. 4 Relationship between geographical characteristics and resilience's attributes

For those cases in which the data of the analysis showed a great intensity in those resilience actions, the municipality policy and programmatic guidelines of those cities, regarding 2015, have also been analyzed. This confirms the deterministic and non-random variables, and the declared will of the municipality regarding the positive variation detected about these specific urban variables as shown in table 5.

Urban Variable	City	Programmatic Policy Guidelines	Source
Living	Aosta	▲	Aosta Official Municipality Website
	Novara	▲	Novara Official Municipality Website
	Messina		Messina Official Municipality Website
	Rovigo		Rovigo Official Municipality Website
Environment	Bari		Bari Official Municipality Website
	Perugia	▲	Perugia Official Municipality Website
	Messina		Messina Official Municipality Website
	Taranto	▲	Taranto Official Municipality Website
Mobility	Prato	▲	Prato Official Municipality Website
	Aosta		Aosta Official Municipality Website
	Brindisi		Brindisi Official Municipality Website
	Ferrara	▲	Ferrara Official Municipality Website
Legality	Crotone	▲	Crotone Official Municipality Website
	Isernia		Isernia Official Municipality Website
	Oristano	▲	Oristano Official Municipality Website
	Catania	▲	Catania Official Municipality Website

Tab. 5 Random and determinism analysis of resilience trough municipality programmatic policy guidelines

In most cases, the result obtained from the data available from the official municipality website of each city demonstrates that the positive resilient action which emerged from the analysis of this work is explicitly provided in the programmatic policy actions, therefore demonstrating an evident cause-effect deterministic character of such actions and not a statistical error. The proposed work, also if somewhat based on an observatory window, showed that resilience is a possible cultural paradigm change for Italian cities and the ability to be resilient in terms of efficaciousness in urban strategy it is necessary to take the influence of geographic determinism in count.

Urban Variable	Sub – variables	Metrics
Living	Economic suffering	Declaration number less than 0 euro + number of declarations 0-10.000 euro/ Total number of declarations
	Coworking	Percentage of co-working services on the total recorded in Italy
	Urban attractivity	Index of the migratory balance 2015 (migratory balance 2015 / population 1 January 2015 x 1.
Environment	Nets for sustainability	Number of municipalities that have reached step 2 or 3 of the SEAP (Sustainability Environment Actions Plan) over total municipalities in the province
	Common Sspaces	Urban green area for urban gardens, equipped green areas, sports areas outdoors / per capita
Mobility	Railway utility	Share of stations gold, platinum, silver on the total
	Bikesharing	Availability of bicycles for 10 thousand inhabitants
Legality	Organized crime	Ranking of provinces for the presence of crimes related to organized crime (average 2010 - 2013; Italy index number = 100)
	Commercial illegality	Ranking of provinces due to the structural presence of commercial illegality, crimes reported per inhabitant (average 2010 - 2013, values normalized, Italy = 100
	Recycling	District ranking by the structural presence of money laundering crimes (average 2010 - 2013, Italy index number = 100)
	Voluntary homicides	Voluntary murders consumed per 100,000 inhabitants (number per thousand inhabitants)

Appendix. Source: Author's elaboration on Icityrace data

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IMAGE SOURCES

Fig. 1; 2; 3; 4: 5; 6; 7; 8; 9; 10; 11; 12; 13; 14; 15; 16; 17: Author's elaboration

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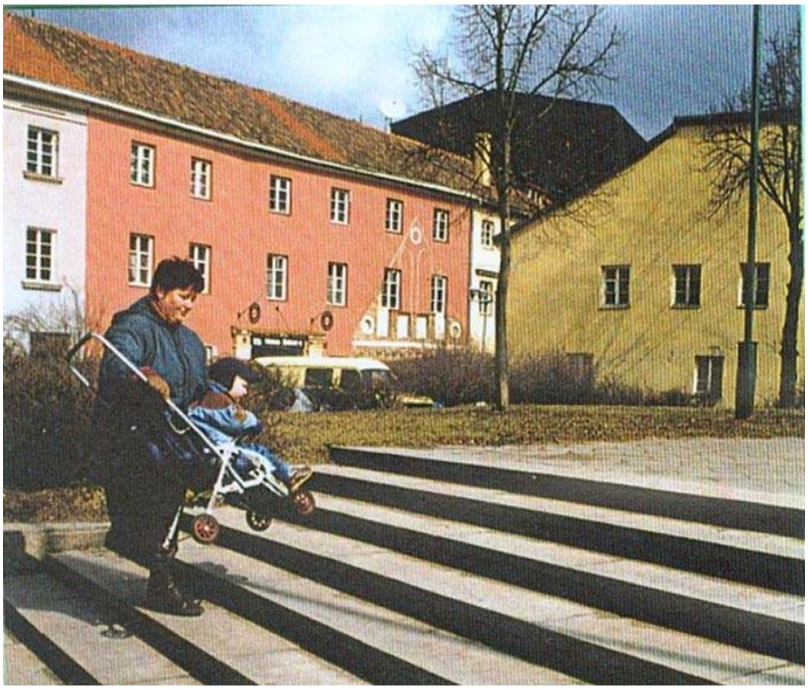

MONITORING USER-BASED ACCESSIBILITY ASSESSMENT IN URBAN ENVIRONMENTS AND IN PUBLIC BUILDINGS

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ABSTRACT
The research features analysis of user-experience-based accessibility assessment and progress monitoring of buildings and public spaces; this analysis is used as a tool for facilitating the development of humane, socially sustainable and an inclusive urban environment and architecture. A group of users representing people with different kinds of disabilities, the elderly and families with children was created to assess the quality of physical access to the buildings of different functions and locations across the cities of Vilnius, Lithuania and Singapore, Republic of Singapore. A school, two hospitals, a rehabilitation centre and two offices were selected for access monitoring in Vilnius City, while a hotel, a café and two metro stations with public squares were chosen for access assessment in Singapore (Fig. 11). The article draws a comparative analysis on accessibility of the selected buildings in Vilnius City and in Singapore where the same pre-tested method was applied to assess accessibility in 2000 – 2017. The results show a definite improvement of access quality over time and identify the critical aspects of urban spaces and buildings. The segment of plot planning represents the lowest quality of access for all assessed building types as compared to the building segment and the external–internal element segments. The paper also draws conclusions that access improvement is a continuous process of implementing advanced urban policy instruments, and city planners can contribute to it by constantly analysing and presenting to public the monitoring data about the progress in accessibility of buildings and urban spaces. Comparing the assessment results between Vilnius City and Singapore – cities that are located in different global regions and in different socio-economic environments – provides a practical tool for benchmarking, monitoring and prioritising this process.

KEYWORDS:
Accessibility; Architecture; Urban Planning; Regulation; Assessment.

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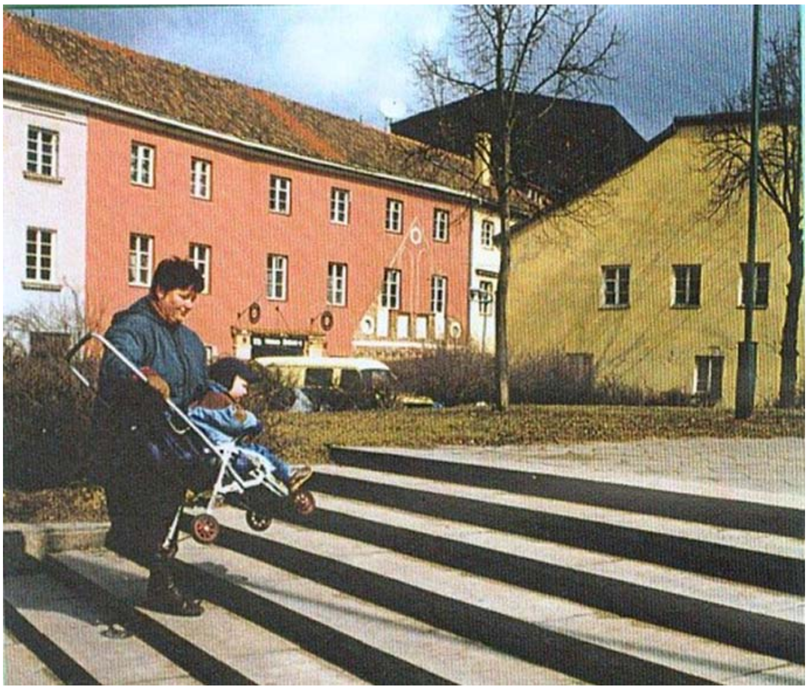

监控城市环境与公共建筑的基于用户的可达性评定

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摘要

本研究分析了建筑与公共场所的基于用户体验的可达性评定与进程监控；本分析被用作促进人文发展、社会可持续发展与包容性城市环境与建筑的工具。成立了一个代表各色人等：残疾人、老人、有子女的家庭的用户小组，以评估立陶宛维尔纽斯与新加坡等城市不同功能与位置的建筑物的实体可达性/出行（physical access）质量。在维尔纽斯选择了一所学校、两家医院、一家康复中心、两座办公楼用作可达性/出行监控，而在新加坡选择了一家酒店、一家咖啡厅、两个有公共广场的地铁站用作访可达性/出行评估（图 11）。本文对维尔纽斯与新加坡两市所选定的建筑的可达性进行了对比分析，而此相同的预测试方法也适用于 2000 - 2017 的可达性评定。结果表明，随着时间的推移，可达性质量有了一定的改善，并确定了城市空间和建筑的关键方面。与建筑部分和外部-内部要素（自然环境）部分相比，建筑用地规划部分代表了所有评估建筑类型的最低可达性/出行质量。本文还得出结论：改善出行条件是实施先进城市政策手段的一个持续过程，城市规划者可凭借不断分析和向公众展示建筑和城市空间可达性进展情况的监控数据来帮助这一点。对比位于不同的全球区域与社会经济环境中的维尔纽斯与新加坡城市之间的评估结果，为此过程的基准测试、监控与优先次序提供了一个实用工具。

关键词：
可达性；建筑物；城市规划；法规；评估

1 AIM OF RESEARCH

The research aims to analyse how the accessibility assessment method that was developed and pilot-tested by the author works in different urban settings and hopes to demonstrate its potentials for monitoring and improving the accessibility of publicly used buildings and urban spaces. The results of this research could be practically used for self-assessment initiatives by the assessed and many other institutions, urban planners, architects, property developers and users. The theoretical approach of the research rests on the methodology of reshaping urban environments by implementing advanced improvement programmes and assessing their results by evaluating, comparing and monitoring the consumer's perspective in local socio-economic environments (Bromley, Matthews, & Thomas, 2007). The research also aims to test the assessment tool for benchmarking the accessibility improvement process in different socio-economic and environmental contexts and therefore the author has selected the cities located in different geographical and cultural environments. It is expected that the compared and monitored assessment results can set the milestones for tracking and fine-tuning the accessibility progress in different environmental locations.

2 BACKGROUND

The researchers demonstrate a growing interest in the assessment of social processes. In the last two decades, the volume of papers in this field has increased immensely: in a Web of Science search on "assessment methods accessibility" (1996 – 6 items, 2017 – 196 items). Most of the papers had a background in the environmental, social and health sciences presenting the research in psychological, medical and bio-climatic aspects of person – environment interaction. The problems of better access to public environments and all kinds of services are frequently analysed as a policy instrument leading modern cities towards socially sustainable urbanism based on non-discrimination, justice and satisfaction for all city dwellers. Having integrated many additional user-friendly environment solutions, accessibility as a knowledge platform has advanced to the inclusive design with user-centred planning and design principles featuring a responsive, flexible, convenient and welcoming environment for all (Mulligan & Fletcher, 2006). In the current research, the accessibility assessment is extended beyond simple access to services and facilities – it also takes into account the qualities of safety, security and comfort in urban environments and in public buildings. This approach corresponds to a complex structure of socio-economic and environmental aspects of the built environment that most modern cities are implementing as their long-term strategy.

Politicians, practitioners and researchers look on urban access as a continuous process, with a clear goal of developing more inclusive and responsive urban communities. Therefore, those cities that have started the process earlier have achieved more by going further and could serve as a good case study for others. The process usually starts with setting a strategy, programming the process and planning adequate measures for accessibility improvement as land use plans for open spaces and buildings of the most diverse functions are drawn up (Stockholm, 2011). Recently, access assessment has focused on the elements of public mobility infrastructure, such as road crossings (Blecic et al., 2017), metro, bus and train stations. Multiple users' needs intersect in a limited space and existing obstacles not only increase the necessary connectivity time but also decrease the number of amenities and comfort for the users of this infrastructure (Sun, 2016). Specific aspects of a safe environment, such as outdoor lighting, are frequently analysed and outlined as having tremendous importance on movement safety and comfort of users in public areas (Johansson et al., 2011). Accessibility programmes currently are developed along with the general sustainability strategy, including life-cycle analysis of constructed buildings and economic, ecologic and cultural aspects of sustainability, and even deliver the platform of educational research for planning and design professionals as well as for city managers (Ahlberg et al., 2003). Creating eco-homes for eco-communities is based on a highest accessibility standards and practices, and the outcomes are assessed in all phases of development, from the concept to the built facility (Bhakta & Pickerill, 2016). Multiple external and internal space planning implications are resolved easily if one looks at the issue from the perspective of the user, who is also a customer buying goods and services (Rosemary et al., 2007).

National and European standards regulate the accessibility features in design and construction, yet there are many specific cases that need individual solutions for providing users with a safer, easier and more pleasing access. The first comprehensive regulation in this field was launched in Lithuania in 1993, and upgraded in 2001 and 2010 (Statybos Techninių Reikalavimų Reglamentas STR 2.03.01:2001, 2001; Statybos Techninis Reglamentas STR 2.03.01:2001, 2010). Singapore, which is the next site of our interest, adopted the access legislation in 2007 (Accessibility Code, 2007), followed by the upgraded version in 2013 (Accessibility Code, 2013). In some countries – for example, in the United States, which has introduced the Americans with Disabilities Act (ADA) in 1990 and upgraded it in 2010 – building standards are accompanied by guidelines that present detailed comments, advice and examples for standard implementation (Americans, 1994; Guidance, 2010). There is research evidence showing that awareness of local authorities is higher than the knowledge needed for implementing the national accessible environment standards (Kamarudin, Hashim, Mahmood, Ariff, & Ismail, 2012). Indeed, accessibility requirements are horizontally integrated in regulation of urban planning, architecture, landscape, mobility, infrastructure and other sectors. Naturally, regulation reflects on national socio-economic and environmental priorities, and adjustments are made in time to meet these goals. Researchers often rely on the national regulation or global design standards if the national ones are vague or non-existent while shaping their evaluation tools (Meşhur, 2016).

Researchers globally apply different self-adapted or authority-recommended access assessment methods to measure and evaluate the quality of the built environment and different kinds of buildings. Accordingly, various assessment tools are developed. It is essential that these tools should correspond to the specific purpose, especially using the survey results: if the aim is to support the owners or managers of facilities to make them more accessible, then the assessment should be detailed enough to figure out the weak points of the said environment that need improvement (Calder & Mulligan, 2014, p. 28). Researchers focus their attention on accessibility at different scales, from public areas to buildings and to their interiors (Bromley et al., 2007) using the corresponding assessment tools. There are a number of assessment tools, such as checklists, questionnaires, interview forms, expert analysis etc., used to evaluate access quality. Calder and Mulligan recommend that researchers consider conducting psychometric assessments of the instruments to be used for an adequate sample size. In addition, easy-to-administer tools with clear scoring benchmarks have rendered more objective and reliable results (Calder & Mulligan, 2014). Still, the tools employing universal user experience for surveys that give the overall evaluation of internal and external qualities of buildings in the public arena are rare to find.

As accessibility is a universal urban paradigm and policy instrument that is implemented to last a long time, methods that allow for comparing and monitoring access progress are needed, and just few research attempts could be found in this area. As a result, benchmarking and comparative analysis are needed to measure and compare access qualities in different urban settings. Society is the major disabling force as it marginalises impaired people socially, economically and politically by allowing the creation of non-accessible spaces and buildings (Gabel & Peters, 2004; Shakespeare, 2006). Traditional city construction has often led to the emergence of inaccessible environments as it follows the sequence of using conventional solutions that turn into barriers for many citizens (Casas, 2007). As a result, impairment-affected individual disability to perform certain actions or functions confront the limiting factors of the environment, which lead to a person's handicap in private or public life and result in the person's isolation to various extents and prevent the person from participating in community and an active social life (Fig. 1). Multidimensional and inter-sectoral accessibility programmes have a goal to divert the process of person–environment interaction from the point of handicap to an accessible environment track (Fig. 2, top) by creating and implementing the complex accessibility approach. The results of these implementations preventing a person from falling into the trap of a handicap and are led back to a normal life track are analysed in this paper (Fig. 2, bottom).

Fig. 1 Traditional flow from personal impairment to disability

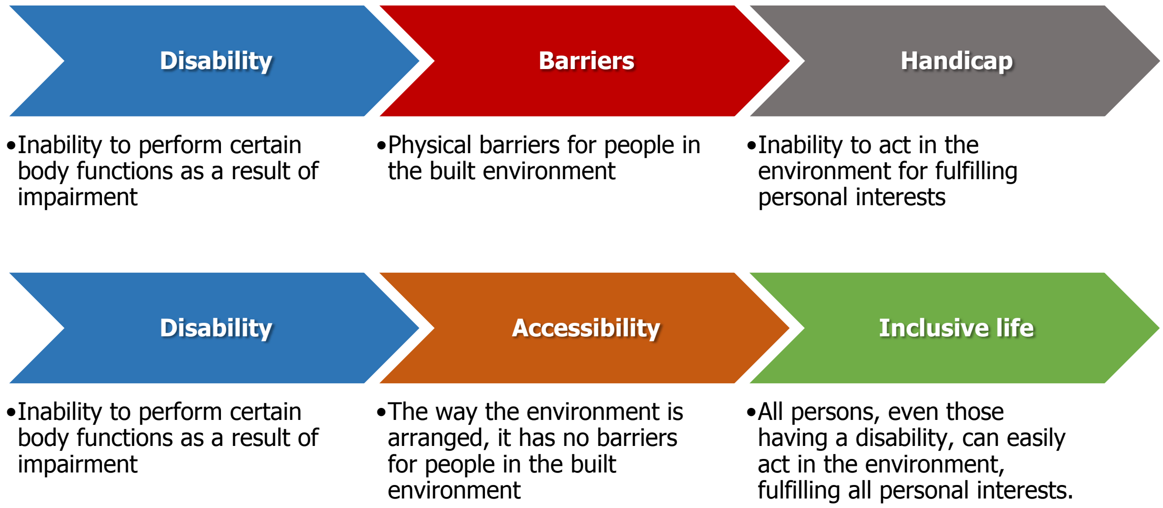

Fig. 2 The sequence of managing disability in barrier-full (top) and accessible barrier-free (bottom) environments

As it emerges from the background analysis, there is a need for a comprehensive, objective and easy-to-use system for access assessment and monitoring that fits different urban environments and diverse socio-economic conditions. The assessment tool should function over the variety of scales of urban environments from interior details, public and commercial buildings and to open spaces, mobility and infrastructure facilities. The assessment tool based on users' experience and clear scoring benchmarks could report on the access quality – both at the level of fundamental needs for safety and security, and the higher user's aspirations for comfort and satisfaction – as required by the universal design principles that emerged on the ground of accessibility philosophy and practice (Universal, 2007). Users' groups involved in assessment should cover a wide array of disabilities and could extend to the elderly and families with children.

Moreover, comparative analysis and monitoring of access quality progress is important in the fundamental and applied senses as it adds one more important quality segment to a highly complex planning and design agenda (Simon, 1962).

2 METHODOLOGY

A participatory access assessment method involving people with disabilities was created by the author and practically tested at several urban spaces and buildings in Vilnius City (Stauskis, 2017). The method features a comprehensive assessment matrix of 59 aspects for the assessors to report their on-site experience while testing by using the particular building's system or element. The same method, with some adjustments, was used to assess several public premises in Singapore in 2012 (Fig. 11) and in Vilnius in 2017. The paper draws an analysis based on the assessment results in Vilnius and Singapore, and discusses the trends that are specifics for these two cities.

At first glance, Vilnius and Singapore are two very different locations. However, there is an essential similarity in common for them and for many other urban centres. On the one hand, these cities are located in different geo-climatic and socio-economic regions: Vilnius – in North-East Europe, with a moderate cold continental climate, developing economy in an ethnically homogenous society; Singapore – in South-East Asia, with a hot tropical climate, ethnically heterogeneous society and world-leading economy. On the other hand, both cities are on the same path of improving accessibility of the urban environment and buildings by implementing different regulations in the context of regional traditions and economic potential.

Therefore, it is scientifically important, acceptable and practically adequate to evaluate accessibility in these two different places by using the same method and the same assessment tool. More, it is important to know how efficient is the assessment tool for monitoring accessibility of the same buildings over different time and to analyse the monitoring results.

The accessibility level of the selected facilities was assessed by a team of instructed evaluators according to the specially designed method that comprised a concise matrix of aspects covering different environment segments, structured over three levels: the site (i), the building (ii), and the details (iii). The assessment was carried out according to the original assessment methodology created and previously pilot-tested by the author in assessing several buildings in Vilnius City. The averages from the individual assessment scores were derived for each assessed accessibility aspect, for every environmental segment (i-ii-iii), and finally, for all facilities. As a result, the overall averages were derived for all assessed facilities of the assessment cycle for 2000, 2012 and 2017. The number of negative scores (0–4) granted by the assessors for all environmental aspects was accounted for in the same way. After accessibility was assessed for all aspects in the range of 1–10, the received results were normalised to a 0–1 range using formulas 1 and 2.

$$\boxed{\mathbf{Z_i = X_i - X_{min} / X_{max} - X_{min}}} \quad [1]$$

Z_i = i-th normalised value;

$X = x_1, x_2, \ldots x_i$;

X_{min} = minimal value of X;

X_{max} = maximal value of X;

The negative score numbers were normalised using the formula 2:

$$\boxed{\mathbf{Z_{ni} = X_{ni} - X_{n-min} / X_{n-max} - X_{n-min}}} \quad [2]$$

Z_{ni} – i-th negative normalised value;

X_{ni} – $x_{n1}, x_{n2}, \ldots x_{ni}$;

X_{n-min} – minimal negative value of X_n;

X_{n-max} – maximal negative value of X_n;

The original methodology was upgraded for the recent assessment cycle by including the evaluation the lowest assessment scores (0–4), which are an important indicator of the extremely low accessibility. As those elements of the environment that were given the lowest scores are principally non-accessible barriers that are critically limiting access to and usability of the whole facility and not just its part, the normalised non-accessible assessment scores were included in the final assessment as the diminishing criterion of the overall evaluation.

The final scores were obtained by subtracting the normalised negative scores from the normalised average assessment scores (formula 3). Formula 3 delivers the final assessment score:

$$\boxed{\mathbf{Z_{i-fin} = X_{i-ass} - X_{i-neg}}} \quad [3]$$

Z_{i-fin} – final score of assessment of i-th facility;
X_{i-ass} – normalised average assessment score of i-th facility;
X_{i-neg} – normalised negative assessment score of i-th facility.

Assessments were carried out in reality by a team of seven assessors with varying physical conditions, different environmental needs and diverse capabilities (Fig. 4). The composition of the assessor's team and the social profile wasdesigned to cover the natural array of most vulnerable user groups with diverse needs representing the broad spectrum of modern society (Fig. 11). An elder person and a parent with a baby in a stroller to reflect the interests of the elderly and young families complimented the assessor's teams for Vilnius 2017 and Singapore 2012 tests (Fig. 11). The assessor's team featured a variety of occupations, ages and gender balance (Fig. 3). To increase the quality of the assessor's feedback about usability and performance of the assessed facilities the assessment was practically implemented by reporting an on-site user's experience of testing different environment elements. The individual assessment scores were filled in the summary matrix in decimal grades from 0 to 10 in an Excel spreadsheet.
The usability and performance of buildings and other built facilities in their environment could be assessed by different value levels starting from the basic safety qualities; once this was achieved, it could proceed to the higher level of comfort of use. In addition, if this was realised, assessment could rise to the top qualities that please and satisfy user's aspirations (Gehl, 2010). This structure of values (Fig. 3) suggests that comfort may be only addressed after the basic safety needs are ensured, and pleasure level is targeted on the ground of good performance in safety and comfort aspects. Therefore, the original assessment method was upgraded by grading the value levels of the assessed urban environment and the selected buildings, and the assessors were instructed to evaluate the aspects of: (1) safety, (2) comfort, and (3) pleasure of use (Fig. 3).

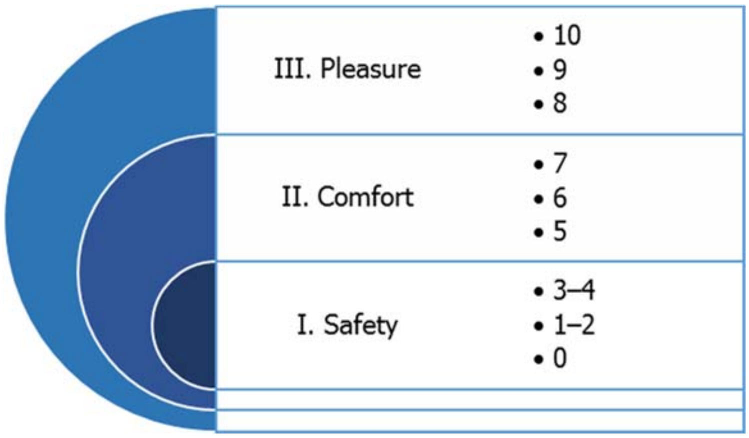

Fig. 3 The scores for assessed value levels of the environment elements and buildings

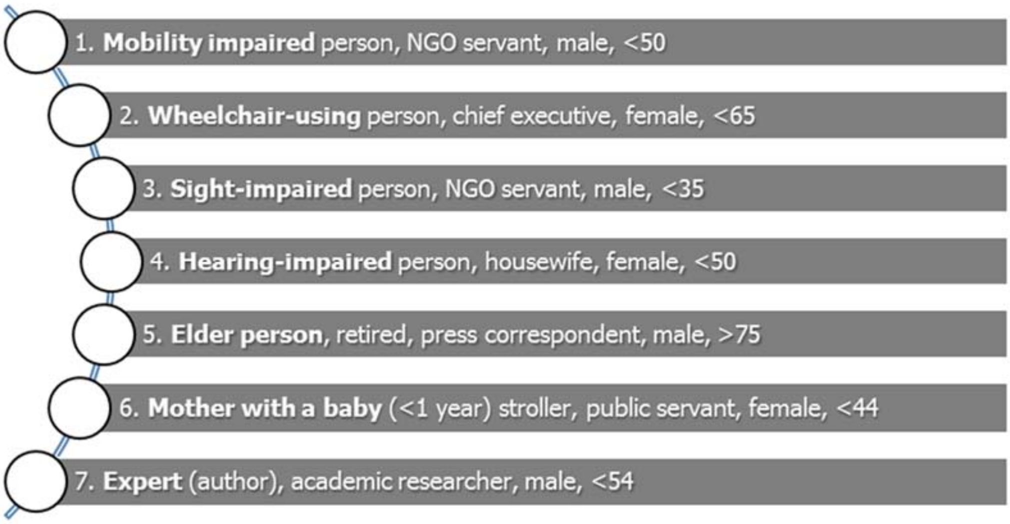

Fig. 4 Assessor's team composition represent the array of physical and social condition, gender, occupation and age

3 RESULTS

As each assessor had an opportunity to experience his own specific environmental needs by testing the use of given environment elements in urban space and in buildings, the overall assessment results reflect the needs of major physically sensitive user's groups.

The summary normalized results (Table 1) show the highest (object 9) and the lowest (object 1) *average assessment* scores, on the one hand. On the other hand, the table outlines the largest (object 4) and the smallest (object 2) numbers for *negative* scores given by the assessors, and these are different objects than those ranked by an average assessment score. According to the *total* assessment grade, the object 9 earns the highest score, object 4 – the lowest score. The highest assessment score was assigned to object 9, the same as for the assessment average, and the lowest – to objects 4 and 11, the same 4 that got most negative scores. In total, six objects received overall negative scores (Fig. 5).

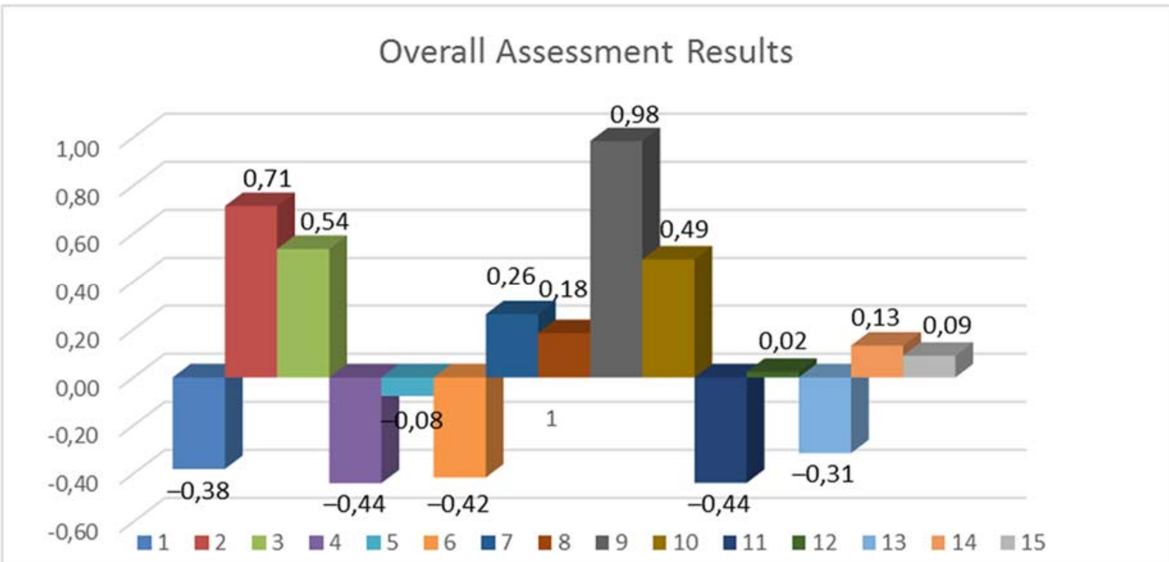

Fig. 5 Overall assessment results for all objects (1–14 Table 1)

No.	Year built or refurbished	Object, city, assessment year	Assessment average		Non-accessible elements assessment		Overall score
			Score	Normal	Number	Normal	
1	1989	Office LŽNS, Vilnius 2000	6,28	0,00	33	0,38	–0,38
2	1998	Office LŽNAPA, Vilnius 2000	8,18	0,71	**9**	**0,00**	0,71
3	2005	Office LŽNAPA, Vilnius 2017	8,17	0,71	20	0,17	0,54
4	1998	Social Affairs and Labour Ministry, Vilnius 2000	7,77	0,56	72	1,00	–**0,44**
5	2010	Social Affairs and Labour Ministry, Vilnius 2017	7,51	0,46	43	0,54	–0,08
6	1990	MM hospital, Vilnius 2000	6,65	0,14	44	0,56	–0,42
7	2011	MM hospital, Vilnius 2017	7,75	0,55	28	0,30	0,26
8	1998	Rehabilitation centre Baldžio Šilas, Vilnius 2000	7,36	0,41	23	0,22	0,18
9	2014	RVUL hospital, Vilnius 2017	8,94	**1,00**	10	0,02	**0,98**
10	2010	Versmė School, Vilnius 2017	8,18	0,71	23	0,22	0,49
11	2005	V-Hotel, Singapore 2012	6,38	0,04	39	0,48	–**0,44**
12	2010	Metro station Dhoby Ghaut, Singapore 2012	6,72	0,17	18	0,14	0,02
13	2010	Metro station Lavender, Singapore 2012	6,54	0,10	35	0,41	–0,31
14	2010	Starbucks cafe, Singapore 2012	6,8	0,20	13	0,06	0,13
15		**Average all objects**					**0,09**
16		Average Vilnius 2000 and 2017					0,19
17		Average Singapore 2012					–0,15
18		Difference Vilnius (2000–2017) and Singapore (2012)					**0,34**

Tab. 1 The summary of all assessment results Vilnius 2000, 2017, Singapore 2012

Comparing the assessment results, the averages of Vilnius's and Singapore's objects show that the combined scores for Vilnius 2000 and 2017 assessments are, by normalisation, 0.32 higher than for Singapore 2012 (Table 1). This may relate to earlier implementation of accessibilty-promoting building regulations, dynamic growth of public awareness after 1990 and some other factors in the respective countries.

The site segment delivered the lowest score (6.52) from all the assessed buildings in all environmental segments (Fig. 6, 11). The highest assessment score was given to the buildings segment (7.64). Comparing assessment averages from all objects, the lowest score (5.61) was assigned to the site segment in Vilnius in 2000 and the highest score (8.57) to the building segment in Vilnius in 2017. Average assessment of Vilnius's objects in 2017 got the highest score (8.18) while comparing all three assessment cycles (Fig. 7).

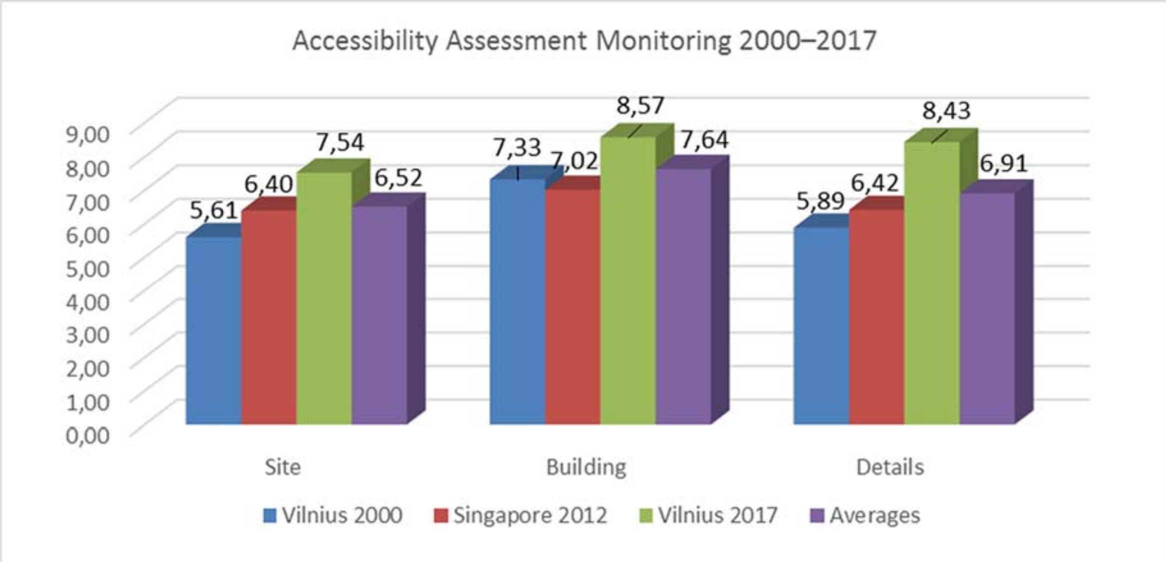

Fig. 6 Accessibility assessment monitoring 2000–2017

Comparing average assessment scores in Vilnius, we see a 30.2% improvement from 2000 to 2017 (Fig. 7). Some objects have increased their assessment grades from 2000 to 2017 (4–5 and 6–7, Table 1), but one has decreased its grade (2–3). All objects assessed in 2017 have earned overall positive grades (3, 5, 7, 9, 10). For Singapore, object 14 has rendered the highest positive score (0.13), which is one of the lowest compared to Vilnius City object's assessment scores.

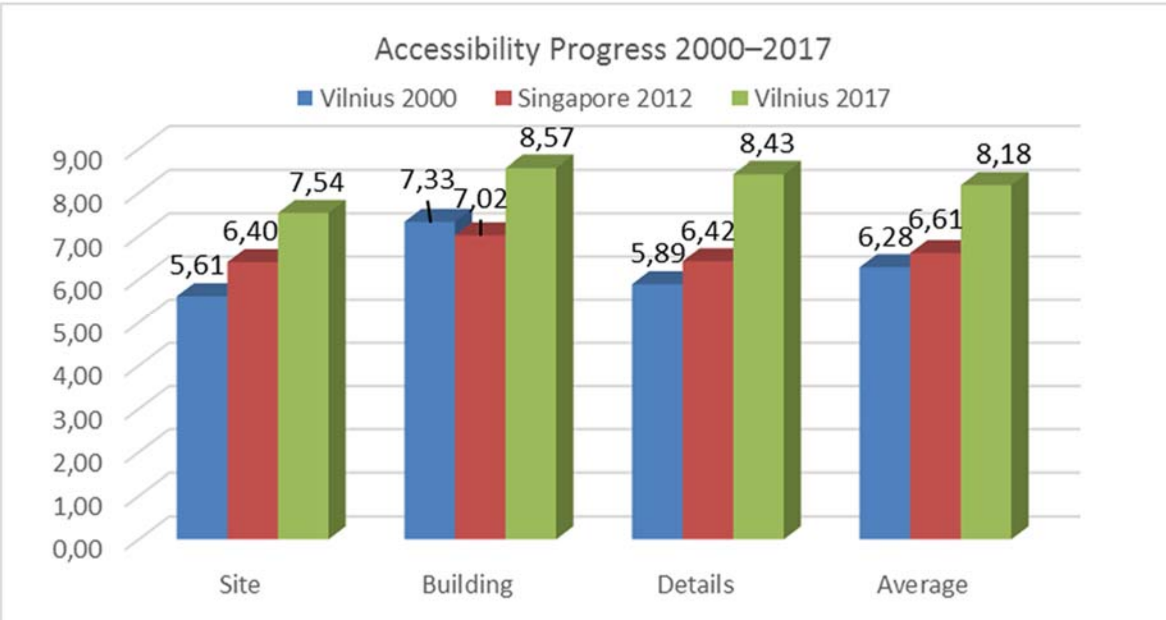

Fig. 7 Accessibility assessment for different environment segments

Finally, assessment results allow for monitoring the accessibility quality in the analysed urban sites and buildings at different times (Fig. 7). Accessibility level in all environment segments has increased in the period 2000–2017 by 30.2%. The elements of the ***site*** segment were graded the lowest scores through all assessment periods. The biggest progress through the analyzed period is observed in the segment of ***site and building details*** (43%) and the ***building's site*** (34.3%).

This shows the precise impact of the variety of accessibility promoting measures as more strict regulation and control, intensified professional upgrade, rising public awareness and others that urban planning and architectural design practices take into account for improving the quality of both public and private environments and buildings. Analysing the assessment results according to the year of construction (or refurbishment) of the surveyed buildings in the interval of 1989–2014 reveals a definite increase in accessibility scores from −0.38 for facilities built in 1989 to 0.98 for those built or refurbished in 2014 (Fig. 8). This trend has become especially evident after 2005 and continues until recently, and the more strict control of the regulation requirements is one of the reasons along with the improved skills of city planners and architects

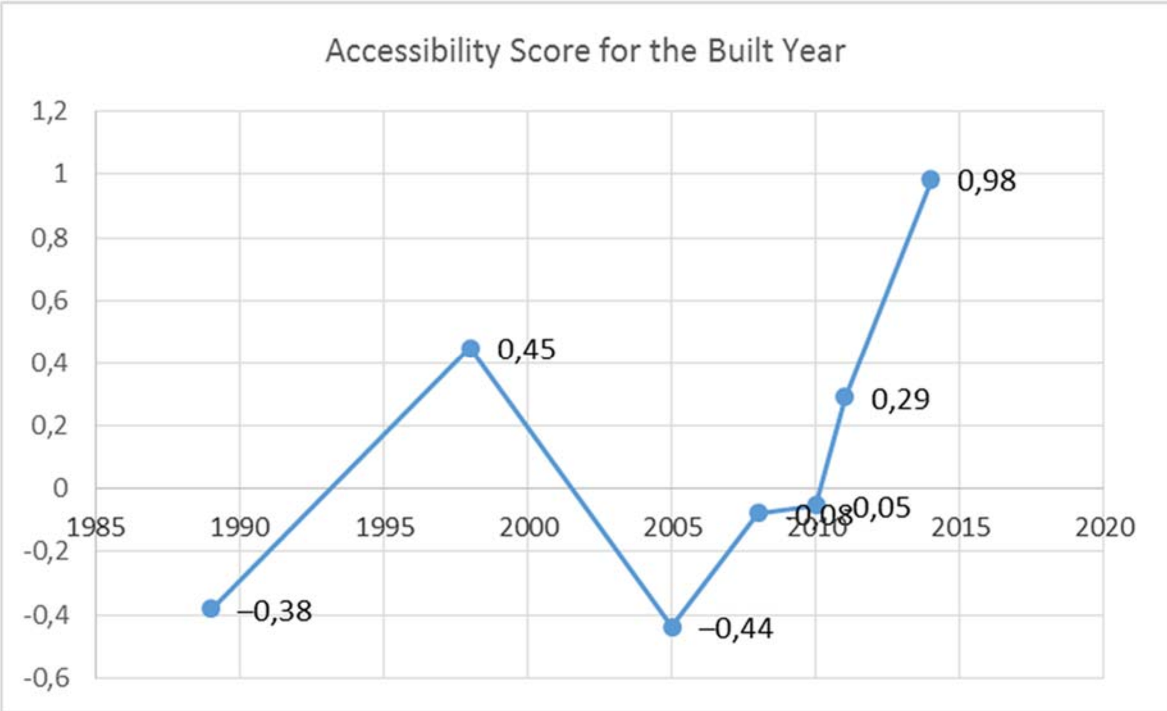

Fig. 8 Accessibility assessment scores for the year of construction of the object

As assessor's team was composed to represent a group of people with varying conditions, of different occupations, ages and experiences, the comparison of each assessor's average grades was also drawn up. The data analysis shows that the lowest assessment scores were delivered by the assessor with limited mobility, who was walking with additional support (the expert's scores are excluded). The hearing-impaired assessor delivered the highest average scores (Fig. 9). Consistency is another important aspect of the obtained accessibility assessment results. The scores assigned by different assessors present great variety for the different positions and environment segments. Examples in Figures 10, 11 show that the assessment averages for all aspects of two assessed objects differ from two to nine. It could be assumed that the grades lower than the average (6,5 – red line on Fig. 10) for the given object are below the lowest acceptable threshold and these assessed elements in buildings or in urban spaces need urgent improvement in order to continue using them. The rest of the assessed elements should be improved in the shortest possible time as decided by the authorities for urban spaces and the owners or the users of publicly used buildings and facilities.
As different assessors have different needs in the environment, their assessments reported different results even on the same environment element. E g the curb is a good guide for the sight-impaired person, but the same curb is a real obstacle for the wheelchair user. The question is how different assessments of the same element could be considered to make an impact on the overall design, which has to take into account different human needs, but make one planning or design decision. Analysis of the assessment matrix reveal that there are cases when assessors' scores coincide, but there are also cases when these scores differ greatly (Fig. 11).

Quality of parking, external ramps, main entrance, elevators and signage have all delivered radically different (4–10, 3–9) scores. However, many environment elements scored in the same high or low way (external rest places, warning surfaces, floor material and others).

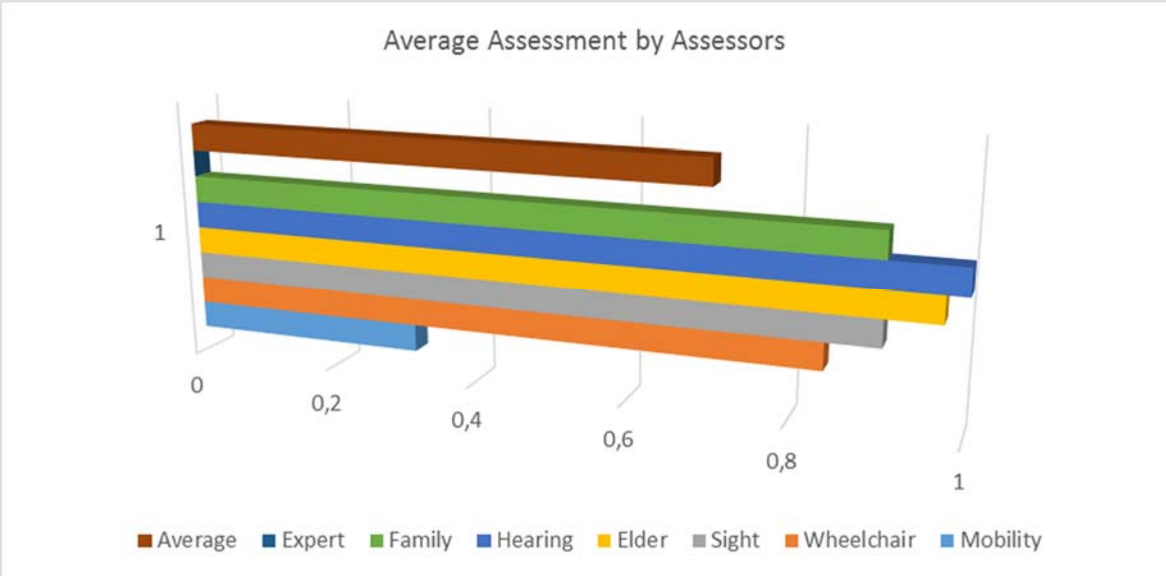

Fig. 9 Normalised average assessment by different assessors (0–1)

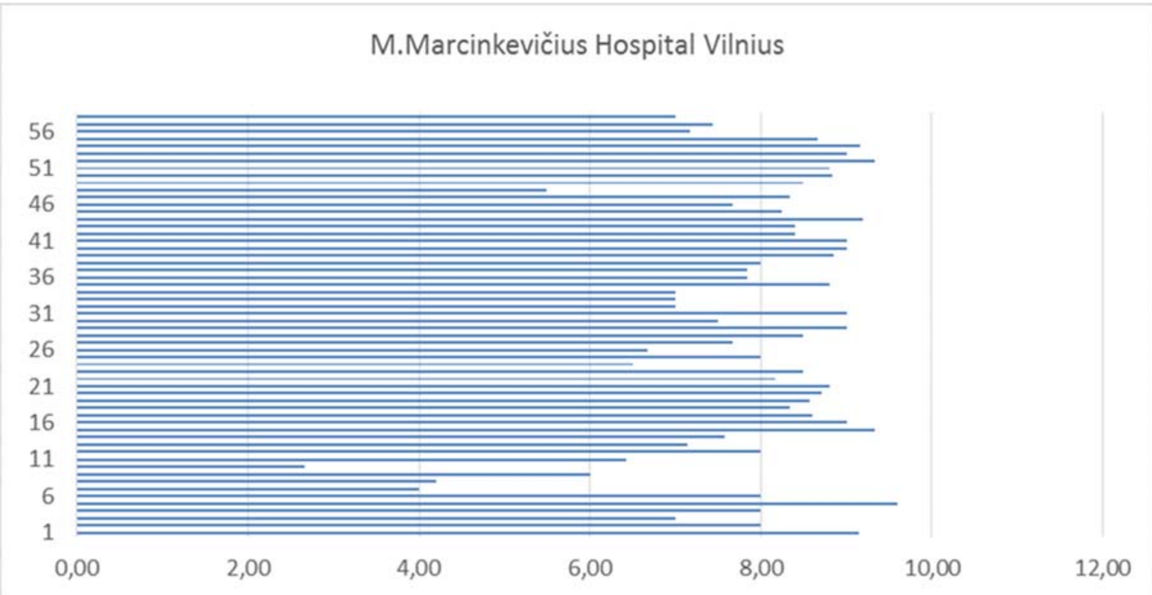

Fig. 10 Assessment averages for all aspects of 7 (MM Hospital in Vilnius City) and 12 (MRT Station in Singapore) objects

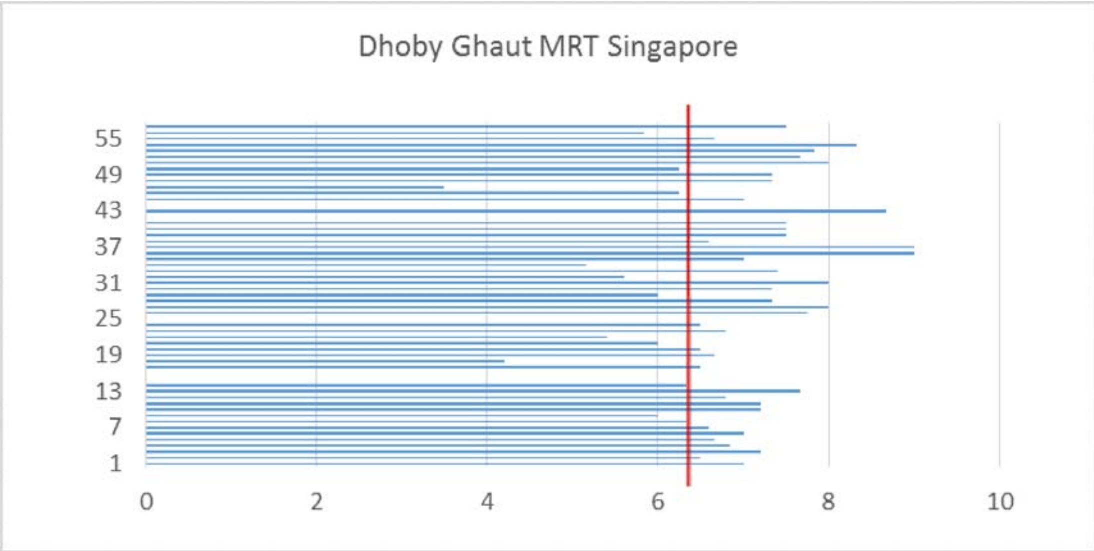

Fig. 10.a Assessment averages for all aspects of 12 (MRT Station in Singapore) objects

Building	Assessor	The Site – Assessment aspects 1	2	3	4	5	6	7	8	9	10	11	Sum	Aver
												Negative	7	
1. LŽNAPAoffice	1. Moving with supports	n	n	n	8	n	n	7	7	5	5	n	32	6,4
	2. Wheelchair user	10	n	n	10	10	10	10	10	10	5	n	75	9,375
	3. Blind person	5	n	n	7	n	n	n	n	8	n	n	20	6,667
	4. Elder person	9	n	9	n	10	n	8	9	9	n	n	54	9
	5. Mother with a baby	8	n	n	8	8	7	8	10	10	8	n	67	8,375
	6. Expert	9	n	n	8	4	n	8	9	5	3	n	46	6,571
	Average:	8,20		9,00	8,20	8,00	8,50	8,20	9,00	7,83	5,25		294	7,731
												Negative	14	
2. Social Affairs Ministry	1. Moving with supports	8	n	5	0	8	0	3	1	1	n	n	26	3,25
	2. Wheelchair user	7	n	7	7	n	9	4	4	0	4	n	42	5,25
	3. Blind person	8	n	n	7	n	9	9	9	n	n	6	48	8
	4. Elder person	6	n	n	6	10	6	6	6	8	n	n	48	6,857
	5. Mother with a baby	4	n	n	8	8	9	4	9	10	4	n	56	7
	6. Hearing impaired person	9	n	n	9	9	7	n	n	n	n	n	34	8,5
	7. Expert	6	n	n	7	8	n	6	9	4	2	n	42	6
	Average:	6,86		6,00	6,29	8,60	6,67	5,33	6,33	4,60	3,33	6,00	296	6,408
												Negative	7	
3. RVUL Hospital	1. Moving with supports	n	n	10	10	10	8	8	9	9	8	n	72	9
	2. Wheelchair user	10	n	n	10	10	10	10	10	10	4	n	74	9,25
	3. Blind person	5	n	n	7	n	7	n	n	10	n	n	29	7,25
	4. Elder person	9	n	10	n	10	10	9	10	10	n	n	68	9,714
	5. Mother with a baby	8	n	n	9	10	9	9	10	9	10	n	74	9,25
	6. Expert	8	n	n	7	9	5	5	5	5	4	n	48	6
	Average:	8,00		10,00	8,60	9,80	8,17	8,20	8,80	8,83	6,50		365	8,411
												Negative	8	
4. School Versme	1. Moving with supports	9	n	n	8	9	n	9	4	6	4	n	49	7
	2. Wheelchair user	8	n	7	7	8	n	10	10	4	4	n	58	7,25
	3. Blind person	n	n	n	7	n	n	n	8	n	n	7	22	7,333
	4. Elder person	n	n	n	8	7	8	8	8	6	6	n	51	7,286
	5. Hearing impaired person	10	n	n	10	9	9	n	n	9	7	n	54	9
	6. Mother with a baby	8	n	n	10	10	n	10	10	5	n	n	53	8,833
	7. Expert	6	n	n	6	7	n	4	4	4	4	n	35	5
	Average:	8,20		7,00	8,00	8,33	8,50	8,20	7,33	5,67	5,00	7,00	322	7,784
												Negative	9	
5. M. Marcinkevičiaus Hospital	1. Moving with supports	8	n	n	8	10	n	4	4	6	4	n	44	6,286
	2. Wheelchair user	6	n	6	7	10	n	0	0	n	0	n	29	4,143
	3. Blind person	10	n	n	7	n	n	n	n	n	n	n	17	8,5
	4. Elder person	9	8	8	n	n	n	n	n	6	n	n	31	7,75
	5. Hearing impaired person	10	n	n	9	9	n	6	6	n	n	n	40	8
	5. Mother with a baby	9	n	n	8	10	10	7	8	n	n	n	52	8,667
	6. Expert	8	n	n	6	9	6	3	3	6	4	n	45	5,625
	Average:	8,57	8,00	7,00	7,50	9,60	8,00	4,00	4,20	6,00	2,67	#DIV/0!	258	6,996
														7,466
	Good - very good	8 9 10												
	Low - very low	4 3 2 1 0												
	Total average:	7,97	8,00	7,80	7,72	8,87	7,97	6,79	7,13	6,59	4,55	#DIV/0!		7,47

Fig. 11 Assessment matrix, section The Site, Vilnius City 2017. Good – very good scores are in green highlight, low – very low scores are in red highlight

Fig. 12a Assessment of mobility system in Singapore 2012

Fig. 12b Assessment of urban open space in Singapore 2012

Fig. 12c Assessment of metro station in Singapore 2012

Fig. 12d Assessment of the cafe entrance in Singapore 2012

4 DISCUSSION

The results for all 14 assessed objects – open spaces and building (Table 1) show that eight objects have earned an overall positive assessment result and six have gained negative results (Fig. 5). The negative assessment results indicate that the urban space or the building is, in general, inaccessible and point out several critical obstacles that should be improved. The exact elements that need the improvement are listed in the assessment matrix and could guide the individually tuned accessibility programme and design for the given buildings in both cities (Fig. 11). This especially applies to the objects No. 1, 4, 6, 11 and 13 (Table 1). The used assessment method and the applied tool are suitable for accounting for and representing the low and high grades of accessibility that correspond to the low or high quality of accessibility to particular spaces and buildings. They can also serve as a proper comparing and monitoring tool that indicates the amount of progress or drawback in accessibility quality achieved over a certain period.

Assessment results, when grouped by the environment segment, identify the access level and its change in the outlined site, building and detail's segments. It is helpful for the building owner or facility manager to monitor access progress over time to figure out how efficient the taken measures are and to modify them according to the monitoring results, if needed. In this case, monitoring the assessment results shows that the site segment needs more attention from authorities, from academic institutions and professional associations to raise the competence of urban planners and architects for developing the best site planning and design solutions. Better legal regulation and support by guideline is needed for this segment as well. By evaluating the results from the point of the year of construction of the assessed spaces and buildings, one can see definite improvement in accessibility level – the new and the refurbished buildings are designed according to the valid regulations and the best design and management practices. One could suppose that higher user expectations are also driving further improvement of professional architect and planner practices by increasing the pressure on professionals to provide for safer, more comfortable and more pleasing urban planning and architectural design solutions.

The variety of assessment results delivered by different assessors recommend keeping and even extending the wide spectrum of representatives of various user groups to cover more specific needs and interests. In spite of evident and fully understandable differences in assessing various aspects of the built environment, the wide array of the assessors is a pre-condition for obtaining universal and comprehensive access assessment results that are both up-to-date, reliable to analyze and practical to implement. Looking at the consistency of assessment results, it is evident that certain elements that scored low or very low exist for each assessed object. Even objects that have earned relatively high average scores have several critically unfit elements for urgent improvement. All elements that have a result lower than the average for the whole object or the average for the given environment segment should be taken as a non-accessible barriers limiting the overall usability of the object. There is a contradiction in the results from the point of assessment by different assessors. This is understandable and justifiable as different physical conditions lead to frequently very different environmental needs and consequently different assessor's attitudes. It is a challenge for city planners and architects to find the optimal solution that fits all space users most: this is a search more for a varying optimal compromise and not for the fixed ideal.

Monitoring the progress of accessibility over time is an evident additional merit of the employed methodology and city politicians, researchers, architects, the media and the public at large could widely exploit it. It helps to set the milestones for progress and demonstrate the reach of certain goals. The overall assessment shows quite an unequal spread of the results: the negative scores represent an accessibility level that is currently an unacceptable barrier for the users as they represent the elements that essentially limit the access and give very low functionality and no comfort. One facility in Vilnius City has dropped in its average accessibility level score from 2000 to 2017 (LZNAPA office), and two have improved their scores (MM Hospital and The Social Affairs and Labor Ministry). On the one hand, this shows that even newly built office buildings need constant supervision and proper maintenance of their essential features, and on the other, that constant implementation of a long-term access improvement program leads to an improved situation, even in very complicated cases at the earlier designed and constructed buildings and urban spaces.

The author of this research took part in the assessment of the presented buildings and spaces as well but these scores were excluded from the calculations. In future, also ordinary citizens could be included in the assessment group as to figure out their degree of satisfaction while using urban spaces and buildings. The assessor's role could be also useful for urban planning, architecture students and young professionals as to strengthen their practical understanding of academic accessibility knowledge and getting the design-related skills and feedback from real space users.

The possibility to shape the assessment tool according to the nature of the assessed objects is open as well: by doing that, the chances for comparing the assessment results of different buildings would be lost, but the results would reflect more the specifics of the particular building's typology.

5 CONCLUSION

It is important to underline that in each case, the assessment tool should be adjusted to the local socio-economic conditions and legal environment by fine-tuning the existing method. The used assessment method should correspond to the way we are going to use the survey results. In the case of the current survey, its result render the best outcomes when applied for analytic purposes, also for creating access improvement programs and monitoring implementation in a flexible, consistent and fluent way.

The user–experience-based assessment tool has demonstrated that it is appropriate for evaluating both the public and the private urban areas and buildings on different scales – from the site planning and functional layout to the design and instalment of interior elements. Involving the extended assessors' group into the assessment process, including people with different disabilities, the elderly and families makes the tool and the process more participatory and more inclusive, with more reliable and representative results. Therefore, we may suggest this easy-to-use and flexible tool for improving the quality of city management in Vilnius and in Singapore and in many other urban communities.

The wider question of what is a good access and what is an unacceptable one arises. Definitely, the objects that have several non-accessible assessment scores (0–4) and an overall negative result (<0) are seriously compromising their usability and comfort by multiple barriers and should urgently generate access improvement programs by using the particular scoring data from this research for replanning and redesign. However, monitoring access progress is an important task for the local authorities that take care of the quality of the public environment and of public buildings.

The used accessibility assessment method contributes to the wider attempts to improve the overall problems of urban environment quality (noise, pollution, climate, etc.). It also contributes to creating a higher value for the built urban spaces and buildings by addressing the issues of enhanced personal safety and security, satisfaction and pleasure for the users. All these measures improve the quality of public spaces and buildings, and by that, contribute to creating better livable cities.

Simultaneously with the recommendations for improving the urban environment and buildings, the question of legal regulation should be constantly looked at. It is evident from the results of research (see Fig. 7) that the urban planning segment needs more attentive regulation in the accessibility aspect from the national and European authorities. Besides the regulation, the professional guidebooks might also contribute to the continuous professional development of architects, city planners, landscape architects, building engineers and city managers.

The more general lessons learnt from this research show that even a single non-accessible element in urban space or in a building could critically prevent people from getting through the space or into the building. This means that every aspect assessed by using this methodology or alternatively the national regulation should be treated as an essential element of space planning or building design, construction and use including refurbishment and renovation. The aesthetical quality of accessible design that architects and designers apply is still problematic as it lacks intuitive logic and artistic quality. Frequently designed elements pop out of the whole project or building by that over-emphasize and exclude accessible space elements as ramps or handrail from the overall architectural style. Architects should more boldly take on the challenges of accessibility and turn them into the outstanding architectural projects. The methodology that we tested in this case for the monitoring efficiency allows adhering to the functional, ergonomic and use requirements that are universal and usual for all citizens.

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IMAGE SOURCES

Fig. cover: picture by the author. Vilnius. Lituania

Fig. 1: Traditional flow from personal impairment to disability. Own elaboration.

Fig. 2: The sequence of managing disability in barrier-full (top) and accessible barrier-free (bottom) environments. Own elaboration.

Fig. 3: The scores for assessed value levels of the environment elements and buildings. Own elaboration.

Fig. 4: Assessor's team composition represent the array of physical and social condition, gender, occupation and age. Own elaboration.

Fig. 5: Overall assessment results for all objects (1–14 Table 1). Own elaboration.

Fig. 6: Accessibility assessment monitoring 2000–2017. Own elaboration.

Fig. 7: Accessibility assessment for different environment segments. Own elaboration.

Fig. 8: Accessibility assessment scores for the year of construction of the object. Own elaboration.

Fig. 9: Normalised average assessment by different assessors (0–1). Own elaboration.

Fig. 10: Assessment averages for all aspects of 7 (MM Hospital in Vilnius City) and 12 (MRT Station in Singapore) objects. Own elaboration.

Fig. 11: Assessment matrix, section The Site, Vilnius City 2017. Good – very good scores are in green highlight, low – very low scores are in red highlight. Own elaboration.

Fig. 12: Assessment of mobility system (a), urban open space (b), metro station (c) and the cafe entrance (d) in Singapore 2012. Pictures by the author.

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RE-SEWING THE URBAN PERIPHERY.

A GREEN STRATEGY FOR FONTIVEGGE DISTRICT IN PERUGIA

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ABSTRACT

The present study debates on the issue of urban regeneration in contemporary cities, adopting a strategic vision which includes the use of vegetation and green infrastructure to create a network of public spaces. Especially, urban periphery lacks of public spaces, meaning a public use of urban space for outdoor activities and social networks.

The extraordinary program for the Italian peripheries, addressed to all the metropolitan cities and provincial capitals in 2016, inspired to Renzo Piano idea of "re-sewing" urban fabrics, has been a good opportunity for testing new approaches to urban regeneration. The case study investigated in this study is the financed project for the city of Perugia, which provides different interventions aimed at improving (and developing new) public spaces through vegetation enhancement and a large area destined to vegetable social gardens as a strategy for urban infill. By recovering public spaces with social purpose and providing a comprehensive strategy for aesthetic improvement of the city, the case study provides a representative example, how greening the city may promote together biodiversity conservation and urban regeneration.

KEYWORDS:

Urban Regeneration; Urban Periphery; Urban Infill; Public Spaces; Green Infrastructure.

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重新部署城市周边。

佩鲁贾地区的绿色战略

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摘要

本研究就当代城市的再生问题进行了讨论，采用了包括利用植被和绿色基础设施建立公共空间网络的战略愿景。特别是城市周边缺乏公共空间，这意味着公众要利用城市空间进行户外活动和社交网络。
2016 年，Renzo Piano 构想了一项名为“重新部署”城市的非凡计划，针对意大利周边地区的大都会城市和省会城市。这对于检测城市再生的新方法而言是一个很好的机会。本研究调查的案例研究是佩鲁贾市的融资项目，该项目提供不同的干预措施，旨在通过增加植被并将大面积蔬菜园作为城市填充战略来改善（并开发新的）公共空间。　案例研究通过恢复具有社会目的的公共空间并提供优化城市美学的综合战略，提供了一个具有代表性的例子，即城市绿化如何能同时促进生物多样性保护和城市再生。

关键词:
城市再生、城市周边、城市填充、公共空间、绿色基础设施

1 INTRODUCTION

The “Extraordinary program for the requalification of urban peripheries”, including a call for proposal addressed to all the metropolitan cities and provincial capitals, entitled *"Notice to present new proposals for the organisation of the Special Program for an intervention to requalify the urban area and the safety of the suburbs"* (DPCM no.127/2016) is a key opportunity to discuss about Italian urban suburbs and about the possible scenarios for a sustainable path of urban growth (Ahvenniemi & al., 2016). Funding of the extraordinary program was devoted to projects addressing problems in suburbs 'characterized by economic and social marginalization (Secchi, 2013), building degradation and shortage of services' (Petranzan, Neri & Purini, 2005).

The program found its cultural reasons in the concept proposed by senator Renzo Piano about 'urban mending', which undoubtedly goes beyond the theme of rebuilding urban fabrics, by including socioeconomic issues related to urban degradation. The "mending" notion proposed by Renzo Piano also recalls the strategy of urban infill (Iacovantuono & Marcoaldi, 2017) , i.e. densification of urban areas (Bettencourt & West, 2011) through the reuse of existing buildings, the construction of new buildings in empty lots, the creation of green areas and urban parks as green networking systems, the development of public services.

The theme of urban regeneration (de Franciscis, 1997) includes different issues related to the pedestrian use of public spaces (Musco, 2009), livability and urban vitality (Clemente, 2017). New projects for contemporary cities often include new constructions on greenfields, more rarely working to develop interstices of the urban fabric, with zero-scale interventions (Aymonino & Mosco, 2006), based essentially on projects of green areas and green infrastructures. Contemporary cities, after taking full advantage of the urban areas and consumed soil, are rewriting a new pact between architecture and nature, building natural landscapes and green infrastructure, called to mend the tears of the urban fabric, to rebalance ecological and environmental instability (Botzat & al., 2016), to regenerate neighbourhoods bogged down by spontaneous urbanization (Bryant, 2006), to define public spaces and places of life (Chon & al., 2009).

Green Infrastructure (GI), often supported by public funding (Regional, National or European), represent an opportunity for urban regeneration (Moffat & al., 2010). Projects born to rebalance urban metabolism, have shaped structural urban features in contemporary cities, sometimes with a great iconic and representative value. Examples are the New York highway, which has become a famous place frequented by residents and tourists; the system of parks and public spaces along the Madrid Rio, the Rose Fitzgerald Kennedy Greenway of Boston, the Buffalo Bayou Promenade. Planning and building urban gardens within inner cities, according to a reverse process that starts from the bottom, or by involvement of citizens in small local interventions, contributes to the creation of a green network that goes to graft and overlap to the primary network of green infrastructures. These projects have also fostered new social practices and new uses of urban open spaces.

When referring to GI within cities, zero-scale urban redevelopment interventions are essentially based on public investments (Ahern, 1995), contrary to what happened in the construction of modern and contemporary cities, which are primarily developed grounding on private investments to buildable land. With economic crisis negatively impacting local finance, agents have been increasingly required to look at the opportunities offered by European programs. Other possible sources of funding are represented by national or regional calls, which provide resources for local authorities to carry out interventions of urban regeneration.

In this paper, the proposal of the Municipality of Perugia to the “Extraordinary program of requalification of urban periphery” will be presented. The proposal, entering in a shortlist of financeable projects with a request of 16,388,790.60 euros, is foreseen to start in the next months. The proposal is a representative example of multi-target intervention incorporating and trying to solve a series of critical issues, typical of

urban suburbs, even if it addresses the requalification a central area of the city. In this regard, the proposal is grounded on the multifunctional value of GI and Urban Gardens as a strategy for peri-urban regeneration.
By recovering public spaces with social purpose and providing a comprehensive strategy for aesthetic improvement of the city, Perugia case study provides evidence how greening the city may promote together biodiversity conservation and urban regeneration.

2. URBAN REGENERATION PROJECT FOR FONTIVEGGE DISTRICT, PERUGIA

The project elaborated for the metropolitan area of Perugia was drawn up by the Department of Civil and Environmental Engineering of Perugia University and the Municipality of Perugia and refers to the functional reconnection of the two districts of Fontivegge and Bellocchio separated by railways, and the downstream area of the Perugia train station with the rest of the city.
The project area is a central area of Perugia (the directional center and the Piazza del Bacio designed by Aldo Rossi), where, because of to the presence of the railway station, a progressive social disadvantage has been observed in recent times.
What is striking about this area is that the square designed by the famous architect of Italian rationalism, on which the Umbria Region palace stands, has become a place rarely visited by pedestrians, especially at night, and where the absence of attractive activities open to the public, favors phenomena of social degradation. The project is aimed at creating a public space to promote urban vitality of the entire district (Gehl, 2010), becoming an attractor for young people - which is considered a key factor to ensure urban security (Jacobs, 1961). Urban redesign proposed in the abovementioned project aims at promoting pedestrian accessibility, with a square that gradually descends towards the entrance of the underpass, placing pedestrian and cycle flows at the centre of the scene.
The proposal considers Piazza del Bacio and the large driveway in front of the station, which has the configuration of a large road junction, in an wider vision, that functionally relates the green area behind the upstream square and the district "Bellocchio" on the other side of the railway.
In details, the proposal consists of a series of strictly integrated and easily implemented punctual interventions to improve quality of public buildings (including a library, a new neighborhood center, and the progressive redevelopment of green spaces functioning as a link between the surrounding places), and a series of "widespread" interventions (video surveillance, public lighting, in addition to those of a social nature mainly intended for young people), aimed at improving the level of living in the area. Particularly, it is planned to replace a building currently hosting a commercial centre with a large gym building, and to build a skate park in the opposite area overlooking the square.
The most interesting aspect of the proposal is the theme of the "green infrastructure", which re-incorporate the neighboring green areas, with public spaces in front of the railway area and the natural areas beyond it.
In addition to this green infrastructure, a large area dedicated to Urban Gardens has been planned. Developing this area, could give Perugia a primacy among Italian cities due to the high number of gardens (more than 400) and the central position in the city.
The intervention in the ecological parks gives more value to the area, promoting a coordinated process of improvement of user services and spaces. The main operational activities increase the existing vegetation, especially with the use of crops, and involve the construction of urban gardens for local communities with the aim to stimulate place re-appropriation and social wellbeing. Valorization of soft mobility will be implemented through the tarmac repainting of all the areas that are all divided and yet connected in a network model functional for the discover.
A specific color dominates the interventions of redevelopment, materializing in the printed tarmac according to specific surveys carried out with the support of construction/architectural engineering students.

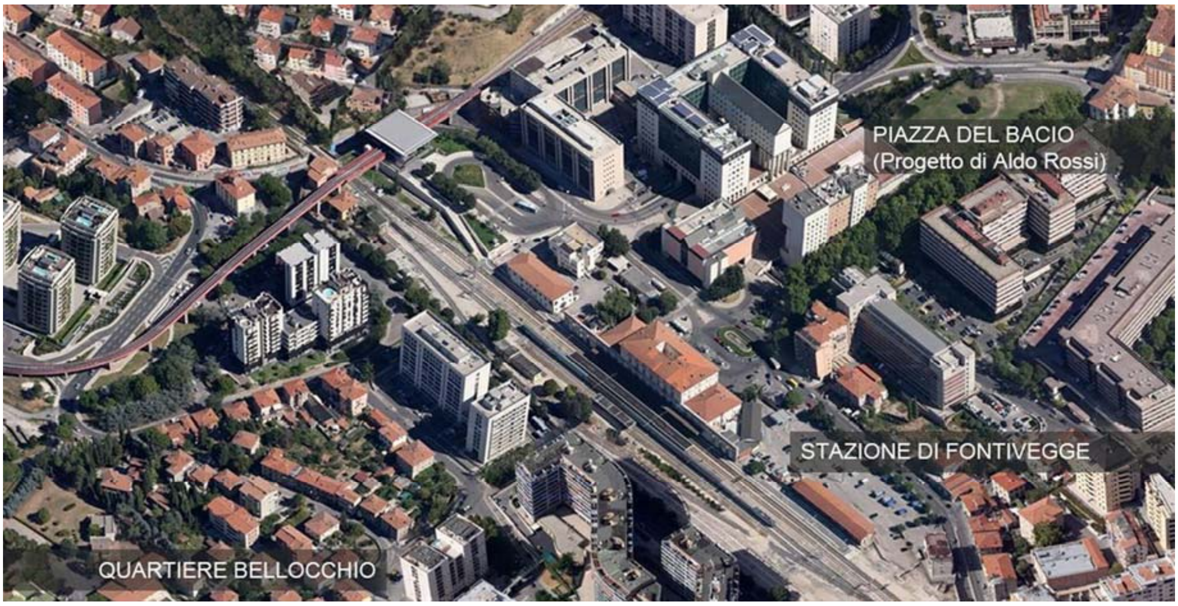

Fig. 1 View of the area project of Fontivegge Ditrict in Perugia

Paths will be enriched with naturalness chromatism to create a fundamental "edible landscape" and strengthen connective value of the ecological redesign. In this regard, the project encourages spontaneous naturalization processes, redefining relationships between vegetation and local communities. The pedestrian network now becomes functional to the green infrastructure system and the polarity of the parks, which at the same time are organically functional to the system for pedestrian and bicycle paths that unfold inside them.

The Green Infrastructure Project is treated as a multifunctional strategy (European Commission, 2012) that combines the idea of increasing habitat and connectivity to native flora and fauna, as well as cyclo-pedonal fruition of the area (Brown & al., 2005). The design of urban gardens has also been dealt with an innovative way of "Biodiverse" gardens, where human disturbance does not eradicate native wild species from the garden, but tries to manage the process of functional terms of ecosystem biodiversity. In particular, buffer zones with spontaneous herbaceous species and hedges (always native species, typical of native claddings) are planned, as well as the use of horticultural and officinal species for increasing pollinating insects. Such infrastructures, in their flowering and fruiting cycle, can take on an appealing centrality for the colors, flavors and smells that characterize them.

The project’s hypothesis is that through the upgrade of green infrastructure if possible to recovery man-made spaces, bringing citizens at the centre of the interventions (European Environmental Agency, 2011).

3. DISCUSSION

The proposal developed for the area of Fontivegge in Perugia is essentially based on a project of public space and a green infrastructure, with the function of urban reconnection, including a large area destined to urban gardens. These interventions will reinforce the pedestrian flows towards the Piazza del Bacio and towards Piazza Vittorio Veneto in front of the station, creating a vibrant urban environment that can be experienced at all hours of the day.

The abovementioned strategy, that can be appealed to a "pervasion of the Green", aims to promote a re-appropriating of urban places stimulating identity. Identity-making become compliant characteristics to achieve innovative management solutions based on participatory planning, public engagement and social cohesion, in order to ensure long-term sustainability of interventions (Farina, 2000).

The project for the area of Fontivegge leads to more general reflections on the role of green infrastructures and urban gardens to regenerate urban space, opening up new possibilities for the recovery of urban suburbs. The following sections debates on the latent relationship between both interventions and urban regeneration.

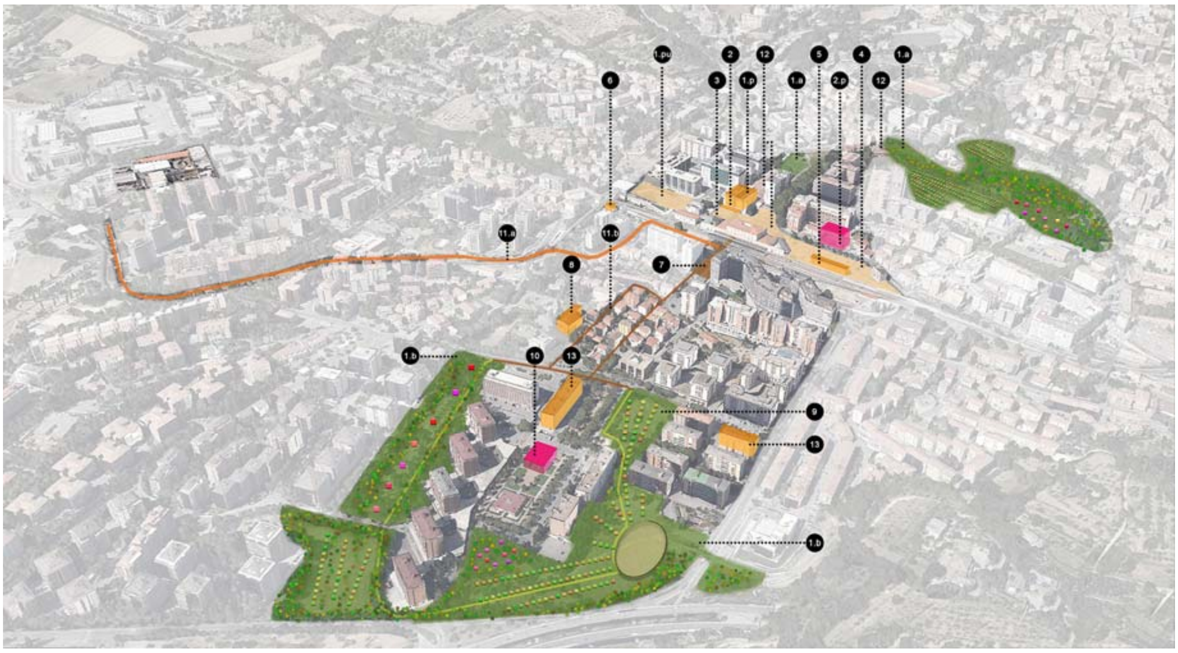

Fig. 2 Masterplan of the whole area, including Bellocchio District and Piazza del Bacio disconnected by the railway station. The drawing highlighs the public spaces and the green strategy.

3.1. THE RULE OF GREEN INFRASTRUCTURE IN THE CONTEMPORARY CITY

Green Infrastructure 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" (Benedict & al., 2002).

Aspects related to ecological functionality and landscape connectivity play a role in ensuring the normal functioning of ecosystems, and this is essential for providing ecosystem services such as food air quality, carbon sequestration, flood management, water treatment, local climate conditions (Inostroza L., 2014), and soil erosion prevention (European Commission, 2010; Whitford & al., 2001). The European Union has issued directives supported by documents aimed at developing Green Infrastructures in Europe within the overall EU 2020 Biodiversity Strategy to achieve requalification of degraded ecosystems by 2020. Taken together, the main objectives of a GI include (i) promotion of ecosystem health and resilience, (ii) biodiversity conservation and maintenance of ecosystem services (Naumann & al., 2011) (iii) improvement of life quality (La Rocca, 2011), based on the multifunctional use of natural capital (European Commission, 2012).

The EU Working Group on GI strategy has proposed that GI also promotes integrated spatial planning identifying multi-functional zones and incorporating habitat restoration measures into land-use plans and policies (GI Working Group Task 1 Recommendations, 2011). Ultimately, GI contributes to a more sustainable economy based on healthy ecosystems delivering multiple benefits and functions.

At the local scale, GI may benefit from small green patches in urban and peri-urban areas, improving landscape connection. Urban greening include practices of urban forestry, agriculture, farming and gardening, together with the recovery of abandoned urban spaces and peri-urban voids.

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). They 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 socioeconomic conditions. The resilience to hostile climatic conditions, in fact, is closely linked to the level of biodiversity, and the preservation of traditional varieties.

As the Perugia project clearly suggests, an important role that green infrastructures play in the urban arena is supporting human activities in public spaces. Mitigation of climate change, biodiversity and environmental re-qualification provide justify the relevance of green infrastructures shaping new urban functions and new opportunities for enjoying public space in contact with nature. In their multifunctional dimension, new pedestrian pathways become attractive for private investors, local stakeholders, who can engage in the same recreational and commercial activities that contribute to making the urban environment vital and attractive.

Fig. 3 View of the park “Vittime della Foibe”

A combined action of top-level governance and active community participation, becomes a strategy for retrieving abandoned areas, refurbishing neighborhoods and revitalizing parts of degraded cities, involving planning authorities and policy makers with responsibilities ranging from the local to the European level (Bassoli & al., 2011).

The Green Infrastructure project assumes the value of urban regeneration (Giovinazzi & Giovinazzi, 2010), or a strategy for improving the quality of life of citizens in terms of "smart city". The bottom-up action of Urban Gardens project moves towards the same goal. They fit into urban voids or in public green areas without maintenance, becoming a strategy for retraining degraded or abandoned urban areas, improving the quality of life of local communities, in terms of “resilient city”.

3.2. THE SOCIAL DIMENSION OF URBAN GARDENS

Urban gardens can be understood as tools to stimulate the persistence of citizens in the urban context, to support sociality and participation, to promote opportunities for meeting, cohesion (European Environmental Agency, 2011), and for the creation of informal exchange and help networks.

Fig. 4 View of the park including the urban gardens

Recovered urban voids converted into green areas can become real social spaces where they can meet people from different social and age groups. For aging people, they constitute an opportunity of aggregation and participation: they exchange ideas and opinions, rediscovering new forms of sociality and relationship among citizens (Kim & Kaplan, 2004).

There is also an increase in the number of gardens for educational activities into the schools, the vegetable gardens in prisons (for reintegration into the workplace of the prisoners); gardens with a rehabilitation function such as those for orthotherapy, gardening and horticulture activities to support rehabilitation programs for people with disabilities. The therapeutic function of horticulture correlates with the theory of taking care of a living organism as a plant, improves self-esteem and helps the patient regain an active role in society and promotes reintegration into a group.

In this regard, the Perugia project indicates how urban gardens may represent a great opportunity for Municipal Administrations to recover abandoned and degraded areas, making them ordered and productive, and fostering public participation in the activity of local government (Mabellis & Maksymiuk, 2009).

Implementing Urban Gardens has a positive effect on the state of local biodiversity, encouraging changes in social behaviour, toward more awareness to the central role of land management practices reducing/absorbing emissions through a network of urban green spaces.

Realizing vegetable social gardens in urban areas finally strengthens the sense of community and re-occupation of the site, strengthens ties through actions voluntarily supported by society and contributes to counteract exclusion and social isolation (Magnaghi, 2009).

By linking territories to local communities, environmental awareness of citizens may increase, preserving "common goods" through self-management processes of public spaces, to fulfill the increasing social demand for "landscape" (Recanatesi & al., 2016), contributing to sustainable urban form (Pili et al., 2017) and determining an overall aesthetic improvement of green cities and suburbs (Colantoni & al., 2015).

Fig. 5 Masterplan and view of "Parco della Pescaia"

4. CONCLUSIONS

Green infrastructure and Urban Gardens have been conceived in multi-level and innovative ways by new tools made available to administrators and citizens.

The Perugia project demonstrates that (re)designing green spaces and green infrastructure as a support system for human activities can revitalize public spaces, encouraging their use by citizens.

The project foresee to develop, test and verify a systemic approach connecting urban green spaces through a network of Biodiverse Urban Gardens suited to preserve biodiversity and native crops in urban environments. The proposal will act with a bottom-up approach with actions dedicated to the relationship between urban gardens and citizenships, considering different functions in an integrated way: the ecological function, the bio-ecological connection, the social dimension and the urban regeneration strategy.

Urban gardens finally represent an interesting model of collaboration between public and private spheres. Compared to the traditional notion of Green Infrastructure, which should be planned from above and implemented through public funding, urban gardens form a biodiversity network and have the same social effects through micro-interventions by involving citizens in the management and maintenance of green spaces, possibly saving public resources.

The design experiences analyzed here clearly outline the intimate differences between Green Infrastructure and Urban Gardens; in the first case, large-scale unit projects are foreseen, with major investments by public administrations; in the second case, small local projects can be realized with the involvement of small, networked communities, with restricted public investments. Green infrastructure units consider the city in terms of "smart city", while the most widespread and interstitial interventions of Urban Gardens seem to be a "resilient strategy", with even more significant social implications.

Using a strategy in line with the European Biodiversity Guidelines can implement and activate urban regeneration processes and enhancing local territories at the same time.

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IMAGE SOURCES

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AN ANALYTICAL TOOL TO SUPPORT THE PEDESTRIANISATION PROCESS

THE CASE OF VIA ROMA, CAGLIARI

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ABSTRACT

The article focuses on the case of the modification of an urban road network: the transformation of a portion of an important distributor road in the urban area of Cagliari into a pedestrian space. By means of this case study the article aims to point out how the conditions of hierarchy constitute a supporting tool for controlling and verifying the project of pedestrianisation. This analysis uses the fundamental conditions of hierarchy as a tool to assess to what extent the modification of the road network articulation has resulted in conditions of lesser inter-connectivity, legibility and functionality.
This analysis evidences that pedestrianisation interventions have not been completely defined within a theoretical system that clearly establishes modes and conditions of implementation. In this perspective the article proposes a system of criteria, founded on the principles of hierarchy, meant to be a theoretical support for processes of pedestrianisation.

KEYWORDS:
Hierarchy, arteriality, constitution, configuration, network.

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支持行人专用区进程的分析工具罗马

卡利亚里案例

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摘要

本文聚焦在城市道路网络改造的案例：将卡利亚里市区的重要干路的一部分改造为步行空间。通过对这一案例的研究，本文旨在指出层次结构条件是如何为控制与证实行人专用区项目构成一个支持工具。本分析使用了层次结构的基本条件作为一个工具来评估道路网连接的改造在多大程度上能够导致连接性、易可识别性与功能性降低的条件。
分析表明行人专用区干预在明确建立实施方式与条件的理论体系中未能被完全界定。从这个角度来看，本文提出了一个建立在层次结构原则之上的标准体系，旨在为行人专用区进程提供一个理论支持。

关键词：
层次结构，干路（干道），构造（章程），结构（布局
网络

1 INTRODUCTION

Contemporaneity is denoted by the rediscovery of the porous character of territories, that urges the research of different modes of interpreting, conceptualising and organising mobility networks (Secchi, 2005). The isotropic structure of environmental networks, of cycling and pedestrian paths, open spaces and mass transport, is regarded as the foundation of a porous and permeable configuration of territories; this spatial organization is the condition for redistributing the spatial capital, increasing resilience of urbanised territories, restoring continuity between different ecological systems and increasing the plurality of modes of practicing spaces. (Alexander et al., 1977; La Cecla 2014; Jacobs, 1961; Gehl, 1987; Salingaros, 2005; Secchi, 2013). In this last instance, particularly, are encompassed the modification of the relationships with one's own body and space (Secchi, 2000), the transformation of leisure time (Donini, 2008; Magris, 2005), the rediscovery of the significance of usual local-scale practices as opportunities for encounters generative of original identities, codes, ideas (BenjaminElliott, 2011, Jacobs, 1961; Alexander et al., 1977; Gehl, 198791; Salingaros, 2005a;b; Tonucci, 2005; Secchi, 20142013; La Cecla, 20152014, Tiboni & Rossetti, 2012).
A question emerges, related to the discontinuities determined by the primary distribution networks – and by their constitutive discrete elements (Secchi 2005, 20142013, Bianchetti 2014). This question meets the criticism to some figures on which the network articulation is based and the search for alternative metaphors and paradigms (Ventura 1989, Magnani & Val 1989; Magnani, 2005, Viganò 2010). As a consequence, an instance of domestication of main transport infrastructures arises: it often results in transformation policies of large mobility spaces routes – or of portions of these – into multi-functional pedestrian spaces.
When these interventions modify the hierarchies on which road patterns and relations between different modes of movement are established, they lead to conditions of lesser functionality of transport networks: pedestrianisation strategies have not been fully defined within a coherent theoretical system meant to establish fundamental criteria, conditions and modalities of implementation.
This article presents and analyses the case study of the partial pedestrianization of an urban arterial road, in Cagliari. This analysis points out how hierarchy is a fundamental condition of some desired structural properties of transportation networks: coherence, legibility, inter-connectivity of road patterns, and safety and fluidity of circulation (Jiang, 2009; Marshall, 2005; 20142016; Salingaros, 2005; Xie & Levinson, 2007; Yerra & Levinson, 2005). Moreover, it infers, from the structural conditions of hierarchy, a qualitative method for control and appraisal of the project of pedestrianisation from the structural conditions of hierarchy.
The article consists of four sections; the first one introduces the case study and describes trans-scalar transformations induced on the mobility network by the partial pedestrianization of via Roma. These transformations are thus attributed to alterations in the hierarchical structure of interdependent and non-discursive (Hillier, 1996) relations between different routes. The second section, thus, defines the notion of hierarchy, related to transport networks, and identifies its fundamental conditions; the purpose is to show evidence that hierarchy is the condition of some desirable networks structure properties. The subsequent section identifies the cause of the discontinuity of minor networks; it proposes a hierarchy of modes of movement, based on speed bands, as a criterion for defining the relationships between different modes of interaction simultaneously present along a route. The fourth section describes a qualitative analytical method, based on the conditions of the hierarchy, and describes its application to the case study. The conclusions reflect on the findings of the previous sections and consider their potential as criteria for the definition and implementation of regeneration actions in road networks links.

2 HIERARCHY

As stated by Marshall (2005), in order to define hierarchy, a preliminary consideration concerning the distinction between the different dimensions of structures is required: *composition*, which refers to the metric

characteristics of a system; *configuration*, related to its topology; and *constitution*, which identifies distinct types of elements and determines their relations of interdependence. This distinction results in the definition of hierarchy as a structure of types (Marshall, 2005) and, more precisely, as a particular form of constitution, identified by four specific structural conditions: 1) differentiation of components; 2) ordered ranking of elements; 3), arteriality or necessary connections and 4) access constraint that restricts admissible connections only to those established between elements of the same type or complementary, i.e. whose rank diverges of just one position (or degree). Arteriality, in particular, is a fundamental feature of road networks: the contiguity of routes that constitute strategic itineraries at a specific level of scale. Thus, a network could be conceptualized as a structure of contiguous and complete sub-networks of different scales. Arteriality is the implicit fundament of any relevant functional classification of roads, since it is a category by which the specific function of each arc can be recognised in relation to the network, and referred to the dimension of the geographic realm served.
Some measurable properties have been identified to derive the function of each route from the analysis of the network configuration: *cardinality*, determined by observing the conditions of continuity and termination in the nodes of each route (Marshall, 2016), and *betweenness*, that measures the significance of each arc as a bridging element between distinct topological shorter paths (Jiang, 2009).

2.1 FAVOURABLE PROPERTIES OF A NETWORK

A road pattern that satisfies the structural conditions of hierarchy also possesses two fundamental desirable properties of networks (Marshall, 2005; Xie & Levinson, 2007): *legibility* and *inter-connectivity*. These properties are related to the user experience and determine individual behaviors and route choices, whose interaction defines the distribution of flows (Xie & Levinson 2007).
Legibility determines to what extent it is simple to gather the structure of a network. Arteriality and access constraint are fundamental features that allow users to determine their position within the network, according to the status of the route along which they proceed (Marshall, 2005). This condition thus implies the recognisability of the type, hence of the rank, of each route.
Inter-connectivity depends on the number, type and pattern of routes and intersections. Inter-connectivity can be measured as a function of the perceived continuity of movement across a network: this, in turn, is determined by measuring the number of transfers between roads of different classes (Xie & Levinson, 2007): as arteriality implies contiguity of strategic routes, it also ensures continuity of movement within the sub-network of primary distribution, thus resulting in an increased inter-connection of the entire system. However, this formulation of the continuity variable doesn't consider that the crossing of an intersection in case of vehicular mobility - even if between routes of the same class - results per se in an increased path discontinuity, due to the inconvenience associated with variations of speed and direction. Salingaros (2005) observes that, beyond a certain dimension, in an isotropic network of local-scale routes, the number of nodes traversed during a generic trip increases to the point of resulting in a perception of greater discontinuity and of decreased network connectivity. The introduction of larger scale elements and their configuration within a contiguous sub-network result in an increase of inter-connectivity and path continuity. Thus, the requirement of ensuring continuity implies the reduction in the number of accesses to the main routes and the spacing of consecutive intersections: it results in the configuration of arterial roads as discrete elements (Pisano, 2016, 2018) and, as far as vehicular mobility is concerned, in the requirement of ensuring conditions of access constraint.
Levinson and Yerra (2005) also demonstrate how hierarchy is an emerging property of complex systems: an isotropic network tends to modify and self-organize according to a hierarchical constitution. Jiang's analyses (2009) demonstrate the validity of this hypothesis by verifying the power laws informing the distribution of size and frequency of some fundamental variables related to the form or function of the routes in a network: for example, a rank order rule is recognized in the distribution of street length values and the cumulative

distribution of paths connectivity values and betweenness values resembles the 80/20 principle. Likewise, considering the distribution of flows within the road layout of the urban area of Gavle, Jiang concludes that the mobility function of a route descends from its morphology and its structural role within the configuration of the network.

2.2 A HIERARCHY OF MODES OF MOVEMENT

Having defined hierarchy as a specific type of *constitution*, indeed, as a structure of types, it can be concluded that the discontinuity of urbanized territories, pedestrian and cycling paths, and open spaces depends on specific functional and morphological features of types; thus, on parameters selected as a basis for route classification. The discontinuity of minor networks is implicit in conventional route typologies where the system function is derived from the mobility function, according to an imposed inverse relationship between the distribution function and the access function: thus an exclusionary relationship – hence a separation – is introduced between the transit function and any form of minute scale interaction that unfolds within the road space or between roads and buildings. Consequently, cycling and pedestrian surfaces occupy the last tier of the hierarchy and, consistently with the condition of arteriality, they constitute fragmented and discontinuous fabrics, dispersed among arterial routes exclusively designed for vehicular transit. Therefore, the restoration of continuity of territorial structures requires to overcome the inverse relationship between transit function and urban function and to interpret them as distinct but compatible dimensions of infrastructural spaces; this paradigm shift results in the possibility of conceptualizing strategic routes as multi-modal and multi-functional spaces; it is also consistent with the definition of route types in constitutional terms, according to the principle of arteriality.

The fundamental question arising from this first conclusion concerns the definition of the conditions within which different modes of movement can coexist in the same road section. This question can be expressed in terms of determination of admissible connections between elements of a hierarchy: the speed differential is considered as the most relevant criterion for determining the degree of separation between distinct modes of movement (Marshall, 2005). Thus, speed is identified as the parameter for a modal hierarchy; according to this, consistently with the principle of *access constraint*, the conditions of contiguity and separation between different modes of transport and their relative surfaces are determined. Moreover, these conditions are a criterion for establishing admissible connections between roads engaged by different modes of movement. Adherence to this criterion is a fundamental condition for ensuring fluidity and safety of circulation, as it implies a substantial reduction of conflicts among modes of movement characterized by significantly different speeds. In addition, since the categories of traffic admitted along a road depend on its function within the transport network, the degree of separation among surfaces intended for specific modes of movement constitutes a morphological parameter that determines the consistency between the typological definition of a route and its geometry. This coherence is implicit in the first principle of hierarchy: the distinction of components. The formalisation of these concepts as criteria of a tool for preliminary evaluation of transformation of the network structure constitutes the object of the research discussed here. In the following paragraphs authors present the methodology and the case study (the city of Cagliari).

3 METHODOLOGY

This section, based on findings summarised in previous sections, proposes a qualitative method founded on the structural conditions of hierarchy and explores its application as a tool for verifying whether the transformations of arterial routes into pedestrian spaces alter the functionality of mobility networks. This approach reflects the need of managing the road space at a network level (Jones, 2017). The analysis requiresfirst step is to reconstruct the configuration of the considered portion of the road layout: The Open Street Map database is selected as a fundamental, independent and available source of data (Almendros-

Jiménez et al. 2017; Jiang & Okabe, 2014) for reconstructing the configuration of the road layout. Then the road layout is represented as a route structure (Marshall, 2005, 2016). and a qualitative evaluation of its constitutional properties is developed. Moreover, in the OpenStreetMap database some types are defined according to several parameters and express the different dimensions of a road space: for example, the land uses along margins. These denominations specify the fundamental definition related to the significance of the route within the network. Nevertheless, these denominations have been rejected when implying an inverse relationship between distribution function and access function and, generally, between the transit status and the place status of a route.

Moreover, the proposed analytic method does not consider the principle of arteriality as an explicit criterion: the adherence of the network to this condition is implicit in the typological definition of each arc, classified according to the principle of arteriality, precisely because topologically contiguous within a complete and continuous sub-network that encompasses a specific geographic area. Consequently, only the conditions of *access constraint* and *differentiation of components* are individuated as pertinent parameters. The first condition is verified if non-complementary routes, attributable to types whose ranks differ of more than one position, do not connect contiguously. The second condition is verified if the morphological characters of an element are appropriate to its system function. The variable considered is the degree of separation between lanes and surfaces serving different uses or modes of movement, classified according to their speed values. Therefore, with reference to the categories identified in Table 1, three conditions are imposed: 1) modes of movement attributable to the same class can be accommodated by the same lane; 2) modes of movement of different ranks unfold along contiguous lanes if, among their coded types, there is a rank difference equal to or less than one integer value (S3 and S2); 3) if the difference between their relative coded types exceeds one integer value, the different modes of movement are segregated, each one within a confined surface, or within surfaces separated by lanes intended for intermediate-tier movement modes.

CATEGORY	SPEED BAND	MODES OF MOVEMENT
S5	Very high speed	Train, fast motor movement on motorway, busway, etc.
S4	High speed	The highest speed for a carriageway associated with a footway or urban street
S3.5	Medium-high speed	Medium-high speed motor transport movement
S3	Medium speed	Medium speed motor transport movement
S2.5	Medium-slow	Running; cycling; medium-slow motor movement
S2	Slow	Jogging; slow cycling or very slow motor movement
S1.5	Very slow	Walking pace; cycling or parking at walking pace
S1	Walking speed	Slow walking pace

Table 1. Stratification by speed; (Marshall, 2005)

4 CASE STUDY

This article is founded on the analysis of a concrete case of modification of an urban road network: the pedestrianisation of a portion of a main distributor in the urban area of Cagliari. Cagliari is the core of the metropolitan ciy of Cagliari constituted by 17 municipalities and its territory is defined by a polycentric structure, in which a complex pattern of relations of communication and social dependence are easily identifiable. Cagliari emerged as an optimal case study because of the concentration of conditions relevant to our studies: 1) the structure of the urbanised region, determined by processes of dispersion of residential and productive functions along main transportation corridors; 2) the concentration of metropolitan-scale services (educational, cultural, social) and of administrative functions in the compact city; 3) a transport system mainly

reliant on the road network; 4) a strong pressure on arterial distributors and on the network of urban sub-arterial and secondary distributors. Recent surveys measure 164.637 cars entering the urban area of Cagliari in an average week day and 130.336 cars leaving the urban centre (Comune di Cagliari, 2012), on a population of 156.538 residents (Comune di Cagliari, 2017); 5) presence of urban corridors relevant as distributors serving the metropolitan areas and as urban places (Via Roma, Viale Colombo): hence a competition for space arises among different uses and practices; vi) the strong commitment of the local authorities in policies able to foster sustainable modes of transport, including the introduction of a service of bicycle-sharing, sporting events (Cagliari respira – since 2008) and cultural initiatives (Museo in Transito – since 2015), experimentations and promotional campaigns (Zeus - Zero Emission Urban Bus System – Project, started in 2015) and the reorganisation of public open spaces. This last action is articulated in the following interventions: (i) the network extension of lanes reserved for public transport means and of cycling paths; (ii) the pedestrianisation of different areas of Cagliari (such as the Villanova and Marina districts) and of roads (such as the Corso Vittorio Emanuele, starting from 2016), and finally, (iii) the restoration of significant outdoor urban places (such as via Manno, starting from 2017, via Garibaldi, starting from 2015, piazza Garibaldi and piazza San Michele, starting from 2017). These factors result in a particular sensitivity of the context to the implementation of policies not grounded on a solid theoretical framework.
As a result, our research aims at proposing a preliminary analytical tool for the evaluation of hypothesis of modification of the structure of road network, based on the recognition of the relevance of the figure of hierarchy and, thus, on the utilisation of its structural condition as pertinent criteria.

4.1 THE PEDESTRIANISATION PROCESS

Opened in 1883, Via Roma consists of two carriageways – "*Lato Portici*" towards the city and "*Lato Porto*" towards the sea – separated by a central tree-lined promenade and it is delimited by a sequence of buildings opening towards the road space through a passageway. It is one of the main arteries crossing the center of Cagliari: some of the major buildings of the political power, such as the Civic Palace and the Regional Council, aligned along its margins. After the Second World War, via Roma assumed the role of fundamental urban distributor, intensely frequented by pedestrians and engaged by large flows of private vehicles, trolleybuses and buses. Therefore, it emerges the significance of via Roma within the urban structure.
In particular it emerges that Via Roma constitutes a multi-modal and multi-functional space, since it is part of contiguous circuits of strategic itineraries both at the metropolitan and at the district scale**.** Moreover, it is a fundamental arc within the public transport network. This condition is pointed out by the road classification derived from the Open Street Map database; this defines Via Roma *Lato Porto* as a primary road and Via Roma *Lato Portici* as a tertiary route. In recent years, a series of urban policies, in line with European trends, have led to a global requalification of the historic districts of Cagliari as restricted traffic zones and to the pedestrianization of main commercial streets.
The resulting configuration is connoted by the segregation between portions of the urban fabric – contiguous to the core of the compact historic city – connected by two links only: via Roma to the south and Porta Cristina to the northern extremity of the hill of Castello. This partial fracture and the consequent concentration of different flows along Via Roma have led to several proposals for the re-arrangement of the road surface: the re-configurations of the road sections, the concentration of public transport lines within a dedicated carriageway and the transformation of the central promenade into a reserved parking area for the residents of Marina district; these interventions add to the radical hypothesis of removal and confinement of vehicle lanes within entrenchments or tunnels, in order to release Via Roma from urban and metropolitan scale traffic flows. In this context lies the decision taken by the City Council to undertake the temporary pedestrianisation of Via Roma Lato Portici from August, 11 to September, 17, 2017. This experimentation, never conducted

before for such a prolonged period, resulted in numerous variations in traffic circulation and, in particular, in a significant modification of the network configuration.

Fig. 1. Separation between parts of the urban fabric

4.2 ANALYSIS

The transformation of Via Roma *Lato Portici* in a pedestrian space introduces a modification of the road pattern that invests different levels of scale: it determines the overlapping – along the strategic itinerary composed of Via Roma Lato Porto, Viale La Playa and Via Riva di Ponente – between the inter-district/local sub-network and the primary network; moreover routes such as Via Sassari, identifiable as links between the primary and the inter-district subnetworks, evolve into strategic routes within the inter-district sub-network, canalising movement of secondary distribution and penetration towards the primary distributors. As a consequence, Via

Roma *Lato Porto*, Via Riva di Ponente and Viale La Playa – in addition to a function of primary distribution – perform functions of penetration and secondary distribution. Moreover, it is observed, along certain routes, a situation of interference between different modes of movement. For instance, along the first segment of Via Sassari, promiscuity arises between distribution and access of private vehicles, public transport bus access,

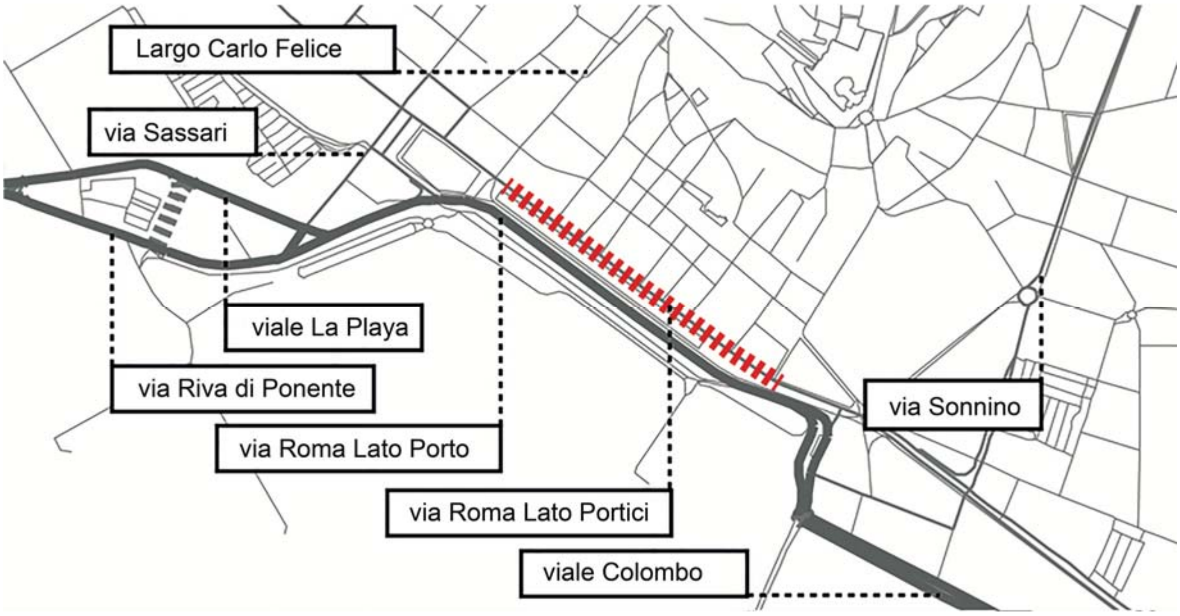

Fig. 2. The pedestrianized arc of via Roma Lato Portici.

parking, and walking. These criticalities, partially pre-existing, are exasperated, in consequence of the pedestrianization intervention, by the concentration, along adjacent routes, of functions of secondary distribution and penetration previously served by via Roma *Lato Portici*. The intervention of pedestrianisation *thus modifies* the link status of adjacent routes (Marshall, 2004; Annunziata & Annunziata, 2015): it increases their significance as bridging elements between two portions of the network strongly connected internally but weakly connected to each other.

Therefore it can be concluded that the transformation of Via Roma affects the fluidity of the circulation, and the legibility of the system. These considerations arise from the situations of congestion observed during the period of the experimentation, at the extremities of Via Roma, particularly in via Sassari, Viale la Playa and Traversa prima La Playa, and admitted by the Municipal Administration (Ansa 2017; Unione Sarda 2017).

As a consequence, it can be observed that the transformation of a single route determines a modification of the structure of the network. Nonetheless, these modifications do not seem to have been adequately considered in the implementation of the intervention of the pedestrianization. In a more general sense, it can be observed that the projects and strategies of transformation of infrastructural spaces – and particularly those regarding the conversion of spaces of mobility in multi-functional pedestrian spaces – lack of adequate predictive tools, meant to support the control and evaluation of trans-scalar effects produced by localized interventions. As a result, an analytic tool is required: this should be founded on a broad comprehension of the network properties engaged by the radical transformation of a road, as in the case of its conversion in a pedestrian space. It can be observed that the intervention proposed for Via Roma Lato Portici seems to engage a complex of interdependent relations constituting the implicit, non-discursive, structure of the network (Hillier, 1996; Cutini, 2017). These relations, as observed by Marshall (2005), constitute the most pertinent basis for a functional classification of roads: "the classification of an individual section of road refers to its relationship with the rest of the network. In other words, this is designation by relation" (Marshall, 2005, p.60): in this perspective, thus, function is intended as network function and not as traffic function; moreover, a classification system founded on the network-function of each road section, constitutes an ordered system that underlines the relative importance and the significance of each element with respect to the network: thus, it defines a hierarchy of roads.

As a consequence, it can be argued that the modification of the status of a road determines the modification of a pattern of relations associated and profoundly connected to the hierarchical organisation of the network; thus, it is by understanding the fundamental properties of hierarchy that a consistent analytic tool can be defined. In the sequent section the authors discuss the application of the proposed qualitative analytic method to the case study.

4.3 CONSIDERATIONS ON THE CASE STUDY

The proposed qualitative method can be regarded as an analytic tool, by means of which to reconstruct alterations in the structure of the road pattern produced by the pedestrianization of via Roma Lato Portici.

The analysis requires to reconstruct the configurational and constitutional properties of the road layout: the network function of each element, hence its type and rank, is derived from the *Open Street Map* database.

The analysis of the road network reveals the existence of three circuits, or rings, that constitute contiguous subsystems of strategic itineraries. Hence, a metropolitan arterial sub-network is identified, consisting of trunk roads and primary distributors and an inner sub-network, contiguous at the scale of the compact urban settlement; these two circuits include the strategic itinerary unfolding along Via Roma (Lato Porto), Via Riva di Ponente and Viale La Playa.

Fig.3. Configuration of the road network and classification of its routes

Then, a contiguous sub-network of secondary and tertiary distributors is identified; this inter-district circuit encompasses Via Roma Lato Portici. This route carries out a local distribution function towards Marina district and it connects to the finest scale district network composed of local streets and pedestrian routes. Applying the proposed analytic method, it can be observed that trans-scalar effects of this intervention, are interpretable as consequences of the modification of the network constitutional properties, that is, of constitutional relations between routes. The partial overlapping between the inter-district network and the metropolitan network – determining the direct conjunction of a tertiary road and of a local road with a primary distributor – implies, in fact, a pattern of connections between routes attributable to different types that does not verify the access constraint condition. Likewise, situations of conflict and interference between different modes of movement and different practices can be interpreted as a pattern of relations between different functions not consistent with the access constraint condition, referred to the proposed modal hierarchy based on speed values.

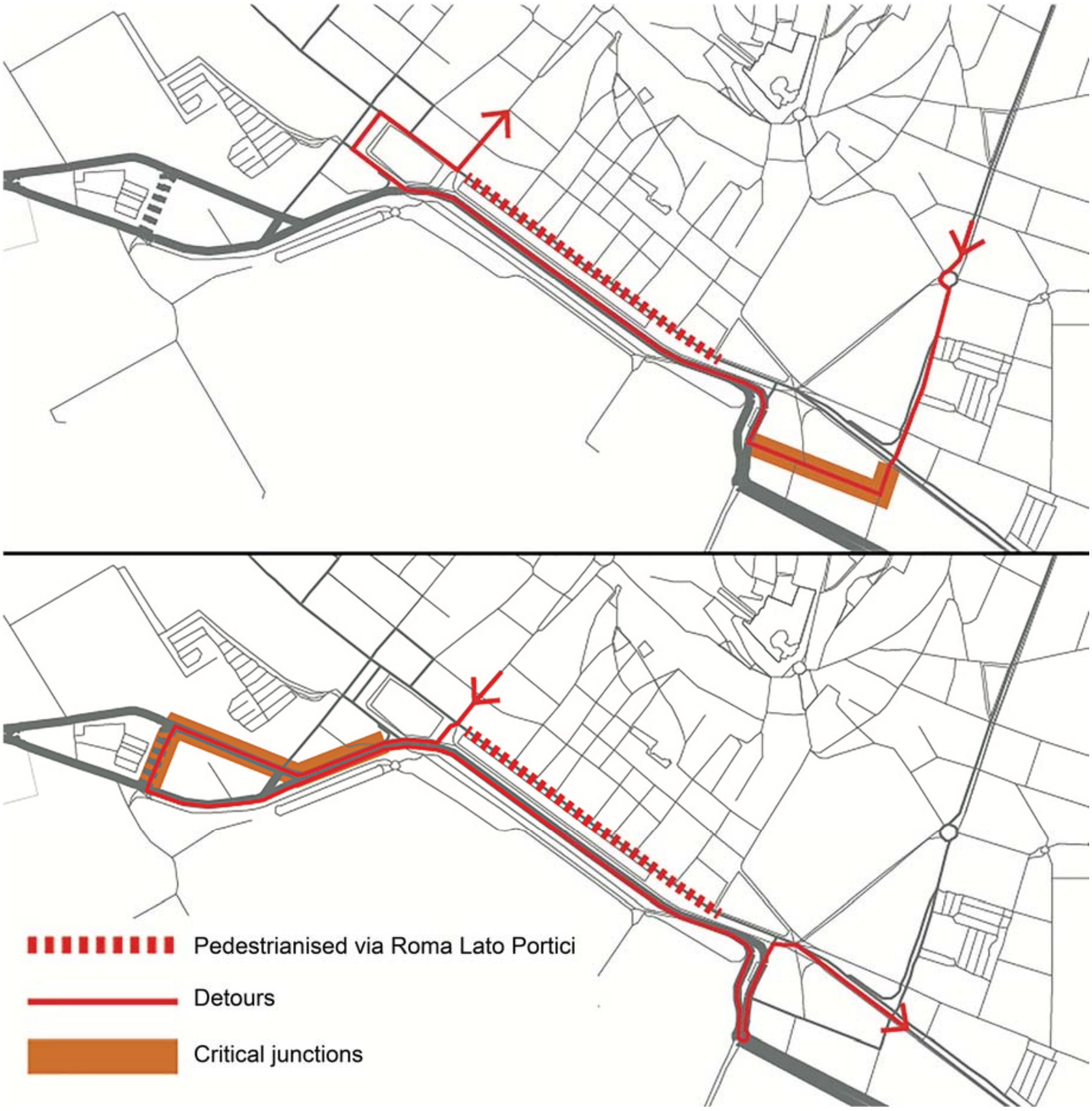

Fig. 4. The Effects of the overlapping between the primary and the inter-districts sub network.

Therefore, the interference, observed along Via Sassari and Viale La Playa, between distribution of vehicular traffic, access function, parking and pedestrian mobility, can be interpreted and described as a condition of contiguity between medium-high speed motor movement (S3) parking at walking pace (S1.5) and slow walking pace (S1), thus as a pattern of direct connections between modes of movement attributable – according to their specific speed bands – to types whose ranks differ of more than one integer. This particular condition results in decreased safety and fluidity of circulation. Moreover, this situation implies the loss of a clear relation between the typological definition of roads, related to their specific function, and the pattern of separation and contiguity relations among surfaces dedicated to different modes of movement: this aspect represents a fundamental morphologic feature of the road space; Therefore, the first principle of hierarchy, the distinction of components, is not satisfied: this results in a lesser recognizability of road types and in a decreased legibility of the network structure. As a consequence, the situations of congestion and the decreased functionality, legibility and coherence of the network, observed during the experimentation period, appear to be interpretable as a consequence of the rupture of the hierarchical properties of the road pattern.

5 CONCLUSIONS

Hierarchy is a fundamental figure for both the analysis and the organization of mobility systems; nonetheless, as it is often interpreted as a generic form of order and identified with particular configurations, it is increasingly invested by a radical critique that prefigures its overcoming (Astolfo & Boano, 2014; Marshall, 2005; Secchi 1989; 2000; Viganò, 2010). Reaffirming the conclusions from previous studies, this article pointed out the distinction between *constitution*, *configuration* and *composition* as different aspects of the same structure, and defined the hierarchy as a specific type of constitution, by investigating its fundamental conditions, referred to road patterns: *distinction of types, rank determination, arteriality* and *access constraint*.

It was then observed how these principles are the condition of certain desirable properties of a transport network, such as *legibility* and *inter-connectivity*. Subsequently, it was noted that the discontinuity of minor networks depends on specific *configurational* and *compositional* features of networks and of infrastructures that constitute the main routes; these aspects are determined by an imposed inverse relationship between the distribution function and the access function. Conversely, the reference to *arteriality* as the most pertinent basis for the functional definition of routes, allows the overcoming of the opposition between mobility and urban place status and the configuration of roads as multi-modal and multi-functional spaces.

Likewise, the condition of *access constraint*, referred to a modal hierarchy based on speed classes, permits to coherently articulate the relationships between various functions along a road. In this way, the fluidity of circulation and the consistency between the typological definition of a route according to its system function and its morphology are guaranteed. From these considerations it emerges the significance of hierarchy as the fundamental condition of a transport network. This case study analysis, conducted by applying a qualitative method based on the conditions of *access constraint* and *distinction of types*, confirms that modifying hierarchical relationships between routes and modes of movement could result in a decrease in functionality of a road network. From these conclusions two alternative strategies emerge:

– the first one, that we could denominate the *recycle strategy*, entails the the modification of the network function of a route and its adjustment or radical transformation, for instance, through its complete pedestrianization. Nonetheless, this strategy requires to verify that the resulting *constitution* of the network still satisfies the conditions of hierarchy, in particular with respect to the principles of *access constraint* and *distinction of types*;

– the second one, referred to as the *healing strategy*, involves the centrality of the *composition* of roads, as the specific aspect to be addressed by interventions of *domestication* of infrastructural elements aimed at restoring the continuity of the territory, increasing its porosity and permeability, and reconstructing and expanding the minute systems of open spaces and of pedestrian and cycling paths.

In this perspective, numerous examples demonstrate the potential of this second strategy as a comprehensive research spacing from corrections of the infrastructure layout to the re-configurations of its transverse and longitudinal sections, from the connection to the soil to the design and organization of margins and residual spaces. Among these examples are La Gran Via de Les Cortes Catalanes designed by Carmen Fiol and Andreu Arriola, Jordi Henrich's Ronda del Mig, the Moll de la Fusta, by Manuel Solà-Morales, in Barcelona; the Atlantic Passeo in Porto, also designed by Manuel de Sola-Morales, and the rest area in Nîmes - Caissargues, designed by Bernard Lassus. It therefore emerges the necessity of the project as a device for investigating strategies that do not alter the function of a route within the mobility system – hence its constitutional and configurational properties – but pursue the integration of different movement functions and practices in the space of the infrastructure, by modifying its compositional features.

6 NOTES

This article is the result of the joint research developed by the two authors on the relationship between network, infrastructure, urbanization and landscape (see Annunziata, Pisano, Annunziata, 2015). In particular, the research on the network properties is mainly attributable to Annunziata, the analysis of the relationship between the network and the urbanized physical space is mainly attributable to Pisano, the methodological construction was jointly developed by Annunziata and Pisano.

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EXPECTATION MANAGEMENT AT THE LOCAL SCALE

LEGAL FAILURE OF PUBLIC PARTICIPATION FOR LARGE URBAN PLANNING PROJECTS

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ABSTRACT

The complex nature of large urban planning projects often results in delays or budget overruns. One of the causes is conflicts of interests between stakeholders. Recent planning failures in projects, due to limited public participation, sparked debates to increase citizen participation in formal planning procedures. This paper investigates how planning law supports public participation in large planning projects that cross municipal borders. The juridical analysis of German and Dutch codified law is based on four elements: literal content, institutional positioning, historical context, and teleological meaning of a legal text. The paper furthermore distinguishes four rationales for participation in planning: support, legitimization, improving plan quality, and education. The analysis shows that these rationales cannot be comprehensively regulated by codified law. Law can enhance the legitimate character of participation, but currently lacks the ability to organize support, improvement of planning, and education at the regional planning level.

KEYWORDS:
Participation; planning law; regional planning; Germany; the Netherlands

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本地范围的期望管理

关于大型城市规划项目之公众参与的法律失败

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摘要

大型城市规划项目的复杂性质往往导致项目延迟或预算超支。原因之一就是利益相关者之间的利益冲突。由于公众参与有限，因此，近期的规划项目失败引发了提高公民参与进正式规划程序的辩论。本文探讨了规划法是如何支持公众参与跨市界的大型规划项目。德国与丹麦成文法律的法理分析是基于四个要素：字面内容（文字内容）、机构职能（制度定位）、历史背景、法律文本的目的意义。本文就参与规划进一步区分为四个理论：支持/资助、合法化、提高规划质量与教育。分析表明，这些理论不能通过成文法律进行全面的规范。法律可以加强参与的合法性，但目前缺乏在区域规划阶段中组织支持/资助、改进规划与教育的能力。

关键词：
参与；规划法；区域规划；德国；荷兰

1 INTRODUCTION

"We planned, it worked" – with this special signboard, the City of Portland proudly announced a successful spatial planning project, which included a downtown plan for retail, parks, transit improvements, and housing efforts. This is worth mentioning, as planning projects often fail to keep within the foreseen time and budget. In particular, large spatial planning projects, such as the renewal of a station area in city centres (Spit & Bertolini, 1998) or the construction of new large infrastructure (e.g. for rail or energy) tend to struggle with time and budget. Moreover, when large urban planning projects reach beyond municipal boundaries in terms of impact and dimension, planning processes are long and dynamic (Dziomba & Matuschewski, 2007; Ibert, 2007). Municipalities have difficulty coping with the complex nature of these projects (Needham, te Raa, Spit, & Zwanikken, 2000). One of the issues that delays projects is conflicts of interests between invested stakeholders. Examples for such planning disasters are the renewal of the main station in Stuttgart, Germany, which raised furious and unexpected protests (Selle, 2011) or the station area in Utrecht, the Netherlands, where public appeals by citizens delayed train and tram facilities for several years. In recent years, there have been claims to include the need for better formal participation procedures in urban planning (Durner, 2011). Public participation in large urban planning projects is criticized as too vague because citizens' actual influence is regarded as limited (Dziomba & Matuschewski, 2007; Enserink & Monnikhof, 2003). This raises discussion on participation and its regulation (Durner, 2011).

Citizen participation is an important element of the spatial planning process (Irvin & Stansbury, 2004, p. 56). Coined as participative planning (Innes & Booher, 2000), the communicative turn in planning (Healey, 1996; Huxley, 2000), or collaborative planning (Innes & Booher 2010) in recent decades, this has become a trend towards more participation and stakeholder involvement in spatial planning (Wegener, 2012). Planning theorists tend to support the idea of more citizen involvement in planning processes (Edelenbos, 2000; Ritter, 2005)—a claim often related to the "ladder of citizen participation" by Arnstein (Arnstein, 1969). It is assumed in the academic debate that as citizen participation increases, the democratic legitimacy of planning increases as well. It is also assumed that it increases the quality of the outcome of planning, or that it creates support for a certain planning process (Hartmann, 2012). Citizen participation is sometimes celebrated as a goal itself in spatial planning (Brownill & Carpenter, 2007b; Dreijerink, Kruize, & van Kamp, 2008; Fagence, 1977; Silver, Scott, & Kazepov, 2010). In planning practice, however, participation often merely becomes "ritual dances" and "window dressing" (Edelenbos, 2000; Wolsink, 2003), where motives and purposes of participation often remain unclear (Hartmann, 2012; Leino & Laine, 2011), and the role and the power of citizens in participatory processes are vague (Donders, Hartmann, & Kokx, 2014). So there is a tension between planning theory on participatory planning and citizen participation in practice. Modes of participatory and collaborative governance that are favoured by planning theory seem not to fit in real world situations, which becomes obvious in large urban projects where citizen participation—or the lack thereof—regularly delays and hinders process and projects.

Planning law formally determines the boundaries and frontiers of urban planning (Stierand, 1993; Yang & Pandey, 2011). Participative governance is often regarded as a realm outside of land use regulations (Dziomba & Matuschewski, 2007; Hartmann & Needham, 2012; Ibert, 2007). Planners tend to pursue different planning objectives when it comes to participation (Albrechts, 2004; Campbell, 1996; Healey, 2002; Needham, 2006; van Straalen, Janssen-Jansen, & van den Brink, 2014). The impact of law on participatory and collaborative governance has often been marginalized or neglected in planning theory (Hartmann & Spit, 2015; Healey, 2003), but the legal perspective provides an understanding of how spatial planning processes function and are embedded in a certain legal context. The general assumption in this paper is that the law is a key systemic variable for the functioning and robustness of participative governance (Hartmann & Needham, 2012). Applying the method of the juridical analysis, this contribution compares two planning laws—the German and the Dutch—and their respective citizen participation, to trace the rationale of participation in planning law. The central question is: to what extent does planning law support public participation beyond municipal boundaries?

In both countries, Germany and the Netherlands, participation is deeply embedded in planning legislation. A commentary on German participation regulations mentions that participation is an instrument for increasing democratic quality by citizen involvement in public decisions. It can also be seen as a process of legitimizing state activity, and serves as a tool to increase information (Battis, 2007). In 2011, the Dutch parliament proclaimed that public participation in spatial planning is of national interest for three reasons: it leads to broader public support, to a better quality of decisions, and to a more democratic process (Tweede Kamer der Staten-Generaal, 2011). The emphasis on participation during large projects in the new Dutch Environment and Spatial Planning Act ('*Omgevingswet*')—to be enacted in 2021—highlights this proclamation by the Dutch parliament. Furthermore, the European Union wants its members to stimulate participation (Directive 2003/35/EC: providing for public participation for the drawing up of certain plans and programmes relating to the environment, 2003). We assume that the general arguments in this paper might be applicable to other countries with codified law as well as to the wider international debate on the relation between participation and regulation.

2 METHODOLOGICAL APPROACH: JURIDICAL ANALYSIS OF PARTICIPATION REGULATIONS

In this paper, codified law in Germany and the Netherlands are taken as starting points to analyse the relation between participation and planning law. In principle, there are two viewpoints when analysing legal texts. The first presumes a legal text to be an imperative itself, inducing a normative impact on the regulated subject through its wording. The second viewpoint perceives a legal text merely as "raw material for the communicative process" (Engberg, 2002), which needs to be contextualized by interpretation in concrete situations. Germany and the Netherlands are examples of the first legal tradition (the latter would be the Anglo-American interpretation). As such, our analysis of codified law aims to reconstruct the intention of a legislator (Stelmach & Brożek, 2011). Von Savigny developed a method of juridical analysis of codified law (Ifsen, 2004) using four elements: literal content, institutional positioning, historical context, and teleological meaning of a legal text (Stelmach & Brożek, 2011). This methodological approach is applied in this paper to German and Dutch planning law concerning citizen participation.

Our analysis is based on land use regulation, the German Federal Building Code (*Baugesetzbuch, BauGB*) and the Dutch Spatial Planning Act (*Wet Ruimtelijke Ordening*, Wro). It is important to note that German and Dutch planning laws only determine procedural aspects of participation. The *BauGB* and the *Wro* both emphasize early-stage participation and a display of the formal plan at the municipal level. The regulations are quite elaborate and sophisticated for the display of land-use plans, but both leave some scope for the specific realization of early-stage participation. We have analysed the legal texts and the official parliamentary explanations (German *Drucksache* and Dutch *nota van toelichting*, and its commentaries of both the *BauGB* and *Wro*). Furthermore, we have studied related and constitutional law of both countries (German constitutional law: *Grundgesetz,* German Regional Planning Act: *Raumordnungsgesetz (ROG),* Dutch General law on administration: *Algemene Wet Bestuursrecht,* and Dutch decree on regional planning: *Besluit Ruimtelijke Ordening*). This analysis is complemented by secondary data from other studies and an extensive literature review.

3 JURIDICAL ANALYSIS: PARTICIPATION IN GERMAN AND DUTCH PLANNING LAW

The juridical analysis consists of four steps. Accordingly, the first of the following four sections focuses on the content of the regulations for participation in land-use planning in Germany and the Netherlands. The second analyses the institutional positioning of the regulations: what are the superior laws and what is the position of the regulations? Third, the historic development of participation regulations will be elaborated upon by contextualizing the law within the political debate. Fourth and finally, we will look for the teleological meaning of the regulations. This implies that we want to identify the legislator's intended purpose to recognize gaps between intentions and their realization. These four steps will help conclude how the law constrains or supports participation in large spatial planning projects. In each step, the two countries are addressed individually.

3.1 THE LITERAL CONTENT

GERMANY

In Germany the Federal Building Code (*Baugesetzbuch*, *BauGB*) is the most important law for municipal land-use planning. Municipal land-use planning is the central and most important instrument of spatial planning (besides regional planning) (Krautzberger, 2007). The Federal Building Code demands that municipal bodies regulate land use within their administrative territory; the municipality may not plan beyond this territory (Krautzberger, 2007). Besides the Federal Building Code, the Regional Planning Act (*Raumordnungsgesetz, ROG*) regulates spatial planning above the municipal level.

Section 3 of the Federal Building Code (BauGB) contains the most important regulations for participation procedures in German land-use plan procedures. German spatial planning law distinguishes here between early-stage participation and the plan display. Early-stage participation is open to the "general public" (Pahl-Weber & Henckel, 2008).

Nobody may be excluded from this early-stage participation (Berghäuser & Berghäuser, 2009). The text of the law also implies that this formal participation step needs to be taken in early phases of the project to create an opportunity to seriously take alternatives into consideration (Braam, 1999) and to incorporate hitherto neglected or overlooked arguments, facts, and ideas in the planning process (Bergäuser & Berghäuser, 2009).

The display of the draft plan ('Planauslegung') serves to collect recommendations for and objections to the plan (Pahl-Weber & Henckel, 2008). It is an independent and free-standing procedural step in the planning process (Battis, 2007). It is not so open in terms of both content and citizen participation. Section 3.2 BauGB determines that the display of the plan needs to be announced in a customary manner in the municipality. This formulation was intended as a minimum requirement for the announcement, but it also implies that it is not necessary to include citizens beyond the municipal boundaries in the participation process. Every citizen who puts forth a comment, proposal, or objection for or against a plan is entitled to an individual response. Only when more than 50 similar comments have been handed in, will the municipality respond with a public announcement of their answers (Battis, Krautzberger, & Löhr, 1997). This regulation is quite relevant for large projects because in such cases, the total of 50 comments is easily exceeded. In contrast to the early-stage participation, the plan display is quite strongly predetermined by law.

Yet, certain large projects may not fall under the regulations of the BauGB, but rather under the ROG—the Regional Planning Act. In general, the Regional Planning Act is not binding for individuals, but only for administration. An exception is the '*Raumordnungsverfahren'*, according to Article 15 of the law. It describes a special planning procedure for large projects.

This means that not all large projects require such a special planning procedure, but only projects that are relevant beyond municipal boundaries or have a supra-local impact. At a first glance, public participation on the regional level has many similarities with the municipal planning, but an important difference is that on the regional level there is no early-stage participation, only a single-step procedure for public participation (Spannowsky et al. 2010). In addition, participation as regulated in the Regional Planning Act is not obligatory, but a "can" regulation. Planning authorities may decide if, when, and to what extent the general public will be involved.

THE NETHERLANDS

The most relevant Dutch law on participation in land-use planning is the "Wet ruimtelijke ordening" (Wro) from 2008, which replaced the WRO (in capital letters) (van der Schoot, 2011). The new Wro aims at strengthening decisions at the local level, deregulation, and accelerating planning procedures (Kamphorst, Pleijte M., Kistenhas, & Kersten, 2008). Accordingly, it provides more flexible and more open planning processes (Kamphorst et al.), which strengthens the citizens' role (Tweede Kamer der Staten-Generaal, 2007, p. 14). Like the German BauGB, the Dutch Wro is a national-level law. Only the constitution and treaties or other international rules are superior (Taekema et al., 2011).

The Wro prescribes the procedure for the land-use plans (bestemmingsplannen) in which the first and last phases are relevant: the first is a fairly open participation process, similar to the German early-stage participation, and the last is the plan display ('terinzagelegging'), which is an opportunity to raise final objections. Besides binding land-use plans, the Dutch planning system under the Wro also prescribes 'structuurvisies'. These are strategic plans on the national, regional, and municipal level, which are only self-binding for the respective authority. For participation procedures, the Wro offers no binding regulations (van der Schoot, 2011, p. 57). The Wro is the most important planning law in the Netherlands (Faludi, 2000). The 'Algemene Wet Bestuursrecht' (AWB) (the general law for the actions of public administration) and the 'Besluit ruimtelijke ordening' (Bro) (spatial planning decree) specify the regulations laid out in the Wro. The Bro prescribes the details of the announcements for early-stage participation and the formal plan display (1.3.1 Bro). Section 1.3.1 Bro then refers to the AWB, which enables the administration to determine according to section 3.12 AWB who is, in fact, entitled to take part in early-stage participation (van der Schoot, 2011, p. 27). Therefore, the procedure is not open to everyone. The details of the formal procedure of the plan display are also regulated in the AWB, as section 3.8 of Wro prescribes (Needham, 2007) which are: the announcement, the length of the display, the entitled group, and the procedures (3.11 AWB). To be entitled to participate, a person or organization must have an interest that is directly affected by the intentional consequences of the plan in question (Needham, 2007).

3.2 THE INSTITUTIONAL POSITIONING

GERMANY

In Germany, the competence to govern within their own territory is an important and much valued principle. It is founded in German constitutional law (section 28 Grundgesetz, GG). Accordingly, German participation in land-use planning has a strong emphasis on municipal territory. Although Battis et al. (2007) see in the formulation of section 3.1 of the BauGB a right to participate for every legal body or natural person that might be affected, or that has any other interest in the plan (including from outside the municipality) (Battis, Krautzberger, & Löhr, 2007), the fact that the municipality determines who potentially might be affected (Battis et al., 2007) makes participation beyond municipal boundaries unlikely. At the regional level, which is relevant for large spatial projects, it is important to recognize that since the last reform of federalism in Germany, regional planning belongs to the "concurrent legislation". This means that the states in Germany may deviate from the national regional planning law and make their own regulations on participation. Finally, all 16 states have a regional planning law that involves the general public in regional planning procedures in one way or another (Spannowsky et al. 2010), whereas in some states participation is obligatory for regional planning. Because of the legal character of the regional planning legislation in Germany, however, participants may only object and comment on the spatial impact of projects and plans, but they may not comment or object against private interest (those are regulated at the local land-use planning level). This requires the planning authority to filter only those comments and objections that are in the general public interest (Spannowsky et al., 2010). This makes public participation on the regional level in Germany labour-intensive and complicated.

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Besides the written formal rules, the Netherlands has a tradition of unwritten law. Of great importance are the "rules of responsible public administration" (Needham, 2006) or "principles of good governance" (Taekema et al., 2011). Although they are not formally determined, courts recognize them as an accepted codex for governmental activities (Needham, 2006). Therefore, they have considerable impact at the local level. Such rules include that an agency should honour earlier promises, make decisions carefully, and consider all relevant facts (Taekema et al., 2011). This also implies that citizens' objections to plans are taken seriously, even if they are raised outside the formal planning procedures. Like in the German case, in Dutch practice, major decisions about a plan are often already made before a project enters the formal planning procedure in accordance with the Wro (de Leede, Smaal, & Spit, 1993). This means that citizens are often confronted with detailed plans for large projects, rather than being involved in the design of the projects. Although regional and national planning authorities explain this as a necessity, due to careful preparation (complicated calculations, mandatory environmental impact assessments), citizens can consider this a closed process.

3.3 HISTORICAL CONTEXT

THE INFLUENCE OF EU LEGISLATION

The Aarhus Convention of 1998 can be seen as a milestone for participation in planning (Dreijerink et al., 2008). It is an international treaty on participation in environmental planning, which initiated the 2003 passing of a European Union directive to support participation (Directive 2003/35/EC, 2003). National planning laws in Germany and the Netherlands have implemented it in their BauGB and Wro (respectively WRO). It is important to recognize that both laws were influenced by the same superior EU legislation, because this partly explains the similarities in both planning laws. Although land-use planning in Germany and in the Netherlands is in many respects crucially different (Tennekes & Harbers, 2012), regulations for participation in land-use planning pursue considerably similar approaches in both countries.

GERMANY: DARE DEMOCRACY, BUT SPEED UP PROCEDURES

The German Chancellor Willy Brandt's State of the Nation Address from 1969 is often quoted as the origin of public participation in Germany (Selle, 2010). With his famous sentence "Wir wollen mehr Demokratie wagen"—we want to brave more democracy—he argued for more co responsibility for citizens in different policy fields (Bundeskanzler Willy Brandt, 1969). In accordance with this, and with Arnstein's idea of participation as a form of citizen empowerment (Arnstein, 1969; Fagence, 1977, p. 4), the 1976 reform of the Federal Building Code aimed at a more intensive and earlier involvement of citizens in the planning process (Söfker, 2009, p. XIII).

Later, arguments against participation arose in reference to the efficiency of planning procedures (Battis et al., 2007). In the 1980s, the Western German parliament discussed the participation of citizens in regional planning procedures, while the government was concerned that this might affect the efficiency of planning processes (Deutscher Bundestag, 1980; Deutscher Bundestag, 1986). Also before the major reform in 1998 ('BauROG'), participation was under pressure from attempts to speed up processes, but finally the regulations for participation were strengthened (Battis et al., 1997). In 2006, a law was passed to accelerate planning and reduce participation processes (Söfker, 2009), making the tension between participation and plan efficiency quite obvious.

And today? In today's planning practice, participation is often conducted as a formality as Selle (2010) concludes. A "culture of participation" is missing in spatial planning (Berghäuser & Berghäuser, 2009). Some authors even speak about "Kommunikationsverweigerung"—refusal to communicate—on the authorities' part (Selle, 2010). It seems that, in the last few years, spatial planning practice has become almost fatalistic towards participation, as is quite adequately illustrated by an early observation from Cvetkovich & Earle: "'public involvement' in practice often means holding a hearing primarily to inform the public, after the fact, of a decision that has been made" (Cvetkovich & Earle, 1992). Accordingly, the commitment of German administrations is regarded as deficient (Selle, 2010).

THE NETHERLANDS: 'SNELLER EN BETER' (QUICKER AND BETTER)

As in Germany, different phases of participation can be identified over time. Participation has historically developed not only from spatial planning practice but rather from major political arguments and milestones in legislation, projects, and societal change (van Coenen, de Rob, & Johan, 2001). In the positivistic planning period after the Second World War, planning was predominantly technocratic, and not only in the Netherlands. Planners were assumed to know the public interest (Needham, 2007). In addition, 'pillarization' framed Dutch society at this time: society was split into subgroups along religious and socio-economic lines. The period is considered to have been characterized by a passive political attitude among Dutch citizens. By the end of the 1960s, 'depillarization' began to nurture new forms of participation (Michels, 2006).

Van Coenen et al. (2001) investigated how participation evolved in the period between 1970 and 2000 in the Netherlands (Yang & Pandey, 2011). They distinguished three phases during that time span in which participation had different functions: in the phase between 1970 and 1980 it functioned as a catalyst for protests and to authorize democratic decision-making. This style of governance in environmental policy is regarded as top-down regulation (Schreuder, 2001). The period is also characterized as a time of rationalistic planning, solving engineering planning problems (Baum, 1977; Rittel & Webber, 1973). In this phase, public participation was only about specific aspects of planning.

Guided by the idea of preserving natural resources, stronger legal and financial constraints were installed in the 1980s (Schreuder, 2001). At that time, policymakers pursued a broader and more integrated approach towards participation (Dreijerink et al., 2008). The famous Dutch "polder model" became more of a principle in public decision-making (Needham, 2007; Schreuder, 2001). Van Coenen et al. (2001) identified the 1980s as a time when participation became an important formal instrument to legitimize governmental actions.

Then, until the 2000s, participation developed as an instrument of reconsideration in the negotiation of agreements and covenants (Schreuder, 2001). Trust and common interest were considered the driving forces of Dutch economic and environmental problem solving (Schreuder, 2001). Meanwhile, land-use plans gradually became a less important planning instrument in Dutch planning practice because they were considered too inflexible. The requirement to be both a plan and a juridical ordinance made it difficult to react flexibly to new developments (Buitelaar, 2012) so the exemption procedures ('vrijstellingsprocedure') of former section 19 Wro became popular (van der Schoot, 2011) and often replaced the land-use plan itself. Participation was obligatory for this procedure only from 1999 onwards (van Buuren et al., 1999). From 1999 onward, every legally binding spatial planning procedure included participation in the formal procedures, including early-stage participation and a plan display.

A study of participation in 2006 advises that regulations in the Dutch Spatial Planning Act need to be adjusted to facilitate better participation (Tweede Kamer der Staten-Generaal, 2008). Accordingly, the law was revised in 2008. It strengthens the role of citizens in formal planning procedures (Tweede Kamer der Staten-Generaal, 2007). In 2011, the Dutch parliament proclaimed that public participation in urban planning is of national interest, as it leads to more democratic planning processes (Tweede Kamer der Staten-Generaal, 2011). At the same time, governmental agencies wished to accelerate planning procedures (Kamphorst et al., 2008). This is expressed by the term used by the Commission Elverding: "quicker and better"; accordingly, the Crisis and Recovery Act of March 2010 shortened planning procedures. This required smooth and well-functioning citizen participation processes, but simultaneously decreased the ability to appeal to municipal plans (for specific projects). Michels concluded that although several approaches aimed to improve participation have been discussed in the Netherlands, the "traditional hierarchical approach to policymaking" has not been revised (Michels, 2006). Still, in the past few years, a counter-movement to participation that aims to speed up planning processes has been the trend.

3.4 TELEOLOGICAL MEANING OF A LEGAL TEXT

GERMANY AND THE NETHERLANDS: SIMILAR PROCEDURES

Roughly spoken, the participation procedures for land-use plans are quite alike in the Netherlands and in Germany. In both countries, formal participation is organized procedurally, and the procedures are similar. In broad terms, the participation regulations in both Germany and the Netherlands pursue a "linear and sequential" planning process (Enserink & Monnikhof, 2003). This is not surprising, because Dutch law was inspired by German legal thinking (Taekema, de Roo, & Elion-Valter, 2011). A "linear and sequential" planning process clearly determines the planning steps where the public is involved and where it is implicitly excluded. However, a less sequential process is required, such as a participatory co-design (Enserink & Monnikhof, 2003). The basic idea of such a process is not to separate participation from the design process; but participation is envisaged as accompanying the whole planning process. Such a concept seems highly appropriate, since a procedure with just two occasions for formal participation (at an early stage and at the end of the planning process) seems outdated, and certainly not suitable for changing stakeholders, large areas, complexity, uncertainty, and the long duration of planning processes for large projects.

The question of who may participate in a planning process has a crucial impact on the result of the participation (Ibert, 2007). The early-stage participation and the plan display under both laws—the BauGB and the Wro—are related to the formal proceedings of land-use plans at the municipal level. Consequently, the regulations on participation also refer to the territory of the municipality. Large projects are here considered as exceeding the territory of the municipality in size, importance, or effect. However, regulations for participation do not reach beyond municipal boundaries. Particularly in the case of large projects, this can be crucial: most large projects unfold their positive effects on a large spatial scale, whereas the negative effects most often affect local people directly on a local scale. For example, a huge new inner-city shopping centre might bring nuisances such as traffic jams, noise emissions, or economic threats upon shops in the direct neighbourhood, but it produces jobs, convenient shopping opportunities, and economic growth on a large spatial scale, which may even exceed the regional level. Furthermore, as large planning processes are very long and dynamic, municipalities—burdened with implementing participation—have difficulty in coping with them (Needham, te Raa, Spit, & Zwanikken, 2000). Public participation in such large urban planning projects is criticized as too vague because citizens' actual influence is regarded as limited (Dziomba & Matuschewski, 2007; Enserink & Monnikhof, 2003). When trying to understand citizen participation, the issue of the right scale is crucial (Crow, 2009). Often, participation in such projects is reduced to pure information regarding already decided issues (Dziomba & Matuschewski, 2007).

4 LEGAL POSSIBILITIES TO PARTICIPATION IN LARGE SCALE INFRASTRUCTURE PROJECTS

Earlier (see paragraph 1), we distinguish four purposes for participation in planning: support, legitimization, improving plan quality, and education. In this section we discuss how these purposes are taken up in German and Dutch planning law and what that entails for large projects. Our analysis shows legislators are not very concise in their definition of what they want to achieve with participation. Rather, multiple andpartly contradictory purposes of participation are mentioned in policy documents. Achieving one purpose (e.g., increasing support) means neglecting or at least not focusing on other purposes (e.g., increasing plan quality). Participation thus always remains imperfect, and an optimal balance between these partially contradictory purposes needs to be struck.

Still, we have looked at the four purposes of participation as mentioned above. First, we identified support as raising the number of citizens who agree with the plan. Even though historical analysis shows participation in planning has increased, it does not match the requirements and realities of large projects. Decisions are often already fixed before the formal planning procedure starts. Second, achieving legitimate participation would entail having a majority of involved citizens that agree to the plan. Our analysis shows that the legal emphasis on the municipal level does not suit large projects with effects beyond municipal territories, especially in the Netherlands, as our analysis shows that even in early-stage participation procedures, the government can choose whom to involve (and whom to exclude). Third, for improving plan quality, one could argue that open participatory processes and early-stage participation will improve the quality of the plan, as more and diverse stakeholders are involved. Our historical analysis shows initial improvement, but the recent focus on the formal plan display in large projects could reduce open participatory processes again. As such, we are curious to see if the new Dutch Environment and Spatial Planning Act—aimed at more flexible and inclusive planning processes—can turn the tide. Fourth, the formulations in the BauGB and the Wro are not adequate to satisfy an ambition of education, especially in large projects, especially since the historic development of participation in both countries has emerged from political debate and not from planning practice or citizen protests. This helps to understand the struggle among planning practitioners to implement sufficient participation, which is particularly visible in large projects.

5 DISCUSSION: RATIONALES FOR PARTICIPATION

There is some confusion about the rationale for participation (Brownill & Carpenter, 2007a). "Civil servants are often confused about the role and function of participatory practices in urban planning" (Leino & Laine, 2011). Although it is not easy to identify one single rationale for participation, it remains possible to identify several reiterated and important motives. From planning theory, we drew four different rationales of citizen participation in planning processes. It should increase the (public) support for a decision, assist in legalizing plans, improve the quality of a decision, and raise awareness for certain processes and projects, or educate civil society on planning processes (Brownill & Carpenter, 2007b; Donders et al., 2014; Dreijerink et al., 2008; Enserink & Monnikhof, 2003; Hartmann & Spit, 2016; Leino & Laine, 2011; Wesselink, Paavola, Fritsch, & Renn, 2011).

Although land-use planning in Germany and in the Netherlands is in many respects crucially different (see also Tennekes & Harbers, 2012), regulations for participation in land-use planning pursue similar approaches in both countries. Participation regulations in Germany and the Netherlands do not fit large projects reaching beyond municipal boundaries. The juridical analysis shows law considering participation does increase the legitimacy of plans. Still, one could wonder if creating a majority by choosing who to involve is the most fair manner to address participation. Increasing the number of stakeholders to increase public support conflicts with increasing plan quality. It is not necessary to have many stakeholders, but it is necessary to involve stakeholders who are informed and who can add their (lay) knowledge to the project. Increasing the plan quality in this way is more likely to create support for the project. In this respect, the planners involved in large scale projects need facilitative law, rather than law dictating the number of stakeholders involved. Finally, to increase plan quality and add to the number of informed stakeholders, more education, in general, is vital. Yet, planning law cannot force education on stakeholders, so acilitating civil society in communication and understanding of large urban projects will have the largest yield.

Previously we argued that planning law formally determines the boundaries and frontiers of urban planning (Stierand, 1993; Yang & Pandey, 2011). We conclude that law is indeed a key variable for the functioning of participation in planning, especially legitimacy of planning processes (Hartmann & Needham, 2012). Still, we argue other forms of governance are required to facilitate participation in large projects: regulations that focus beyond municipal planning procedures.

The commitment of regional or state public authorities is crucial. The analysis above crucially uncovers a feature of planning law and participation: viable participation for large spatial planning projects cannot be comprehensively regulated by codified law but merely facilitated. Law can enhance the legitimate character of participation, but currently lacks the ability to organize support, improvement of planning, or education at the regional planning level.

Finding approaches to creating or to increasing such commitment requires analyses outside the realm of planning law or a major change in planning law itself. Planning law for the most part focusses on the local scale, especially in relation to participation. If citizen participation were to be legally enforced in large urban projects, planning law itself needs restructuring towards the regional level or at least an ability to accommodate cross boundary projects. If we have a first look towards the new Dutch Environment and Planning act, which aims to stimulate citizen participation in large scale projects, we see that the law is still oriented at the local scale.

The new Act suggests that regional planning is possible, but regulation is established in such a manner that it counteracts regional enforcement via law. As such, commitment of regional and state public authorities to facilitate citizen participation is a key variable for the success of large urban projects.

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Società Italiana degli Economisti dei Trasporti e della Logistica
Italian Society of Transport and Logistics Economists

XX Scientific Meeting
"Mobility and the city: policies for sustainability"
DAStU, Politecnico di Milano Milan, June 20th-22nd, 2018

The italian society of transport and logistics economists (società italiana di economia dei trasporti e della logistica, siet) is organising its annual conference to be held at politecnico di milano, milan, italy. The conference, hosting original scientific contributions from scholars and practitioners in all fields of transport economics, is introduced by a plenary session focusing on the relationship between cities, territories and mobility. This complex relationship, now often faced under the label of "sustainable mobility", is actually made of many interconnected layers: economy, governance, land-use planning, technical and technological choices, environment, etc. The session will try to explore such dimensions, in particular taking into account the role of land-use planning and of governance structure in the mobility-related outcomes.

The conference is organised in one initial plenary session followed by parallel sessions. The 3-days are concluded by a side-event, open to non-academic participants, about the rising phenomenon of travel platforms and their influence on market regulation. Special session reference persons and normal sessions moderators are invited to join the final parallel session, fully devoted to the discussion of results and of possible research topics.
Two type of sessions will be organized:
- sessions with pre-defined discussant;
- sessions with open discussion.

TeMA

Journal of
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REVIEWS PAGES

THE RESILIENCE CITY/THE FRAGILE CITY. METHODS, TOOLS AND BEST PRACTICES 1(2018)

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.

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02_BOOKS

The books review suggests brand new publications related with the theme of the journal number.

author: Gerardo Carpentieri
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03_LAWS

The law section proposes a critical synthesis of the normative aspect of the issue theme.

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04_UBAN PRACTICES

Urban practices describes the most innovative application in practice of the journal theme.

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05_NEWS AND EVENTS

News and events section keeps the readers up-to-date on congresses, events and exhibition related to the journal theme.

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TeMA

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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，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，能够对与城市和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
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02_BOOKS
书评推荐与期刊该期主题相关的最新出版著作。

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03_LAWS
法律部分提供主题相关标准方面的大量综述。

author: Maria Rosa Tremiterra
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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。

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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。

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01

THE RESILIENCE CITY/THE FRAGILE CITY. METHODS, TOOLS AND BEST PRACTICES 1(2018)

REVIEW PAGES: WEB RESOURCES

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In this number

AWARDS FOR GREEN CITIES

The protection of our territory has become one of the highest priorities and the concept of sustainable development has increasingly taken off among the various countries of the European Union. Sustainable development has long been the focus of attention in the European project, and the EU's commitment supports a development that meets the needs of today without compromising the ability of future generations to meet their own needs (COM (2016)), 739 final).
In urban areas, population and therefore the density of urban activities are increasingly growing, with a consequent increase in pollution. However, though cities represent a significant source of global pollution, they can develop mitigation and adaptation strategies to combat the effects of climate change (Papa et al., 2014). In recent years, in fact, the European Commission has recognized the role and commitment of local authorities in implementing strategies for achieving a sustainable development and in this regard it has presented several projects aimed at rewarding efforts and initiatives of those cities that strive to promote a more environmentally-friendly urban life. Moreover, prizes are awarded to the cities that have stood out for intelligent planning, i.e. those cities which propose models and tools for sustainable urban development on the basis of new requirements (energy, waste, sustainability, etc.) as a priority imposed by global challenges (climate change, land use, etc.) (Papa et al., 2015).
The prizes identify the winning cities as the "role-models" to inspire other cities by creating a sort of friendly competition so that cities can share their experiences and then try to overcome themselves in a challenge that may only grant a higher level of common well-being.
Awarding a prize to a city can also be a source of pride for its citizens who can be encouraged to lead an environmentally-friendly lifestyle, not underestimating the fact that a green city becomes a pole of attraction for new green investors.

European Green Capital
http://ec.europa.eu/environment/europeangreencapital/

ENVIRONMENT EUROPEAN GREEN CAPITAL is the website developed by the European Commission which shows two prizes awarded each year to different cities: the European Green Capital Award and the European Green Leaf Award. The European Green Capital Award is the result of an initiative organized by 15 European cities (Tallinn, Helsinki, Riga, Vilnius, Berlin, Warsaw, Madrid, Ljubljana, Prague, Vienna, Kiel, Kotka, Dartford, Tartu & Glasgow) and the Association of Estonian cities on May 15, 2006 in Tallinn, Estonia.
At the top of the webpage are present two sections: about ECGA and Applying for ECGA, where applicants can read all the information on how to participate in the award, the jury and selection criteria as well as the cities that won the prize in previous years.
This award is open to any EU Member States and candidate countries for EU membership, Iceland, Liechtenstein, Norway and Switzerland. Another key requirement is that the cities of the countries listed above, which aspire to the prize, must have a population of more than 100,000 inhabitants. The winning city will not be able to resubmit the application for a period of ten years after its year as European Green Capital.
After submitting the application, the city that aspires to the role of European Green Capital will be evaluated by a jury made up of representatives of seven European institutions, including the Commission itself. The jury will evaluate the city on the basis of 12 environmental indicators:
– Climate change: mitigation;
– climate Change: adaptation;
– sustainable urban mobility;
– sustainable land use;
– nature and biodiversity;
– air quality;
– noise;
– waste;
– water;
– green growth and eco-innovation;
– energy performance;
– governance.
The jury will assess the information provided by each city on the basis of the 12 indicators above listed and will draw up a shortlist of cities. The shortlisted cities will be invited to submit to the jury the communication strategies supported by the action plans in order to explain how they intend to realize their green year project. Following these presentations, the jury will select the European Green Capital. Stockholm was the first winning city in 2010, followed by Hamburg in 2011, Vitoria-Gastiez in 2012, Nantes in 2013, Copenhagen in 2014, Bristol in 2015, Ljubljana in 2016, Essen in 2017, Nijmegen in 2018 and Oslo in 2019.
All the cities are recognised for their coherent record of achieving high environmental standards and commitment to ambitious targets. Lastly, in the "about ECGA" section, by clicking on Quicklinks it is possible to connect to social media like YouTube, Facebook and Twitter. Furthermore, under the section board, there is a string which allows to view videos on YouTube.

EUROPEAN GREEN LEAF
https://ec.europa.eu/environment/europeangreencapital/

Another award shown on the ENVIRONMENT EUROPEAN GREEN CAPITAL website is the European Green Leaf Award. This competition is aimed at cities and towns across Europe that have populations of between 20,000 and 100,000 people, recognizing the commitment to improving environmental performance, with a particular focus on the efforts that generate green growth and new jobs. In the top bar, by clicking on the European Green Leaf it is possible to access ten sub-sections displaying information about the competition: the rules of participation, the award criteria, the cities that previously won the prize, the jury's training and the objectives of this competition.

Every year cities can apply for the European Green Leaf Award but the previous years' winners of this award can not apply for a three-year period, and in the same year the same city can not apply for the Green Leaf Award if it has already applied for the Green Capital Award.

The Green Leaf Award has a two-stage evaluation process. First, an international independent expert group assesses each city's application by selecting a shortlist for the next phase of the competition. Applicants are assessed on the basis of six topic areas:

– Climate change and energy performance;
– sustainable urban mobility;
– nature, biodiversity and sustainable land use;
– air quality and noise
– waste and circular economy;
– water.

The European Green Leaf Award application form also includes a 'City Introduction and Context section', where every applicant is asked to briefly present the respective city, indicating the main challenges it faces and how to address them. A Good Practice Section is also included at the end of the application form where cities are invited to submit three good practices they are undertaking across three different environmental topic areas.

This information and the links from which it is possible to download all the material for participation in the competition are available in the subsection EGLA Evaluation process. Moreover, by clicking on EGLA Winning Cities, it is possible to view all the cities that have received the prize in previous years, as the Spanish city of Mollet del Vallès and the Portuguese city of Torres Vedras, which won the inaugural European Green Leaf Awards in 2015; the Irish city of Galway is the winner of the European Green Leaf Award 2017 and the Belgian city of Leuven and the Swedish city of Växjö are the joint winners of the European Green Leaf Awards in 2018. In addition, within the same section, for each city the winner is linked to the respective press release documents. In the EGLA subsection 2019 (in the lower right side) there are links to social media such as YouTube, Facebook and Twitter. Lastly, by going back to the initial page of the site and clicking on the section of the European Green Leaf Award (in addition to a brief description of the award and the background) it is possible to view an animated video that shows how to make cities greener with a link to a YouTube section dedicated to the same theme.

CRESCO AWARD
https://crescoaward.ideatre60.it/

CRESCO AWARD is the website promoted by the Sodalitas Foundation which has been committed to supporting and spreading the culture of sustainability for over 20 years. The website is organized into six sections:
– CRESCO AWARD: sustainable cities;
– competition;
– how to participate;
– evaluation criteria and processes;
– companies awards;
– partnership.
This award (unlike the two above mentioned) is addressed to Italian and non-European cities and aims to enhance the innovative drive of Italian Municipalities by establishing a recognition for the most effective initiatives to promote the sustainable development of territories in a widespread way.
Participation in the CRESCO AWARD is open to Municipalities, Metropolitan cities and the Union/Association of Municipalities that can submit one or more projects related to the themes presented in the Sustainable Development Goals. Participants will have the opportunity to become part of the ANCI "Smart Cities Observatory" and to give visibility to their projects through the "Agenda Urbana" portal, the national platform promoted and implemented by ANCI that collects the innovative design experiences implemented by Italian cities. The results of the CRESCO AWARD will be disseminated through a communication plan drawn up by Fondazione Sodalitas, ANCI and the project partners. Applicants for the CRESCO AWARD can access the crescoaward.ideatre60 website by clicking in the "Participate in the Competitions" section and selecting the entry "CRESCO AWARD Sustainable Cities".
Lastly, in the home of the website, at the top right side, there are links with social networks like facebook and twitter.

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IMAGE SOURCES

The images are from: http://ec.europa.eu/environment/europeangreencapital/; https://crescoaward.ideatre60.it; https://pixabay.com/it/la-tutela-ambientale-886669/

02

THE RESILIENCE/THE FRAGILE CITY. METHODS, TOOLS AND BEST PRACTICES 1(2018)

REVIEW PAGES: BOOKS

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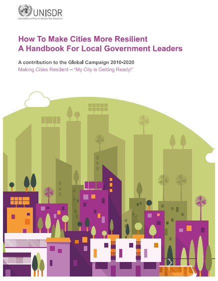
In this number

STRATEGIES AND POLICIES

Over the fifty percent of the world's population now live in urban areas, and this is projected to increase to sixty-six percent by 2050. Growth and the complex characteristics of cities can present occasions for sustainable development, while at the same time they have the potential to increase vulnerabilities and risk. Physical and spatial characteristics of urban areas, the socio-economic vulnerability of the population, the inadequacy of institutional capabilities and environmental challenges are some of the risk drivers that thrive under the complex situation that is in cities. Strategies and policies can be developed to address each of these issues and move towards safe, equitable and sustainable urban development. Cities are not only the places in which a majority of people live, they are also the core of the world's economy, generating over of eighty percent of global GDP. Today, almost all disproportionately phenomenon born in the cities, as the effects of climate change, aging infrastructure, population growth and migration, and social and economic inequity (Balaban & Şenol Balaban, 2015). In these places, there are important political centres and stand at the forefront of the challenges and opportunities. The spatial planning tools potentially can make a significant contribution in tackling the uncertainty and complexity of climate change (Salata & Yiannakou, 2016). So, the world has grown more urban, more integrated, and with a greater number of people at risk than ever before. These conditions require new models of urban governance. From extreme weather events to refugee crises, from disease pandemics to cyber-attacks, business-as-usual models of reactive planning and decision-making will not engender the fundamental strength and flexibility essential for the human to live. Building urban resilience is to survive, adapt, and grow the capacity of individuals, communities, institutions, businesses, and systems to live within urban areas. Acute shocks are sudden, sharp events that threaten the urban areas, such as earthquakes, disease outbreaks, or terrorist attacks. Chronic stresses, such as high unemployment, overtaxed or inefficient public transportation systems, or chronic recurrent flooding, weaken the urban area over time and exacerbate the effects when they inevitably occur. Mayors, local government officials, and decision makers are at the forefront of dealing with the impact of these negative phenomena. According to these themes, this section suggests three books and reports that help to better understand the issue of this number: How To Make Cities More Resilient A Handbook For Local Government Leaders; The London Plan - The Spatial Development Strategy for Greater London; and Cities Taking Action.



Title: **How To Make Cities More Resilient A Handbook For Local Government Leaders**
Author/editor: Ebru A. Gencer (CUDRR+R and UPAG)
Publisher: The United Nations Office for Disaster Risk Reduction (UNISDR)
Publication year: 2017
ISBN code: 978-92-1-101496-9

This handbook is designed primarily for local government leaders and policy makers. It seeks to support public policy and decision making so they can implement activities to reduce disaster risk and build resilience. It sets out practical guidance for putting the "Ten Essentials for Making Cities Resilient", into action. This handbook showcases the knowledge and expertise of several Campaign cities. It responds to the call for better access to information and knowledge resources, and tools to effectively deal with the impacts of natural hazards and climate change. It provides an overview of key strategies and actions as part of an overall sustainable urban development strategy. The annex to this Handbook contains links to tools, resources, and examples from partner cities. A web-based information platform, where cities and local governments can share their own tools, plans, regulations, and practices complements the handbook. Throughout the handbook, we refer to "cities" and "local governments." The approach to resilience, as described, also applies to sub-national administrations of different sizes and levels, including at regional, provincial, and metropolitan, city, municipal, township, and village levels.

A Resilient City is one, where: There is strong leadership and coordination and responsibilities in disaster risk management are clearly delineated. This includes effective stakeholder engagement, well defined policies and strategies and distribution of tasks, effective lines of communication and mechanisms that facilitate effective risk management; The city is up-to-date on knowledge about hazards. Risk assessments are routinely prepared as a basis for urban planning and long-term development, including current and future investment decisions that contribute to improved resilience; There is an adequate financial plan that complements and promotes mechanisms to support resilience activities; Urban planning is carried out based on up-to-date risk information with a focus on the most vulnerable groups; Natural ecosystems within and around the city's territory are identified, protected and monitored to sustain and safeguard their protective functions as natural buffers; All institutions relevant to a city's resilience are strengthened to have the capabilities they need to execute their roles; The social connectedness and culture of mutual help are strengthened through community, education, and multi-media channels of communication; There is a strategy to protect, update and maintain critical infrastructure to ensure that services continue and to increase resilience against hazards and the impacts of climate change; Effective disaster response is ensured by creating and regularly updating preparedness plans, connecting to early warning systems and increasing emergency and management capacities through public preparedness drills; Post-disaster recovery, rehabilitation, and reconstruction strategies are aligned with long term planning and provide an improved city environment after disaster events. The four priorities for action are: disaster risk management should be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment; Disaster risk governance at the national, regional and global levels is very important for prevention, mitigation, preparedness, response, recovery, and rehabilitation. It fosters collaboration and partnership; Public and private investment in disaster risk prevention and reduction through structural and non-structural measures are essential to enhance the economic, social, health and cultural resilience of persons, communities, countries and their assets, as well as the environment; The growth of disaster risk means that there is a need to strengthen disaster preparedness for response, take action in the anticipation of events, and ensure capacities are in place for effective response and recovery at all levels.

Title: **The London Plan - The Spatial Development Strategy for Greater London**
Author/editor: Mayor of London
Publisher: Greater London Authority
Publication year: 2017
ISBN code: -

Under the legislation establishing the Greater London Authority (GLA), the Mayor is required to publish a Spatial Development Strategy (SDS) and keep it under review. The SDS is known as the London Plan. As the overall strategic plan for London, it sets out an integrated economic, environmental, transport and social framework for the development of London over the next 20-25 years. The general objectives for the London Plan, and the process for drawing it up, altering it and replacing it, are set out in the Greater London Authority Act 1999 (as amended) and supporting detailed regulations. The Plan has been developed in line with these requirements. The legislation stipulates that the London Plan should only deal with things of strategic importance to Greater London taking account of the principal purposes of the Greater London Authority which are: promoting economic development and wealth creation in Greater London; promoting social development in Greater London; and promoting the improvement of the environment in Greater London. In developing this strategy, in accordance with the legislation and associated regulations, the Mayor has had regard to: the principle that there should be equality of opportunity for all people; reducing health inequality and promoting Londoners' health; achieving sustainable development in the United Kingdom; climate change and the consequences of climate change; the desirability of promoting and encouraging the use of the Thames, particularly for passenger and freight transportation; the resources available to implement the Mayor's strategies. The document brings together the geographical and locational aspects of the Mayor's other strategies, including those dealing with Transport, Environment, Economic Development, Housing, Culture, Health and Health Inequalities. The draft Plan has been developed alongside the Mayor's other statutory strategies to ensure consistency with those strategies. The London Plan is legally part of each of London's Local Planning Authorities' Development Plan and must be taken into account when planning decisions are taken in any part of London. Planning applications should be determined in accordance with it, unless there are sound planning reasons (other material considerations) which indicate otherwise. The Plan provides the strategic, London-wide policy context for borough local development plan documents; all local development plan documents and Neighbourhood Plans have to be 'in general conformity' with the London Plan. This means it is not an alteration or update to previous Plans. This Plan will be the third London Plan, the previous ones being the 2004 Plan produced by former Mayor of London Ken Livingstone and the 2011 Plan produced by former Mayor of London Boris Johnson. All of the other iterations of the London Plan from 2004-2016 have been alterations. Once adopted this Plan will replace all previous versions. This Plan is different to those that have gone before it. It is more ambitious and focused than any previous Plans. The concept of Good Growth – growth that is socially and economically inclusive and environmentally sustainable – underpins the Plan and ensures that it is focused on sustainable development. The drafting of the Plan aims to ensure that London is ready to implement this ambitious Plan as soon as possible and that the policies do not take years to implement due to the time it can take to update local development plan documents. As the London Plan is part of every borough's development plan, there is no requirement for the policies to be repeated at the local level before they can be implemented. However, in some instances a local approach is required within the context of the overall policy. The Plan clearly sets out where this is the case. This Plan provides the framework to address the key planning issues facing London. This allows boroughs to spend time and resources on those issues that have a distinctly local dimension and on measures that will help deliver the growth London needs.

Title: **Cities Taking Action**
Author/editor: 100 Resilient Cities
Publisher: Rockefeller Foundation
Publication year: 2017
ISBN code: -

The Rockefeller Foundation has been a leader in urban policy since the late 1950s when it launched an Urban Design Studies program. One of its first grants was to a then-obscure author for the research and writing of The Death and Life of Great American Cities. In 2013, building on this long tradition, and in celebration of its 100-year anniversary, the Rockefeller Foundation launched 100 Resilient Cities (100RC), a non-profit dedicated to helping cities around the world become more resilient to the physical, social, and economic challenges of the 21st century. The mission is to catalyze an urban resilience movement, and we have rapidly built a dynamic global organization. The Foundation work along four key pathways in pursuit of our mission: City action; Resilience solutions; Local leaders; and Global Influence. 100RC's diverse and dynamic network of cities is facing a common set of shocks and stresses. Member cities face rainfall flooding, infrastructure failure, earthquake, extreme heat, and disease outbreak as their most common shocks, and aging infrastructure, a lack of affordable housing, inadequate public transportation, environmental degradation, and economic inequality as their most common stresses. The more than 30 Resilience Strategies published by 100RC member cities so far contain more than 1,600 action-oriented initiatives – from discrete social programs to ambitious infrastructure projects, running on timescales from a few months to multiple generations. These cities are already hard at work implementing these actions, and thus far have leveraged more than $535M in external funding from private, public, and philanthropic sources to that end. This report focuses on some of the ways cities are now taking action, looking closely at the following seven projects, and illustrates how resilience thinking can maximize the impact of a city's efforts and ensure each project returns multiple benefits for residents: Boston is incorporating racial equity goals into its plans for extending its metro transit system; Medellín is protecting informal communities from landslides while improving social cohesion among residents; Melbourne will create a cohesive strategy for managing urban forests across its many jurisdictions; Surat will address its twin problems of insufficient water quantity and quality; New Orleans is developing new systems for flood protection; New York is exemplifying the ethos of "build back stronger" in a highly vulnerable community; Mexico City is deploying innovative finance to meet the basic water needs of its vulnerable populations in a manner that will also protect its ecosystems and boost its resilience to climate change.

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03

THE RESILIENCE CITY/THE FRAGILE CITY. METHODS, TOOLS AND BEST PRACTICES 1 (2018)

REVIEW PAGES: LAWS

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In this number

CLIMATE CHANGE ADAPTATION OF COASTAL AREAS IN THE EU MEMBER STATES

In 2013 European Union adopted the EU Strategy on Adaptation to Climate Change, in line with the Green Paper on "Adapting to climate change in Europe – options for EU action" of June 2007. This strategy was one of the steps that European Union has been sweeping in order to encourage the Member States to adopt adaptation strategies at different levels that are national, regional and local (Papa et al., 2014). In particular, the aim of the strategy is "*to contribute to a more climate-resilient Europe […] enhancing the preparedness and capacity to respond to the impacts of climate change at local, regional, national and EU levels*". The EU Adaptation Strategy focuses on promoting:

- the adoption of adaptation strategies by the Member States and supporting adaptation also at the local level through the Covenant of Mayors for Climate and Energy;
- the climate-proofing action at EU level in specific key vulnerable sectors (e.g. agriculture, cohesion policy, etc.) for making Europe more resilient (Swart et al., 2009);
- the sharing of knowledge about adaptation among decision-makers through the development of specific platform such as Climate-ADAPT.

Together with the EU Adaptation Strategy there are several documents, named Commission Staff Working Documents (SWDs). Those SWDs focus on how to implement adaptation policies in specific fields, one of which – the SWD (2013) 133 - is referred to coastal areas. Coastal areas are considered the most productive areas in the world but, at the same time, the most vulnerable areas to climate change and natural hazards (Neumann et al., 2015). Such document highlights the importance of those areas as pointed out firstly by the Recommendation on the Integrated Coastal Zone Management (ICZM) in 2002 and then by the Directive 2014/89/EU of the European Parliament and of the Council establishing a framework for maritime spatial planning. In particular, the document highlights that "*under a no-adaptation scenario, it is estimated that between 200,000 […] and 780,000 people […] could be affected by coastal flooding by 2100*". In this perspective, effective adaptation action can influence positively the resilience of coastal areas to climate change impacts. Nowadays, the majority of EU Member States have adopted their own National Adaptation Strategies. Nevertheless, the National Adaptation Strategies adopted by Member State with coastline include specific strategies or addresses for coastal zones.

Hence, in this number the National Adaptation Strategies of the Netherlands, Denmark and Germany are presented in order to highlight which strategies they propose for coastal areas in relation to the EU Adaptation Strategy and eventually which addresses are provided for the future territorial and urban planning.

NATIONAL ADAPTATION STRATEGY IN THE NETHERLANDS

The National Adaptation Strategy in the Netherlands has been adopted by the Council of Ministers in December 2016 and it is one of the most recent National Adaptation Strategy in Strategy updates the previous National Adaptation Strategy "Make Space for Climate", laid down in 2007. Its formulation has been addressed by the Climate Agenda for Adaptation and Mitigation adopted by the Dutch Cabinet in 2013. The aim of the strategy is to help to "climate-proof" the Netherlands through initiatives at different territorial levels.

The strategy is articulated into five parts: the first one introduces the NAS and describes its main characteristics; the second one sets out the main effects of climate change in the Netherlands; the third and the fourth ones illustrate which actions are necessary to implement and how to reduce the susceptibility of the Netherlands to the negative effects of climate change; in the last part the Climate Adaptation Implementation Programme is paved. The 2016 NAS defines four conceptual frameworks. In each framework opportunities and threats are reported for specific effects of climate change which are warmer climate, wetter climate, drier summers and rising of the sea level. Moreover, for each framework implications for nine specific sectors are also identified. Those sectors are: Water and spatial management; Nature; Agriculture, horticulture and fisheries; Health; Recreation and tourism; Infrastructure (air, road, rail, water); Energy; IT and telecommunications; Safety and security. Even if the strategy identifies different policy sectors, it highlights the importance to consider the integration between spatial planning and those policy sectors for defining effective solutions. Indeed, for climate-proofing the Netherlands the NAS promotes the development of the Delta Plan for Spatial Adaptation. In particular, the NAS highlights how much "*it is important to formulate the climate adaptation process in a broader context, to include consideration of the consequence of climate change for nature, health, the food supply chain, spatial design, cultural heritage, housing, urban transformation, and so forth*". In this context, spatial planning plays a key role. The NAS introduces a specific approach for identifying single solutions, which address multiple issues. Such solutions are named "crossovers". Several "crossovers" are referred to the spatial planning and, in particular, to the spatial planning of coastal areas. Coastal areas are not specifically defined and analyzed by the strategy, but the relationships between the Dutch land and the water is clear. The Strategy, indeed, identifies specific crossovers, referred to the interaction between Water-Spatial Planning-Public Spaces-Housing-Infrastructure. The crossovers are:

- Urban transformation based on climate-proof design;
- Use new planning and environmental legislation to promote cooperation and create cohesion;
- Tackling potential flooding within the spatial structure is cheaper than doing so within the water system;
- Knowledge-sharing between local authorities and suppliers such as tree nurseries with a view to promoting climate adaptation through the choice of species to be planted;
- New design requirements for (residential) buildings and roads;
- Subsidence and water table management in relation to spatial functions: there can be conflicts of interest which lead to economic dilemmas and a need for transformation.

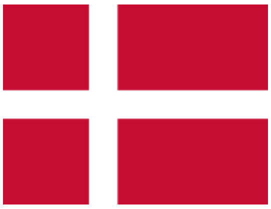
NATIONAL ADAPTATION STRATEGY IN GERMANY

The German Adaptation Strategy (Deutsche Anpassungs Strategie, DAS) has been adopted by the German Federal Cabinet in 2008, before the adoption of the EU Adaptation Strategy, but in line with the EU principles expressed by the Green Paper on “Adapting to climate change in Europe – options for EU action” in 2007. The objective of the DAS is “*to reduce the vulnerability of natural, social and economic systems and to maintain and improve their capacity to adapt to the inevitable impacts of global climate change*”.

The Strategy is articulated into five parts that illustrate: the principles of the strategy; the current state of knowledge with regard to the expected climate changes worldwide and in Germany; the climate change impacts and the ways for facing them; an overview of the international context and Germany’s contribution to adaptation in other parts of the world; finally, the approach and the next steps of the German Adaptation Strategy. The Strategy identifies the future climate change impacts on 15 sectors and areas that are referred also to urban planning. Indeed, among the sectors, there are the Building sector, Energy sector and the Transport infrastructure. A specific focus is given to the Water regime, Water management, coastal and marine protection sector and its impacts. Indeed, studies indicate that it could be an increase in the frequency and size of storm surges and, consequently, coastal areas could be at risk of flooding. Therefore, the Strategy proposes an integrated approach in order to reduce potential risks in the German coastal regions of the North Sea and Baltic Sea by means of the Integrated Coastal Zone Management (ICZM) approach. ICZM “*is intended to bring about better reconciliation of the protection and development of natural resources and near-natural land with economic and social demands*”. In addition, spatial planning plays a key role in the adaptation of coastal areas. Indeed, spatial planning has “*the important function of reconciling different claims on the same space*”, supporting at the same time both mitigation and adaptation. In particular, in coastal areas “*regional planning must lay the foundations for ensuring continued maximum protection from increasing storm surge and flood risks in the future. Adaptation to climate change requires not only dyke building and refurbishment measures, but also the development of new forms of safety precautions – especially passive ones*”. In this perspective, the DAS supports the integration between spatial planning and ICZM approach.

In order to guarantee the implementation of the Strategy, in 2011 the German Federal Cabinet has adopted the “Adaptation Action Plan”. Moreover, the Strategy defines some institutional structures for supporting the strategy process. The last part of the DAS, indeed, has provided for the institution of an inter-ministerial working group on adaptation to climate change, called IWG Adaptation Strategy (IMA Anpassungsstrategie), consist of delegates from the Federal Government. The aim of this working group is to prepare the Adaptation Action Plan, propose updates of the DAS and monitor their implementation. With regard of the cooperation with the German Federal States, the Strategy promotes another wide mandate about the “Federal-Länder dialogue on adaptation to climate change”, initiated by the Ministry of the Environment, Nature Conservation and Nuclear Safety.

The DAS highlights also the importance of the Competence Centre on Climate Impacts and Adaptation (KomPass) and of its services, which will be constantly expanded and opened to all users. Finally, also research plays a key role in the implementation process of the strategy. The need of improving information and advisory facilities for developing effective strategy is the core task of the Climate Service Centre (CSC), coordinated with KomPass and other establishments (e.g. German Weather Service).



NATIONAL ADAPTATION STRATEGY IN DENMARK

In 2008 the Danish Government has adopted the Danish strategy for adaptation to a changing climate. The Danish Strategy is based on the concept that climate change impacts are uncertain and adaptation to climate change is a long-term process. Its purpose is "*that that in future climate change should be considered and integrated into planning and development in the most appropriate way*". In order to define solutions, the strategy describes the future climate with a focus on the variability of the temperature, precipitations and sea level in Denmark and it identifies vulnerabilities of 11 relevant sectors, including Coastal Management and Land Use Planning, for its implementation. With regard to the coastal areas, the Danish Strategy highlights that the risk of flooding and erosion will increase and cities may face complex issues "*since they can be under pressure from higher sea levels, increased precipitation and runoff, as well as changes in groundwater levels*". Therefore, the Strategy defines some recommendations. In particular, concerning new construction or renovation of dykes, coastal protection or harbor installations, "*it is important to consider how many years' climate change should be included in the basic design*". Even if there are no regulations about the coastal protection, the Strategy points out that the Danish Coastal Authority will recommend minimum heights for building footings and dyke heights. Furthermore, even if a socio-economic analysis is required for a better adaptation to the climate change of those areas, the Danish Strategy doesn't consider at all the ICZM approach. The basic approach of the strategy is to consider the future climate change "*integrated into planning and development*". In this perspective, especially in the coastal areas where about 43% of Danish population lives, the Strategy pushes for a more effective planning of land use in order to better face the climate change impacts. Municipalities have a guiding role for integrating adaptation measures in their plans. Indeed, municipal planning should reflect and adapt to the risks and consequences of climate change. The national authorities, indeed, will monitor municipal planning. In this framework, national legislation could be "*limit building and construction in high-risk areas*" or support significant and expensive solutions such as coastal protections, dyke construction, infrastructure protection or water pumping.

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IMAGE SOURCES

The images are from: Fig.1 https://en.wikipedia.org/wiki/Flag_of_Europe; Fig.2 https://en.wikipedia.org/wiki/Flag_of_the_Netherlands; Fig. 3 https://en.wikipedia.org/wiki/Flag_of_Germany; Fig. 4 https://en.wikipedia.org/wiki/Flag_of_Denmark.

04

THE RESILIENCE CITY/THE FRAGILE CITY. METHODS, TOOLS AND BEST PRACTICES 1 (2018)

REVIEW PAGES: URBAN PRACTICES

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In this number

PLANNING FOR RESILIENT CITIES: TWO EUROPEAN 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 centres, the non-profit sector, private stakeholders, citizens, and communities (Stumpp, 2013).
Within this context, several initiatives involving both public and private organisations 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 assist city governments to build greater resilience to climate and disaster. It is dedicated 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, the programme has established the "City Resilience Framework" (CRF), in partnership with the global design firm Arup. The framework provides an innovative model for the local authority 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 honour 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 2013, 102 cities worldwide have joined the programme, and 37 Resilience Strategies (with nearly 1,900 concrete actions and initiatives) have been developed. This contribution presents two relevant Resilient Strategies, developed in Europe within the 100 Resilient Cities framework: ii) the Rotterdam (the Netherlands) Resilient Strategy and ii) the Thessaloniki (Greece) Resilient Strategy.

ROTTERDAM

Rotterdam is a thriving world port city with an urban population of 639,587 inhabitants. The city has a long tradition of continually adapting to new circumstances and anticipating and benefitting from economic and social change. On May 2016, the city of Rotterdam, released its Resilience Strategy within the 100 Resilient Cities framework, outlining its plan to address the main challenges the city will face in the 21th century. The Strategy establishes seven resilience goals, each of them is accompanied by fly wheel actions and additional actions. Fly wheel actions are bigger actions which will make big leaps towards Rotterdam reaching a citywide state of resilience, while the additional actions contribute with lesser impacts. These goals are:

- *Rotterdam: a balanced society.* The goal concerns with building and strengthening resilience in Rotterdam at the individual and the societal level. According to the strategy, this will be achieved trough a coordinated mix of actions such as: i) providing educational opportunities for young people to make them competitive and the ready to work in the "next economy"; ii) supporting a balanced population demographic in Rotterdam and attracting highly educated people to the city by increasing housing affordability for the young population iii) fostering social cohesion through networking initiatives aimed at create permanent links between the different social and ethnic communities populating the city;
- *World Port City built on clean and reliabl*e energy. This goal concerns with the development of a flexible and sustainable energy infrastructure for the port area of the city. This will be achieved through a mix of joint initiatives (involving industries, government and the Rotterdam Port Authority) focused on renewable energy and energy conservation investments;
- *Rotterdam Cyber Port City*. This goal focuses on increasing the resilience of the port area and of the companies working in the port industry against cyber threats. This will be achieved by enhancing awareness, sharing knowledge and joining forces to realize ICT products able to protect computers, networks, programs and data related to the port industry from unauthorized access or attacks that are aimed for exploitation;
- *Climate Adaptive city to a new level*. This goal will reinforce the efforts already started with the Climate Adaptation Strategy (2013) and finalized to enhance the climate resilience of the city. Actions in this domain include: i) small projects led by citizens and businesses under the motto "many small actions make a big difference"; ii) key projects specifically designed to inspire and create publicity and interest around urban resilience, and iii) effective large–scale government- lead projects such as the redevelopment of the city's waterfront;
- *Infrastructure ready for the 21st century.* This goal deals with increasing the resilience of critical urban infrastructures and networks. The goal is supported by different initiatives, ranging from research initiatives aimed at gaining a better understanding of interdependencies between key infrastructures, to planning initiatives aimed at developing protocols and standard procedures for the asset management of underground infrastructures;
- *Rotterdam network: truly our city*. This goal focuses on fostering the engagement and mobilization of Rotterdam's citizens. To this aim a number of initiatives are included such as: i) the creation of networks of government, citizens and institutions to share knowledge around key initiatives; ii) the

development of a "district controlled planning program" aimed at promoting the involvement of the Rotterdam citizens in the decision-making process concerning with the management and planning of district-level facilities, and iii) the re-development of the city's open-data platform and the implementation of other information and inspiration platforms;

- *Anchoring resilience in the city*. This goal concerns with improving the lives of those living in Rotterdam South, a disadvantage part of the city, where the average educational level is lower, there is a higher unemployment rate and the quality of housing is worse. The strategy intends to improve the neighborhood conditions by locating in Rotterdam South new iconic buildings and new public facilities as well as by improving the design and the quality on the neighbor public space.

THESSALONIKI

Thessaloniki is an important Greece city of 363 987 inhabitants, with an active port, a respected university, and a robust tourist industry. The city has recently experienced significant shocks and stresses including a devastating fire and a major earthquake. On March 2017, the city of Thessaloniki released its Resilience Strategy with the support of the 100 Resilient Cities initiative. More than 2,000 people and 40 organizations from across the city participated in workshops, teams, and questionnaires to express their views on Thessaloniki's resilience, with a notable focus on issues related to the local economy and mobility. The strategy will enable the city of Thessaloniki to better address current and forthcoming main challenges and is organized around four main goals, broken down into 30 objectives and more than 100 actions:

- *Shape a thriving and sustainable city with mobility*. The mobility system in Thessaloniki is facing several significant challenges including limited public transport options, over reliance on private car use, and ageing infrastructure. To address these challenges, the strategy presents a number of coordinated initiatives, including: i) reforming the Public Transport Authority to better meets the needs of a complex and evolving mobility system; ii) re-structuring the metropolitan SUMP and align local SUMPs; iii) developing new mobility options in coordination with new urban developments (i.e. according to the principles of Transit Oriented Developme); iv) developing smart urban logistic solution aimed at minimizing costs for businesses and reducing the environmental impacts v) move to clean power for public transport vehicles;
- *Co-create an inclusive city*. This goal deals with the introduction of new methods for civic engagement that will help the city to source local solutions to urban challenges. To meet this goal, the strategy assigns a central role to the "Boroughs" (administrative entities representing a bridge between citizens and the city administration) that currently have very limited authority and thus a weak impact on the development and progress of the city. In particular, the strategy foresees: i) on the institutional side, a complex reform of boroughs; ii) on the practical side, the development of a portfolio of methods for Boroughs to enable community-led projects. A campaign to re-introduce the Boroughs to the people, followed by capacity building workshops are also included in the strategy;
- *Build a dynamic urban economy.* This goal concerns with the development of an urban economy policy agenda which supports local economic cluster activities and prepares the city for a changing world through financial resilience. The agenda includes a series of interventions in different neighborhoods of the city aimed at clustering in specific areas economic activities. For instance, the agenda introduces

decision-making and integrated planning models for the commercial districts of the city. It also provides an integrated Market Redevelopment Strategy for Kapani market area and support tourism and creative economy through specified zones and incentives;

- *Re-discover the city's relationship with the sea.* The city waterfront forms an integral part of Thessaloniki's identity. It also one of the main reasons for Thessaloniki's commercial, cultural and educational success over thousands of years. However, its potentials for fostering urban resilience have not fully exploited. With this strategy, the Municipality of Thessaloniki intends to put forward different initiatives aimed at maximizing the attractiveness, leisure potential and multi-functionality of the waterfront. Initiatives aimed at achieving these goals include: i) the re-development of the bay area, with the location of new recreational infrastructures along the sea-side; ii) the development of resilient off-shore interventions and iii) the restoration of the matitme ecosystem through environmental engineering artworks.

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IMAGE SOURCES

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05

THE RESILIENCE CITY/THE FRAGILE CITY. METHODS, TOOLS AND BEST PRACTICES 1 (2018)

REVIEW PAGES: NEWS AND EVENTS

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In this number

URBAN RESILIENCE AND SOCIO-ECONOMIC FRAGILITY

As an interdependent global society enters an era of unprecedented change, resulting from unforeseen natural and social disasters and vulnerabilities, the resilience of global cities to survive is a pressing concern, as demonstrated by the growing consideration given to global mitigation and adaptation policies (Galderisi, 2104). In this regard, large attention has been focused on the construction of buildings and infrastructures designed to withstand catastrophic events and ensure greater security for the cities, while another important aspect of urban resilience, the socio-economic one, has been more neglected. If the concept of resilience simultaneously embodies the capacity of urban systems to bounce back, adapt or transform, can we say that a city with a static socio-economic structure is inherently fragile?

There are several tragic examples of difficulties for a population to react to socio-economic factors changes even in the absence of destructive environmental disasters that seem to confirm this hypothesis. It is the case of the so-called *shrinking cities*, a phenomenon that generally refers to a metropolitan area that experiences significant population loss in a short period of time. These are cities that have been depopulated as a result of a process of socio-economic changes that they have not been able to adapt to. Particularly vulnerable in this sense are cities that depend on one or few resources such as a specific industry or a mineral resource, with a high risk of depopulation in case of obsolescence of the technology they serve and the related know-how.

Therefore, the differentiation of resources and functions could be an important element for the increase of urban resilience. In human societies the ability to differentiate one's activities, to find new sources of energy or income, to know how to adapt to contextual change, necessarily passes through a series of specific mechanisms and favorable environmental conditions: education, technology, financial abilities of individuals, the redistribution of wealth, inclusiveness in the decision-making system, corruption, judicial bodies, crime etc. Is it possible to calculate the degree of resilience of a city based on these socio-economic characteristics? Attempts to measure social resilience or, on the other hand, its vulnerability, have been carried out by developing investigative tools such as the Social Vulnerability Index (SoVI), which groups 42

variables concerning the socio-economic conditions of the population of a given geographical area in order to examine the spatial patterns of social vulnerability to natural hazards at the county level in the United States and to understand the related social burdens of risk (Cutter et al., 2003). This kind of tools open the way to a thorough knowledge of the phenomenon and above all to its synthetic measurement. Therefore, while the analytical tools start to be formalized, the questions are: what kind of strategies are the best to improve the identified weaknesses of the urban system in terms of socio-economic fragility? and how to measure their effects?
The following selected conferences could represent a fertile ground for scientific advances on these topics.

SECOND ANNUAL INTERNATIONAL URBAN SECURITY AND RESILIENCE CONFERENCE – WORKSHOP

Where: Toronto, Canada
When: 8-10 May 2018
http://urbansecurityresilienceconference.ca/

The increased risk of catastrophic events, whether accidental or deliberate, or by way of natural disasters, means there is now more so than ever before, a need to ensure the resilience of our cities. Large scale urban built infrastructure is a critical node within the intertwined networks of urban areas, which include not only physical components, but also integrated hardware and software aspects. To date, a comprehensive and holistic approach to improve the resilience and security of large scale urban developments against attacks and disruptions, has not been developed thoroughly; therefore, the Second Annual International Urban Security and Resilience Conference could represent a good opportunity to share different experiences and researches on this topic. The conference is divided in six Panels and three workshops alternated with keynote speakers' speeches. The titles of the panels are the followings:

- Cyber risk and the changing role of leadership;
- innovation;
- critical infrastructure planning, design and implementation;
- urban transportation and soft targets;
- counter-terrorism;
- governance and civil society: European perspective.

AESOP ANNUAL CONGRESS 2018

Where: Gothenburg, Sweden
When: 10-14 July 2018
http://www.aesop-planning.eu/

This event will offer the opportunity for scholars from Europe, as well as from around the world, to contribute to the exchange of experiences, ideas and knowledge regarding planning in the 21st century, in particular in relation to the main congress theme: *making space for hope*. It is divided in sixteen tracks articulated in eleven parallel sessions. Among these tracks the number 13 called *Ecologies* "seeks to critically explore the normative content of today's planning for sustainable development in an era that is often called the anthropocene, but also to discuss alternative ways of working with sustainability issues such as mitigation and adaptation, zero-carbon urban development, resilience of places, human/non-human interaction within planning, more-than-human approaches to planning and interrelationships between nature and culture in planning". All these elements drive towards one main question: "Do today's challenges call for new planning practices, new designs, new policies and tools and also new ways of teaching planning?", which will represent the main focus of the session discussion.

THE INTERNATIONAL DISASTER AND RISK CONFERENCES (IDRC)

Where: Davos, Switzerland
When: 26-30 August 2018
https://idrc.info/

The International Disaster and Risk Conference IDRC Davos 2018 is organised by GRF Davos, an organization which promotes the worldwide exchange of know-how and expertise, creates solutions and fosters good practices in integrative risk management and climate change adaptation. The IDRC is a multisectoral platform for disaster risk reduction addressed to practitioners and scientific experts from politics, government, business, science, NGOs, media and the public. Through the IDRC conferences and workshops the GRF Davos wants to make the disaster risk reduction a policy priority, hoping for the institutional strengthening, moved by the awareness that urban resilience is a phenomenon of simultaneous reconstruction of individual personalities, collective identities and public apparatus. This commitment is triggered by the great economic, social and environmental losses of events related to extreme weather and climate conditions, including hydrological ones. Along with climate change, socio-economic developments such as population growth and economic wellbeing, developments in risk areas and degradation of natural ecosystems will influence the exposure and vulnerability of many regions all over the world. To deal with the large number of risks and disasters society is facing today, it is necessary a multidiscipline approach. Therefore, reinforcing the resilience imposes cognizant and public procedures for participation of interests, sharing of citizenship experiences and best practices.

ISCRAM ASIA PACIFIC 2018-INNOVATING FOR RESILIENCE

Where: Wellington, New Zeland
When: 5-7 November 2018
http://www.confer.co.nz/iscramasiapacific2018/

The ISCRAM Association's primary mission is to foster a community dedicated to promoting research and development, exchange of knowledge and deployment of information systems for crisis management, including the social, technical and practical aspects of all information and communication systems used or to be used in all phases of management of emergencies, disasters and crises. The conference, which arises from an innovative path of dialogue and cooperation between operators, policy-makers and scholars developed as a result of the earthquakes that hit New Zealand in the last years, will discuss the international experiences presented in the perspective of building the city's resilience strategy, as in the case of Christchurch, Darfield, Seddon and Kaikoura, which developed an appropriate information systems to support crisis management, after several natural earthquakes. This is a precious opportunity to access valuable knowledge and experience in a field - that of critical asset resilience and strategic infrastructure - of great interest and relevance for the development of our cities' resilience strategy. The purpose of ISCRAM Asia Pacific 2018 is to exchange research into and experiences of information systems use in emergency management, focusing on understanding disaster risk, strengthening disaster risk governance to manage disaster risk, investing in disaster reduction for resilience, and enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction. The conference is articulated in nine tracks, namely:

- Resilience to cope with the unexpected;
- Monitoring and Alerting Systems supporting Business as Usual and Emergency Warnings;
- Data Issues for Situation/Disaster Awareness;
- Geospatial and temporal information capture, management, and analytics in support of Disaster Decision Making;
- Human centred design for collaborative systems supporting 4Rs (Reduction, Readiness, Response and Recovery);
- Understanding Risk, Risk Reduction, Consequences and Forecasting;
- Social Media and Community Engagement Supporting Resilience Building;
- Information systems for disaster healthcare;
- Enhancing Resilience of Natural, Built, and Socio-economic Environments.

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IMAGE SOURCES

The image shown in the first page is taken from:
https://redguard.deviantart.com/art/Glass-City-33589180

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TeMA

Journal of
Land Use, Mobility and Environment

CALL FOR PAPERS: TEMA VOL. 11 (2018)

The Resilience City/The Fragile City. Methods, tools and best practices.

The fragile/resilience city represents a topic that collects itself all the issues related to the urban risks and referred to the different impacts that an urban system has to face with. Studies useful to improve the urban conditions of resilience (physical, environmental, economical, social) are particularly welcome. Main topics to consider could be issues of water, soil, energy, etc.. The identification of urban fragilities could represent a new first step in order to develop and to propose methodological and operative innovations for the planning and the management of the urban and territorial transformations.

The Journal also welcomes contributions that strategically address the following issues:

- new consideration of the planning standards, blue and green networks as a way to mitigate urban risks and increase city resilience;
- the territorial risks and fragilities related to mobility of people, goods, knowledge, etc.;
- the housing issue and the need of urban regeneration of the built heritage;
- socio-economical behaviour and the "dilemma" about emergency and prevention economy;
- the city as magnet of the next future's flows (tourism, culture, economy, migration, etc.).

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

- first issue: 10th January 2018;
- second issue: 10th April 2018;
- third issue: 10th September 2018.

CALL FOR PAPERS: GENERAL CALL.

Papers in Transport, Land Use and Environment

The Journal welcomes papers on topics at the interdisciplinary intersection of transport and land use, including research from the domains of engineering, planning, modeling, behavior, economics, geography, regional science, sociology, architecture and design, network science, and complex systems

EDITORIAL PREFACE: TEMA JOURNAL OF LAND USE MOBILITY AND ENVIRONMENT 2 (2018)

THE RESILIENCE CITY/THE FRAGILE CITY. METHODS, TOOLS AND BEST PRACTICES

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The 11th volume of TeMA Journal consecrates the three issues of 2018 to promotes the scientific debate on the fragile/resilience city that represents a topic collecting itself all the issues related to the urban risks and referred to the different impacts that an urban system has to face with. Studies useful to improve the urban conditions of resilience represent the aim of our editorial work of this year. The identification of urban fragilities could represent a new first step in order to develop and to propose methodological and operative innovations for the planning and the management of the urban and territorial transformations.

The section "Focus" contains two articles. The first article, titled "Urban commons: social resilience experiences to increase the quality of urban system" by Gulia Esopi (University of Pavia, Italy), defines a specific typology of urban commons and aims to show how these are social resilience-based phenomena that can increase the quality of urban system. The contemporary urban studies debate intends the city as a complex system that interacts with other cities creating a complex global network. This research shows that many of urban common characteristics are social resilience based and they reinforce social component capacities.

The second article "Second law of thermodynamics and urban green infrastructure - A knowledge synthesis to address spatial planning strategies" by Mehrnaz Molavi (University of Guilan, Turkey) outlines the necessity for cities to cope with natural disasters. The case of Lahijan, close to the Caspian Sea is studied with the aim of value the level of its resilience. The performed analyses based on the combination of inferential statistics techniques and the Delphi technique revealed that Lahijan is totally in the low spectrum of resilience. The author conclusions underline the need of supporting and strengthening community-based activities, disaster risk reduction, and capacity increase of institutional adaptability in order to assist Lahijan residents to encounter to the human hazards, natural hazards, and increasing risks resulting from change.

The section "Land Use, Mobility and Environment" collects two articles. The first article, titled "The Value of Urban Density", by Fabio Alberto Hernandez Palacio, Sabrina Scherzer, Yngve Karl Frøyen (Norwegian University of Science and Technology), deals with the relationship between urban density and environmental sustainability, through a study based on real estate values. The case study covers residential property prices in Trondheim, Norway and analyses 23 distinct urban areas for the average price per square meter and three density measures: density of coverage, density of housing units and population density. A simple hedonistic pricing model was used based on 1,255 sales transactions for the period 2014 and 2015 which includes the characteristics of the property, such as the type of property and the age of the property; proximity measures, such as distance to the next school or bus stop; and the three density measures. The model, applied to the complete data set and to the two subsets of the outskirts of Trondheim and the center of Trondheim, shows unexpected but interesting results.

The second article, titled "Applying spaces syntax measures in analysing the spatial structure of street network to understand mobility pattern and land use. - A case of an Indian city, Mysore", by Harcharan Pappu (Sri Venkateshwara College of Architecture, India), debates on the comprehensive application of space syntax techniques in analysing the spatial structure of the street network to an Indian city, Mysore. The study is done by breaking the structure into components and analyzed using different measures like integration and choice using depth map software. The analysis is then related to the existing mobility pattern and land use to construe how the spatial structure influences the mobility pattern and land use.

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 on the subject of energy reduction consumption in the transport sector. In particular, the Web section by Rosa Morosini describes three web resources of: (i) Corine Land Cover; (ii) Italian National Institute for Environmental Protection and Research and (iii) European Environment Agency. The Books section by Gerardo Carpentieri briefly reviews three relevant books related to the Issues' theme: (i) Land Use Planning for Urban Flood Risk Management; (ii) Building urban resilience: A guide for Red Cross and Red Crescent engagement and contribution and (iii) Smart Planning: Sustainability and Mobility in the Age of Change. The Law section by Maria Rosa Tremiterra keeps readers up to date with comparison between three legislative documents, in order to increase the flood resilience in the EU Member states (Netherland, England and France). The Urban Practices section by Gennaro Angiello presents two case studies for planning for resilience in two mediterranean capitals: (i) Rome and (ii) Athens. The News and Event section by Andrea Tulisi, proposes a selection of conferences on the topic of Big Data as the tool for urban antifragility.

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URBAN COMMONS:

SOCIAL RESILIENCE EXPERIENCES TO INCREASE THE QUALITY OF URBAN SYSTEM

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ABSTRACT

The present paper defines a specific typology of urban commons and aims to show how these are social resilience based phenomena that can increase the quality of urban system.
The contemporary urban studies debate intends the city as a complex system that interacts with other cities creating a complex global network. At the same time, the city is subject to continuous and rapid changes that generate instability conditions and make it fragile. The institutions, responsible for territory sustainable development, struggle to deal with these phenomena generating situations of inefficiency and poor functioning of city system and its parts. In example, the inability of institutions to manage the territory is represented in static and rigid space arrangements of a fluid system. These situations cause the misuse/under-use of spaces and services by society and the dissatisfaction of city users needs.
In an attempt to fill the gap left by public actors, community initiatives are emerging from below aimed to shape urban space creating new opportunities for community use. These are forms of collaboration and cooperation among different individuals that take responsibility for urban resources by satisfying both collective and individual needs. They are social resilience experiences, or rather reactions-actions by individuals that represent alternatives to traditional planning. The social component abilities (reactive, adaptive and proactive) increase the quality of urban system in terms of enhancement, sustainability and attractiveness. From these interaction among physical elements and individuals, new forms of wealth are generated as urban commons.

KEYWORDS:
Urban commons; social resilience; urban system quality.

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城市共同体

以提高城市系统质量为目的的社会复原能力经验

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摘要

本文定义了一种特定类型的城市共同体，旨在表明这些基于社会复原力的现象如何提高城市系统的质量。
当代的城市研究将城市看作一个复杂的系统；它与其他城市相互作用，从而构建起一个复杂的全球网络。同时，城市面临的种种持续、迅速的变化，产生了不稳定状况且让城市变得脆弱不堪。负责地域可持续发展的各种机构，致力于处理这些导致城市系统及其各部件出现效率低下和运作不力问题的种种现象。例如，机构无力管理的地域的问题，表现为流体系统的静态和刚性空间安排。这些情况导致了社会对空间和服务的滥用/使用不充分，以及城市用户不满意的结果。
作为填补公共行为者留下的空白的一个尝试，出现了如下的社区活动计划，其目的是打造城市空间，提供社区可使用的新机会。不同个人之间进行这些协作和合作的形式，通过满足集体和个人的各种需求，承担了不同城市资源的责任。包括社会复原能力的经验，或者反应力——即作为传统规划方式替代品的个人行动。社会组成部分的能力（反应力、适应性和积极主动性）能提高城市系统在可持续发展和吸引力方面的品质。从各种物理因素和个人之间的这些相互作用中，产生了新形财富，即城市共同体。

关键词：
城市共同体；社会复原力；城市系统品质。

1 INTRODUCTION

1.1 BACKGROUND

In recent decades, the urban studies have underlined the role of the city as a complex system (Pumain, et al., 1989; Nijkamp & Reggiani, 1998; Bertuglia & Staricco, 2000; Batty, 2005; Portugali, 2013). The complexity is due to the duality of urban system, consisting of an artificial component of well-defined elements and *urban agents*. These latter, interacting with the artificial component and the surrounding territory, make the city nature chaotic and difficult to predict (Portugali, 2013). At the same time, the complex urban system interacts with other cities creating a global network that is also complex (Bertuglia & Vaio, 2011). Moreover, the city is exposed to rapid and sudden changes of several nature (political, socio-economic, environmental) which cause continuous mutations of population needs. These events strain the urban system generating instability conditions that threaten its balance and make it 'fragile' (Blečić & Cecchini, 2016). The institutions, responsible for urban sustainable development, have the task to understand the challenges and their effects and to address them through focused and planned strategies. For several reasons (public funding reduction, obsolete and rigid government tools, etc.), they struggle to carry out their assignment, generating deadlock situations that result in inefficiency and poor functioning of city system and its parts. For instance, their inability to manage the territory in order to allow the physical city adaptations implies static and rigid spatial arrangements, that often are unable to meet inhabitants needs. These situations involve the under-use/misuse of spaces and services intended for collective and, therefore, the increase of physical and social degradation. The city parts deterioration compromises the quality of urban environment and landscape, indicators of society well-being along with health, education and training, work and reconciliation of life time, economic wellbeing, social relations, politics and institutions, research and innovation (Istat, 2015). The inability of institutions to meet citizens needs involves a widespread loss of confidence in their role and, consequently, the society's willingness to be a protagonist both in decision-making phases and in operational ones. Thus, autonomous initiatives arise from below aimed to shape urban space creating new opportunities for community use. These are forms of collaboration and cooperation among different subjects and actions of urban resources sharing with the aim to satisfy both collective and individual needs. In particular, experimental practices create places for different activities (social, economic, cultural, recreational, sporting) that, often, allow the recovery of under-utilized or abandoned buildings and spaces. The interactions between social component and physical elements generate forms of wealth comparable with urban commons.

1.2 RESILIENCE IN URBAN SPACE

The ability to cope with external stresses and changes by returning to an equilibrium state (not necessarily equal to the original one) is known with the term of resilience (Newman, 2010; Colucci, 2012; Papa 2012). The present paper focuses on social resilience, understood as actors' abilities to face shocks and adverse conditions (reactive capacity), to adapt to changes preventing possible future risks (adaptive capacity) and to create opportunities for creativity, innovation and development of new skills (proactive capacity) (Adger, 2000; Carpenter et al., 2005; Bohle et al. , 2009; Obrist Pfeiffer & Henley, 2010Brunetta & Baglione, 2013;). Social resilience is a dynamic concept that recognizes in the abilities of individuals (alone, gathered in communities, entire society) the alternative responses to problems of complex systems, such as urban ones.

1.3 AIM, METHODOLOGY AND STRUCTURE OF THE PAPER

The presented research is about the deepening of urban commons concept in relation with resilience and it refers to issues such as alternative planning methods related to place-making and social urban processes. The aim of the paper is to demonstrate how best practices and experiences contribute to increase the urban system resilience. In order to pursue the aim, the research follows a deductive methodology which, starting from the analysis of literary references, traces the general and specific features of urban commons as drivers for social resilience; subsequently it verifies their consistency through the analysis of a case studies database. Moreover, the research shows which specific urban commons features contribute to increase urban resilience by providing collective responses to deadlock situations and, at the same time, experimenting new practices for developing the local territory.

The research work is structured into distinct phases:

- *State of the art*. Brief analysis of the topic: from the main researches conducted in the twentieth century to last decade studies that contextualize the theme in urban areas (§ 2);
- *Investigation*. Phase aimed to understand the key aspects of the topic. It is subdivided into two parts: one that, starting from emerging implications of state of the art, focuses on the general characteristics of urban commons; and another that from the general features traces the specific ones. Through a case studies analysis, the research verifies the consistency of specific features and identifies which of them contribute to increase resilience (§ 3 e 4);
- *Discussions and conclusions*. Comments on remarks arising from the investigation phase and future research developments (§ 5 e 6).

2 STATE OF THE ART

2.1 THE TWENTIETH CENTURY STUDIES

The interest in the concept of the common good has evolved in history in a discontinuous way: introduced for the first time in Roman law, it was left out in the Modern Era due to the prevalence of the public-private dichotomy. From the second half of the twentieth century, the concept has been investigated thanks to conducted studies.

In the essay 'The Tragedy of the Commons' published in 1968, Hardin focuses on common goods that he intends as open access resources that anyone can use for personal gain. The author states that the commons are subjected to an inevitable tragedy due to their over-exploitation by individuals and he believes that the only solution is the ownership of the good (state or private). Property rights make the individual responsible and, by extension, the society sustainable (Hardin, 1968).

Few decades later Ostrom, basing on Hardin's studies, continues the investigation work on the topic. She refers to common pool resources material or intangible, not excludable used or produced by more or less large communities. She states that "*commons is a general term that refers to a resource shared by a group of people*" (Ostrom & Hess, 2007). Ostrom refutes the dichotomy between State and Market proving the existence of an efficient and sustainable governance of resources based on management by communities. The communities, composed by resource appropriators and users, are able to manage natural resources in a sustainable way over time and under certain conditions (knowledge, trust and communication between members and existence of institutions that establish rules on the territory). Community management, in addition to preserving goods, is based on members abilities to foster new cooperative and non-competitive production way. Thanks to theoretical considerations and empirical observations, she elaborates eight key principles of commons cooperative self-management: clearly defined boundaries, congruence between appropriation and provision rules and local condition, collective-choice arrangements, monitoring, graduated sanctions, conflict-resolution mechanisms, minimal recognition of rights to organize, nested enterprises (Ostrom, 1990). At the beginning of the new millennium, Rodotà identifies the commons as goods with widespread ownership that belong to everyone and to nobody, in other words everyone can access them, no one can boast exclusive claims. They are functional to the exercise of fundamental rights and to the development of free personality. For these reasons, they must be safeguarded by subtracting them from the

destructive logic of the short term and must be governed in the interest of future generations incorporating the long-term dimension (Rodotà, 2012).
At the same time, Mattei, supporting Rodotà's thesis, understands the common goods as instruments of basic needs satisfaction and as community rights to be protected and promoted. Moreover, the author claims that the commons exist in a qualitative relationship, in other words they are objects that take value if they are connected to subjects (Mattei, 2011).

2.2 COMMONS IN URBAN AREAS

In the last decade the topic has been contextualized in urban areas (Harvey, 2011; Susser & Tonnelat, 2013; Borch & Kornberger, 2015; Foster & Iaione, 2016) thus becoming a key topic of the contemporary urban studies debate. Referring to the city context, urban commons are small and large scale resources which are collaboratively managed by groups of heterogeneous users.
Each specific context is characterized by specific resources. The common goods analyzed by Ostrom refer to natural resources, characterized by the difficulty to exclude potential beneficiaries and by that the use by an individual decreases the availability for others. These are subtractive resources because the use decrease its value. In example, each cut tree in a forest reduces the availability for other users and the overall value of the resource itself.
Unlike common-pool resources, urban commons belong to a context characterized by peculiarities (such as density, proximity, complexity, etc.) that make urban commons non-subtractive resources whose consumption becomes a productive act that can increase the value of urban systems. Through their daily activities, individuals create the social world of the city and, simultaneously, they product urban commons. According to Harvey *"the common is not, therefore, something extant once upon a time that has since been lost, but something that, like the urban commons, is continuously being produced"* (Harvey, 2011).
Susser and Tonnelat highlight that the commons define three components of the right to the city: the right to urban everyday life, to simultaneity and encounters and to creative activity. The first urban commons refers to production, consumption and use of public services and goods; while the second to spaces of mobility and collectively used (streets, subways, public gardens, web, etc.). The last refers to work of artists in mobilizing communities and redefining the conditions of environment perception. If brought together, these three urban commons set the conditions for the future city (Susser, Tonnelat, 2013). According to Borch e Kornberger the urban commons *"only come into existence through the encounter of people, things and ideas. Density and proximity are the intangible fibres that are woven into the fabric of the urban commons. Far from being a 'pool', the urban commons is seen here as the corollary of interactions in dense network"* (Borch & Kornberger, 2015). Urban interactions make public space valuable, bringing several benefits not only to involved actors but to the whole society and to urban environment and landscape. Interaction facilitates a host of benefits such as cooperation, knowledge exchange, social capital accumulation and various other positive externalities that occur to individuals in close proximity to one another (Foster & Iaione, 2016). Urban commons are non-subtractive resources produced by individuals interaction; their becoming depends on people abilities (reactive, adaptive and proactive) to adapt them to continuous changes.

3 FEATURES OF URBAN COMMONS

The analysis of literature references allows the creation of an overall theoretical framework related to the topic and, at the same time, the deduction of indications that start the investigation about urban commons key features. This phase is subdivided into two parts: one that, starting from the emerging implications of the state of the art, focuses on the general characteristics of the urban commons and another that, from the general characteristics, traces the specific ones.

3.1 GENERAL FEATURES

From an economic point of view, goods are classified according to the characteristics of excludability (possibility to exclude those who do not pay from using the good) and rivalry (consumption by an individual reduces the availability for others) (Frank, Bernanke et al., 2015). Public goods, which are non-excludable and non-rivalrous, are produced, managed and maintained by institutions and are used by community (for example: national defence). An example of urban public good is the square, owned by Public Administration (responsible for managing and maintenance activities) and used by society.

Private goods, excludable and rivalrous, are those whose enjoyment is insured only to a person (or to a small group of people), in a full, exclusive and absolute way. In this case, the owner can sell the good to third parties transferring the same rights (for example: a car). In urban areas, an example of private property is an lot of land owned by the individual. There are also hybrid forms of good, such as common good, rivalrous but non-excludable. The commons are shared resources aimed to satisfy the community needs. They are created by individuals who, through various modality of cooperation and sharing, actively participates in their management and governance. Blackmar defines commons as *"an individual's right not to be excluded from the uses or benefits of resources"* (Blackmar, 2006). In particular, urban commons can be both public (i.e an abandoned school building recovered by a group of citizens and used to satisfy collective benefits) and private (i.e. private lot that is temporarily yielded to inhabitants for collective use).

Further considerations regarding the differences between public, private and common resources emerge considering the ownership, use and care of the good. In particular:

- *Ownership.* Differently from public and private goods for which ownership is a key aspect that defines a specific decision-maker, common goods shift the focus from ownership to the social function. For this reason they can be public or private. People use the resource both through specific methods such as regulations and contracts and through spontaneous actions;
- *Use.* While in private property use is limited to the owner or to a small group of people, in the common goods, as in the public ones, the use is open to a collectively of users;
- *Care.* The care refers to the availability of resources such as time, professional skills, means, donations for the resource enhancement (Arena & Iaione, 2015). It involves activities such management, events planning and maintenance. In public resources, these activities are managed by the Public Administration; while in the private ones the care modalities are carried out or established by the owner. In the case of common goods the individuals act on the public or private resource not only using it but contributing to its care.

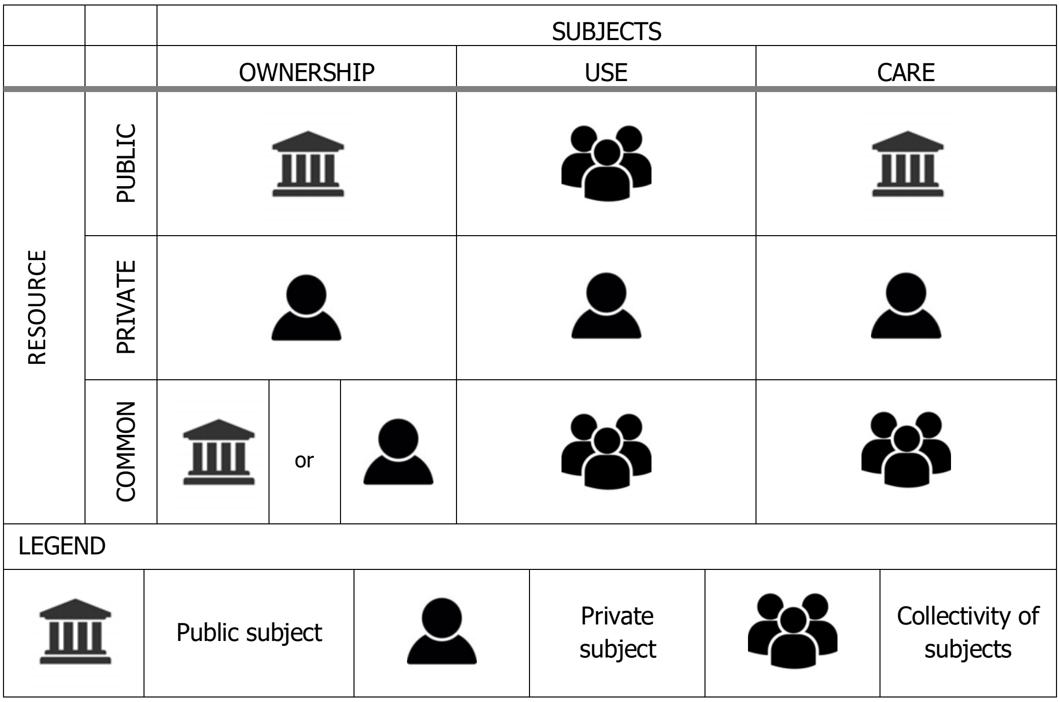
The figure below summarizes the differences between public, private and common urban resources considering the ownership, use and care. In particular, it is valid for physical resources within urban contexts such as open spaces. From these considerations it is possible to affirm that a good becomes common when the community recognizes it by activating for its care. As Mattei says, common good is concretized in the qualitative relations between object (urban space) and subject (individuals).

From the state of the art and the analysis of the main differences between public, private and common resources it is possible to trace the ontological and general features of the urban commons, which are illustrated in figure 1.

In particular:

- *Object resource*. The concept of the common good refers to that of resource, an element or set of elements that can be used by an individual to satisfy his needs. Resources are useful (indispensable for human needs, living beings and ecosystem satisfaction) and scarce (insufficient compared to the requirements). The resources, useful and scarce, are precious elements to protect and to pass on to future generations in accordance with the principle of sustainability;

- *Subject group of individuals*. Presence of individuals who gravitate around the resource for interests of different nature (economic, social, environmental). This is an essential feature because it involves the recognition of resource value by a group of people who are committed to its care;
- *Interactions*. Between subject and object are established direct relations (relating to the actions that individuals perform on the resource) and indirect (typically socio-economic relations) among the various subjects involved. At the same time, these actions produce effects for surrounding urban environment and landscape.



Tab.1 Differences between public, private and common resources

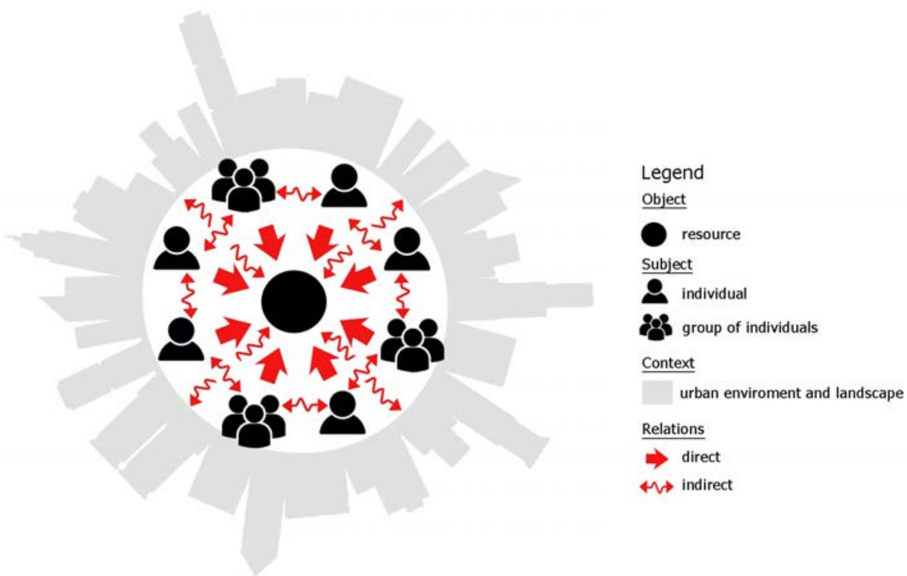


Fig.1 Urban common scheme

3.2 SPECIFIC FEATURES

Later, the research work focuses on specific characteristics which are traced from the general ones. In particular, it refers to specific urban resources, sites for activating communities actions: the urban spaces. It examines urban spaces of different scale (macro and micro) that involve different stakeholders. At macro level, the brownfields are precious resources both for the position (located in strategic urban contexts close to central and high-density areas) and for the presence of urbanization development works. For these reasons, they represent the places of resilience and experimentation to regenerate and reconvert with new functions and activities. At micro level, open spaces, if properly upgraded or in an suitable state of conservation, provide a range of benefits. They represent the places of social relations to be enhanced (i. e. parks and green areas, squares, play areas, school playgrounds, vacant lots). The specific characteristics are divided into physical, social and relational. The physical features refer to those necessary for the resource to be used; social ones are attributes of individuals which use the resource. Finally, the relational characteristics refer to direct and indirect relations that are established among resource, individuals and urban environment and landscape.

Physical specific features:

- *Accessibility*. From the physical point of view, accessibility indicates the possibility of physical and secure access to a resource. This parameter implies the connection of the urban space with the surrounding context and its integration within the city system through an efficient network of infrastructures for fast and soft mobility. Moreover, an accessible resource must allow entry to different users, especially the weak ones (children, elderly, user with mobility and sensory impairments);
- *Quality*. The quality of a resource refers to its state of conservation, in particular to attributes such as order, tidiness. Quality is a necessary feature for an optimal resource use to be pursued and maintained through an efficient management and maintenance way;
- *Reversibility*. Spatial reversibility implies the return to a previous condition or to the original state after an activity cessation. The reversible interventions are based on experimentation periods, thanks to which it is possible to evaluate their degree of success and to make decisions regarding possible changes, the return to original state or the transition to a permanent one;
- *Flexibility*. The 'ability' of an urban resource to physically edit in order to adapt to user needs.

Social specific features:

- *Mix of stakeholders*. The subjects that gravitate around an urban resource can be both public and private. In particular, public actors refer to the administrative sphere, while private actors refer to citizens (alone or in groups), non-profit organizations and businesses. The presence of different subjects consequently implies that of different interests: general (referring to the whole community) and specific (referring to the individual actors). Often, the satisfaction of general interests also entails specific benefits (i.e. improvement the quality of life);
- *Mix of knowledge*. Combination of expert knowledge and common knowledge. Expert knowledge concerns actors who transform their professional competence and cognitive inputs (data, information, concepts, etc.) into output knowledge with added value (problem solutions, innovative ideas, experimental projects). These are intellectuals, members of public administrations, entrepreneurs, professionals, technicians. Common knowledge refers to communities knowledge. Urban commons are experiences that arise from the union of both knowledge in order to address specific tasks or to solve collective problems;
- *Cultural diversity*. The term culture diversity is a fact of contemporary urban contexts: the presence on a territory of multiple cultures. This specific feature can increase the value of an urban commons because it makes a resource identifiable and recognizable by people from different cultural backgrounds;

- *Inclusion*. Feature that implies a free and non-exclusive use of the resource, that is not limited to a few or to a small group of individuals. Social inclusion means ensuring to each individual (regardless of age, gender, ethnicity, etc.) the fruition of the resource, eliminating any form of fence.

Relational specific features:

- *Mix of uses (direct)*. Use refers to resource fruition by a subject in order to satisfy a need. From a temporal point of view, use is distinguished in permanent (long-term) or temporary (short-term). In contemporary urban contexts, characterized by continuous changes and transformations, temporary uses are becoming an increasingly important aspect. *"Temporary uses are flourishing both in the in-between spaces where there is flexibility in the rigors of the property market, and in areas where multi-use is feasible. Some uses are planned an formal; some are informal, accidental, spontaneous or even illegal. Some occur when a city is shrinking, some when it is growing. Some uses last for a night or weekend, some are seasonal, while others may last five years or more. Some are acts of political defiance, while some are government interventions"* (Bishop, Williams, 2012). The urban commons are spaces for collective uses and, therefore, they allow the carrying out of different activities (social, economic, cultural, educational, artistic, recreational, sports, etc.);
- *Social interactions (derived)*. Interactions of social nature that are created as a result of individuals in relations with each other. Social interactions facilitate cooperation and produce mutual benefits such as information sharing, collective action, decision-making ability and the reduction of opportunistic behavior. The set of relations generates a form of wealth based on human needs: the social capital;
- *Interactions with urban environment and landscape (derived)*. The environment refers to ecosystem and its elements. Natural environment (characterized by the prevalence of nature compared to anthropic action) and urban one (entirely produced and transformed by man) constitute the components of the human environment. *"The urban environment influences human well-being, therefore, a healthy, supportive environment is indispensable to quality of life in cities. People need to breathe clean air, have access to clean drinking water and adequate housing conditions and enjoy quiet and peaceful places. Accessible, good quality, well-maintained green spaces and playgrounds, modern transport systems and safe, walkable neighbourhoods that encourage physical activity and social interactions are key constituents of urban quality of life"* (European Environment Agency, 2009). The landscape is understood as a set of elements that contribute to analyze the place through its environmental, social, historical and geographical peculiarities, but also through identity and cultural values that characterize it. *"Landscape means an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors"* (European Landscape Convention, 2000). The actions undertaken by the subjects on the resources involve effects both in terms of urban ecosystem quality, as well as in terms of identity, recognition and enhancement of the city landscape.

4 CASE STUDIES: URBAN COMMONS FOR RESILIENCE

In order to verify the consistency of the characteristics traced and to define the resilience of these specific urban commons, the research analyzes the case studies database created by Francesca Ferguson (2014). The choice of the database is mainly due to several reasons:

- *Geographic context*. The analyzed case studies belong to European contexts, in particular Northern European cities which appear more advanced on the issue of collective management of urban resources. Moreover, from the urban morphology point of view, these contexts present some analogies with the Italian one;
- *Reference scale*. The database considers examples both at the macro and at the micro level;
- *Heterogeneity*. Wide range of actions on urban spaces both permanent and temporary;
- *Specific information*. Data deriving from interviews with the main stakeholders.

In particular, the analyzed case studies are: Superkilen, Copenaghen (I); Tempelhofer Feld, Berlin (II); Prinzessinnengärten, Berlin (III); NDSM wharf, Amsterdam (IV); R-URBAN, Paris (V); Hackney Wick & Fish Island, London (VI); Freehouse, Rotterdam (VII); Geopark, Stavanger (VIII); Plaza Ecópolis, Rivas-Vaciamadrid (IX); Southwark Lido, London (X). Within this paper three examples (I,II,III) are deepened because considered substantial for aspects that will be discussed in the next paragraph. For each case study selected, specific characters are evaluated through the checklist method.

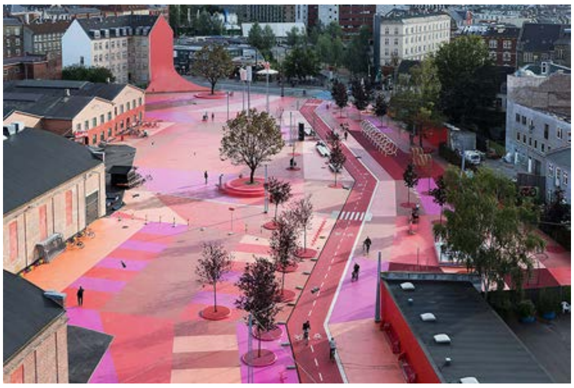


Fig. 2 - 3 Case studies I, II

Fig. 4 - 5 Case studies III, IV

Fig. 6 - 7 Case studies V, VI

Fig. 8 - 9 Case studies VII, VIII

Fig. 10 - 11 Case studies IX, X

4.1 CASE STUDY I: SUPERKILEN, COPENHAGEN (DK)

The urban space Superkilen (Fig. 2) is located north of the city center of Copenhagen and it develops along a strip of land that has been abandoned for decades due to railway line dismantlement. In 2008, the City of Copenhagen with the support of Realdania, a private association supporting philanthropy initiatives, launched a competition call for the realisation of an urban park able to foster the integration of ethnic groups in the area.

The winning project, resulting from the collaboration of architecture and landscape studios, involved the local population through consultation activities such as meetings and workshops. The participatory process covered both the preliminary phases of political and planning discussion and the subsequent phases of organization and management. Superkilen is an urban park characterized by a sequence of spaces destined to different cultural, commercial, recreational and sports activities. Moreover, a broad infrastructure plan was elaborated in order to reorganize mobility system and to connect the area with neighbouring districts by pedestrian and cycle paths (Ferguson, 2014; Archdaily; Realdania; Superflex).

Features that contribute to resilience (7): From physical point of view the conversion of an area from abandoned piece of land to an urban place (*quality*) and the possibility to adapt urban space to different activities (*flexibility*); from the social point of view the presence of expert and common knowledge (*mix of knowledge*) and of different cultures (*cultural diversity*); from the relational point of view, the possibility of using space for different activities (*mix of uses*), the cooperation and information sharing (*social interaction*) and the improvement of surrounding landscape increasing place identity and recognizing (*interactions with the environment and the urban landscape*).

Physical	Accessibility	✓	Safely accessible area in thanks to an infrastructure plan that reorganize mobility system and to connect the area with neighbouring districts by soft mobility paths
	Quality	✓	Abandoned area converted into an available urban space
	Reversibility	×	Permanent urban space
	Flexibility	✓	Possibility to edit some spaces in order to accomodate difference funtions
Social	Mix of stakeholders	✓	Public – Copenhangen City Private – Realdania (association); Topotek 1, BIG Architects, Superflex (designers); local population
	Mix of knowledge	✓	Expert Knowledge – Public Administration, designers Common Knowledge – Local population
	Cultural diversity	✓	Over 50 ethnic groups involved in the process
	Inclusion	✓	Inclusive space. Open Access resource
Relational	Mix of uses	✓	Cultural, commercial, recreational and sports activities
	Social interactions	✓	Sharing information and knowledge; cultural exchanges
	Interactions with urban environment and landscape	✓	New relationships with adjacent buildings and suburban streets; site attractiveness

Tab.2 Superkilen: check list analysis

4.2 CASE STUDY II: TEMPELHOFER FELD, BERLIN (D)

In 2008, following the closure of the Tempelhof airport, the city of Berlin purchased the vast urban space of 386 hectares for public use. Thanks to its strategic position (about 5 km from the city center) and the presence of countless activities, the Tempelhof park (Fig. 3) has become popular among residents and visitors.

The private company responsible for urban space development decided to integrate pioneering uses (small-scale and short-term initiatives experimented by the local population) into the planning process. The concept of the area, arising from the collective architecture of Raumlaborberlin together with the Berlin government and Urban Catalyst Studio, ranges from long-term planning to temporary practices. The spaces are demarcated according to the activities: areas for children and young people education, spaces for sport and leisure, buildings for cultural uses and a cluster for small temporary gardens. In 2013, the masterplan for the construction of new urban districts along the perimeter of the park, generated pressure from citizens that through a referendum decided to maintain the green area. In 2014, a statute based on a process that allow the integration of community initiatives enters into force regulating the park conservation and development (Ferguson, 2014; Raumlaborberlin).

Features that contribute to resilience (7). From physical point of view, the conversion of an disused site into an urban park (*quality*); the possibility to pioneer uses (*reversibility*) and to edit space for different activities (*flexibility*); from the social point of view, expert knowledge and common union (*mix of knowledge*); from the relational point of view, the possibility of using space for different activities (*mix of uses*), experimental practices and knowledge sharing (*social interaction*) and improvement of environment quality and the urban ecological value (*interactions with the environment and the urban landscape*).

Physical	Accessibility	✓	Accessible area by public transport; presence of access points with opening hours that depending on the season
	Quality	✓	Reconversion of a disused site; periodic monitoring of conservation state
	Reversibility	✓	Pioneering uses based on experimentation periods
	Flexibility	✓	Editable space designed to host different kind of events
Social	Mix of stakeholders	✓	Public – Berlin Municipality Private – Studio Urban Catalyst; Tempelhofer Projekt GmbH (designers); local population
	Mix of knowledge	✓	Expert Knowledge – Public Administration, designers Common Knowledge – Local population
	Cultural diversity	–	Date not available
	Inclusion	✓	Inclusive space. Open Access resource
Relational	Mix of uses	✓	Sports, recreational and cultural activities
	Social interactions	✓	Sharing of experimental practices and knowledge; collective action; decision-making ability
	Interactions with urban environment and landscape	✓	Improvement of surrounding environmental quality; increase of the urban ecological value and site attractiveness

Tab.3 Tempelhofer Feld: check list analysis

4.3 CASE STUDY III: PRINZESSINNENGÄRTEN, BERLIN (D)

In 2009, the non-profit company Nomadisch Grün, engaged in the dissemination of practices of urban gardens, launched a pilot project in a public area of Berlin that had been abandoned for several years.The project for Prinzessinnengärten community garden (Fig. 4) is based on an unplanned and gradual development process that has led from the initial phase of site setting up to a virtuous experience of urban agriculture.

The solution, resulting from the support of activists and volunteers network and discussed through various means (media, meetings and petitions), is a mobile garden to be moved in case of site future privatization. It allows the combination of different social, economic, learning and local production activities and temporary uses. Furthermore, Prinzessinnengärten is an informal learning place where skills are acquired through practical experience and knowledge sharing. With this project, the Nomadisch Grün's organization intends to provide opportunities for learning and participation, to increase the productivity and attractiveness of the neighbourhood and to experiment new experiences of urban resources community management (Ferguson, 2014, Prinzessinnengärten, Open Berlin).

Features that contribute to resilience (7). From physical point of view, the improvement of the state of affair and site regeneration (*quality*); the possibility to move the intervention according to future changes (*reversibility*), to edit space for different kind of events (*flexibility*); from the social point of view, the presence of expert knowledge and common (*mix of knowledge*) and the involvement of different culture people (*cultural diversity*); from the relational one, the possibility to use space for different uses (*mix of uses*), to learn and exchange information (*social interaction*) and improvement of sustainability of territory environment quality and the urban ecological value (*interactions with the environment and the urban landscape*).

Physical	Accessibility	✓	Easily accessible area by public transport system (bus, underground)
	Quality	✓	Improvement of the state of affairs and land regeneration
	Reversibility	✓	Designed to be moved in case of site privatization
	Flexibility	✓	Editable space designed to host different kind of events
Social	Mix of stakeholders	×	Private - Nomadisch Grün
	Mix of knowledge	×	Common Knowledge – Population and local associations
	Cultural diversity	✓	Events and learning projects involving experts from different cultures
	Inclusion	✓	Inclusive space. Open Access resource
Relational	Mix of uses	✓	Recreational, cultural, educational, productive, gardening and agriculture activities
	Social interactions	✓	Learning and educational activity; exchange of skills and knowledge; shared activities
	Interactions with urban environment and landscape	✓	Improvement of surrounding environmental quality; new identities creation

Tab.4 Prinzessinnengärten, Berlin (D): check list analysis

4.4 CASE STUDY IV: NDSM WHARF, AMSTERDAM (NL)

Physical	Accessibility	✓	Accessible area by public transport (bus, ferry, subway)
	Quality	✓	Disused buildings converted into spaces for the new activities incubation
	Reversibility	✓	Project based on tests, experiments and experiences selection
	Flexibility	✓	Adaptability of spaces within the building envelope
Social	Mix of stakeholders	✓	Public – Amsterdam Noord borough Private – Kinetisch Noord (group of artists, artisans and non-profit organizations); Vereniging NDSM (user association); Project Organization (organization), local population
	Mix of knowledge	✓	Expert Knowledge – Public Administration Common Knowledge – user associations, local population
	Cultural diversity	–	Date not available
	Inclusion	✓	Inclusive space. Open Access resource
Relational	Mix of uses	✓	Craft, creative, sporting, recreational and cultural activities
	Social interactions	✓	Social cohesion; information sharing; cooperation
	Interactions with urban environment and landscape	✓	Increase of surrounding context attractiveness which becomes a new centrality around which to realize the new cultural and artistic city center

Tab.5 NDSM wharf: check list analysis

Features that contribute to resilience: 7.

4.5 CASE STUDY V: R-URBAN, PARIS (F)

Physical	Accessibility	✓	Proximity to public transport (railway, bus, underground)
	Quality	✓	Urban voids enhancement through new uses
	Reversibility	✓	Temporary urban spaces located on leased land for a short period
	Flexibility	×	Each space has a specific function for network
Social	Mix of stakeholders	✓	Public – Colombes Municipality, Institutions at local and national level Private – local population
	Mix of knowledge	✓	Expert Knowledge – Public Administration, Institutions at local and national level Common Knowledge – local population
	Cultural diversity	–	Date not available
	Inclusion	✓	Inclusive space. Open Access resource
Relational	Mix of uses	✓	Educational, recreational, sporting, recreational and cultural activities
	Social interactions	✓	Knowledge and skills exchange within the community; cooperation
	Interactions with urban environment and landscape	✓	Increase of urban sustainability and local productivity; new identities creation

Tab.6 R-URBAN: check list analysis

Features that contribute to resilience: 6.

4.6 CASE STUDY VI: HACKNEY WICK & FISH ISLAND, LONDON (UK)

Physical	Accessibility	✓	District characterized by efficient transport networks (railway lines, fast and slow mobility infrastructures, canals)
	Quality	✓	Regeneration of disused spaces and buildings
	Reversibility	✓	Temporary projects for existing spaces and buildings
	Flexibility	✓	Adaptive use of existing spaces and buildings for new functions
Social	Mix of stakeholders	✓	Public – London Legacy Development Corporation Private – Muf architecture/art e J&L Gibbons (designers); Public Works (non-profit organisation); local community
	Mix of knowledge	✓	Expert Knowledge – Public Administration, designers Common Knowledge – local community
	Cultural diversity	–	Date not available
	Inclusion	✓	Inclusive space. Open Access resource
Relational	Mix of uses	✓	Entrepreneurial, recreational, cultural and sporting activities
	Social interactions	✓	Neighbourhood community creation; collaboration between different users; district spaces sharing
	Interactions with urban environment and landscape	✓	Enhancement of local resources; regeneration of existing building heritage; identity place creation

Tab.7 Hackney Wick & Fish Island: check list analysis

Features that contribute to resilience: 7.

4.7 CASE STUDY VII: FREEHOUSE, ROTTERDAM (NL)

Physical	Accessibility	✓	Urban area served by public transport (railway, underground)
	Quality	✓	Conversion of abandoned buildings and urban spaces; activation of a local cleaning service
	Reversibility	✓	Experimentation of creative practices and new services
	Flexibility	✓	Editable spaces to different functions
Social	Mix of stakeholders	×	Private – Freehouse (association), Skillcity Rotterdam (designer), Afrikaander Neighbourhood (cooperative), local population
	Mix of knowledge	✓	Expert Knowledge – Freehouse, Skillcity Rotterdam Common Knowledge – Afrikaander Neighbourhood, local population
	Cultural diversity	✓	Involvement of multicultural district population
	Inclusion	✓	Inclusive space. Open Access resource
Relational	Mix of uses	✓	Entrepreneurial, artistic and cultural activities
	Social interactions	✓	Co-production of urban environment, cultural and ideas exchanges, creativity, cultural awareness
	Interactions with urban environment and landscape	✓	Increase of local identity and urban attractiveness

Tab.8 Freehouse: check list analysis

Features that contribute to resilience: 8.

4.8 CASE STUDY VIII: GEOPARK, STAVANGER (N)

Physical	Accessibility	✓	Accessible area by local public transport (bus) and private mobility network (parking closer to the site)
	Quality	✓	Reconversion of an urban void into an urban park
	Reversibility	✓	Tested project that from temporary space (5 years) will become permanent one
	Flexibility	×	Space designed for recreational and playful functions
Social	Mix of stakeholders	✓	Public – Stavanger Municipality Private – Norwegian Petroleum Museum Friendship Society (sponsor), Helen & Hard (designer), local population
	Mix of knowledge	✓	Expert Knowledge – Public Administration, designers Common Knowledge – local population
	Cultural diversity	–	Date not available
	Inclusion	✓	Inclusive space. Open Access resource
Relational	Mix of uses	✓	Sports, recreational and cultural activities
	Social interactions	✓	Sharing ideas for park creation; local social resources activation during design process
	Interactions with urban environment and landscape	✓	Urban identity creation; transformation of previous abandoned waterfront into a space for community; increase in site attractiveness

Tab.9 Geopark: check list analysis

Features that contribute to resilience: 6.

4.9 CASE STUDY IX: PLAZA ECÓPOLIS, RIVAS-VACIAMADRID (ES)

Physical	Accessibility	✓	Accessible area by public transport (bus); protected space by adjacent industrial context
	Quality	✓	Transformation of a disused site into a space for social interaction
	Reversibility	×	Permanent urban space
	Flexibility	✓	Editable spaces to different functions
Social	Mix of stakeholders	✓	Public – City Council of Rivas-Vaciamadrid Private – Ecosistema Urbano (designers), local population
	Mix of knowledge	✓	Expert Knowledge – Public Administration, designers Common Knowledge – Local population
	Cultural diversity	–	Date not available
	Inclusion	✓	Inclusive space. Open Access resource
Relational	Mix of uses	✓	Educational, recreational and cultural activities
	Social interactions	✓	Citizens collaboration to shape the local space; urban collector space for social relations
	Interactions with urban environment and landscape	✓	Improvement of surrounding environmental quality; sustainability increase through energy efficiency systems; identity place creation

Tab.10 Plaza Ecópolis: check list analysis

Features that contribute to resilience: 6.

4.10 CASE STUDY X: SOUTHWARK LIDO, LONDON (UK)

Physical	Accessibility	✓	Accessible area by public transport (bus, underground)
	Quality	✓	Reconversion of a parking lot in community space
	Reversibility	✓	Urban space transitory from an original function (parking lot) to a future one (residential area)
	Flexibility	✓	Adaptive reuse of an urban space
Social	Mix of stakeholders	×	Private – Zogolovitch (property owner); EXYZT, Wayward (designers); local population
	Mix of knowledge	✓	Expert Knowledge – designers Common Knowledge – Local population
	Cultural diversity	–	Date not available
	Inclusion	✓	Inclusive space. Open Access resource
Relational	Mix of uses	✓	2008: recreational, cultural activities 2010: agriculture activities 2011: gardening, artistic and cultural activities
	Social interactions	✓	Collaboration between users; opportunity to redefine a local community; ideas and skills exchanges
	Interactions with urban environment and landscape	✓	Local context enhancement and attractiveness; identity place creation

Tab.11 Southwark Lido: check list analysis

Features that contribute to resilience: 7.

4.11 EMERGING INDICATIONS

The indications emerging from the case studies analysis are shown in the following table. With the exception of cultural diversity feature, it is possible to note a good homogeneity of urban commons characteristics. In particular, the right column reports the percentages related to the features presence in the analyzed examples.

	Case studies										
Specific features	I	II	III	IV	V	VI	VII	VIII	IX	X	%
Accessibility	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	100%
Quality	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	100%
Reversibility	×	✓	✓	✓	✓	✓	✓	✓	×	✓	80%
Flexibility	✓	✓	✓	✓	×	✓	✓	×	✓	✓	80%
Mix of stakeholders	✓	✓	×	✓	✓	✓	×	✓	✓	×	70%
Mix of knowledge	✓	✓	×	✓	✓	✓	✓	✓	✓	✓	90%
Cultural diversity	✓	–	✓	–	–	–	✓	–	–	–	30%
Inclusion	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	100%
Mix of uses	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	100%
Social interactions	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	100%
Interactions with urban environment and landscape	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	100%

Tab.12 Summary of check list analysis

5 THE VALUE OF URBAN COMMONS FOR RESILIENT SYSTEMS

The analysis of case studies brings out some remarks regarding urban commons role for increasing city resilience. The first remark concerns general features and, in particular, the role of local social component (individuals, communities and entire society). The subjects involved in the place-making processes acquire an active role mobilizing their reactive, adaptive and proactive capacities and in this way contributing to care and development of urban resources. In these situations, the good (public or private) becomes common because the social component is active in resource care through several fruition and protection way. The care by individuals is an indicator of resource collective value and, consequently, of urban value of the same.

In Superkilen (case study I) the local population it is involved both during the planning phase through consultation activities such as meetings and workshops and in the organization and management phases. In the case study II (Tempelhofer Feld) the society is active by experimenting with temporary uses of the resource and protecting it from building. Finally, in the example of Prinzessinnengärten (case study III), the local community, gathered in association form, acts spontaneously becoming responsible for the site development process.

The second remark concerns the urban commons specific features more relevant for resilience. In particular:

- *Quality* (100%). The urban resource conversion from abandoned/underused area to urban space for communities is an expression of social component reactive abilities to remedy the inevitable area degradation. In example, Superkilen urban space (case study I) is located on an area previously destined for railway line that had been abandoned for years; Prinzessinnengärten (case study III) occupies a city urban void reconverted into a collective urban garden. Resource quality is recurrent feature in the analyzed case studies;
- *Reversibility* (80%). The possibility of experimenting with temporary uses in order to verify the most suitable for specific case helps to increase resilience because it implies greater adaptability over time to social needs. This feature refers to temporary space as solutions both to temporarily fill urban voids (case studies III, V, VI, VIII, X) and as opportunities to experiment with alternative practices (case study II, IV, VII);
- *Flexibility* (80%). The possibility to adapt the physical space or its parts according to user needs. In example, some areas of Superkilen are designed to accommodate various functions (such as market,

sports and events); NDSM wharf represents an adaptive reuse example within which buildings are edited to accommodate different functions;

- *Mix of knowledge* (90%). The union of expert knowledge and common in order to solve collective problems and the ability to find alternative solutions is a characteristic that shows the proactive abilities of social component. Except for the case study III, this feature is recurring in the case studies analyzed where both experts (i.e. Public Administration, designers) and the local population (individuals or groups of citizens) are involved;
- *Cultural diversity* (30%). Peculiarities of actors involved that contribute to creating opportunities for cultural exchange and skills development and to adapt the space to different cultures needs. Cultural diversity is present in three of analyzed cases (I, III, VII) in which multiethnic society is involved in different process phases generating an identity space for different ethnic groups;
- *Mix of uses* (100%). The possibility of using space for different types activities implies the ability to adapt it to different needs at the same time. This characteristic is present in all the case studies in which the interventions on urban space are aimed to host different activities;
- *Social interactions* (100%). The cooperation and sharing of information are actors' proactive capacities that allows exchanges of information, new skills production, creativity, innovation applied to urban resources. In some analyzed cases information sharing takes place through specific educational or training activities organized (case studies III, IV, IX);
- *Interactions with the environment and the urban landscape* (100%). The undertaken actions generate effects for urban environment and surrounding landscape quality. In example, the creation/maintenance of green areas (case studies I, II, III, V, IX, X) generates positive effects for the surrounding urban environment, such as the mitigation of the local microclimate and the increasing of ecosystem ecological quality. In all case studies analyzed, these experiences bring improvements to local landscape in terms of enhancement and identity.

6 CONCLUSIONS

The research shows that many of urban common characteristics contribute to resilience. For this reason, it is possible to state that "urban commons are social resilience based" and they reinforce social component capacities. Through the mobilization of actors abilities, urban commons become alternative solutions to deadlock situations aimed to shape urban space by adapting it to different needs. This aspect gives dynamism and liveliness to urban resource, key characteristics in contexts characterized by continuous and sudden changes. At the same time, they become opportunities for the creativity, innovation and new knowledge development generated by the meeting of different skills and cultures.

Moreover, these phenomena bring positive externalities for local context improving the quality of the environment and the urban landscape. They represent sustainable solutions for different uses and activities of which people can benefit from alongside the services provided by state and market. By satisfying collective needs, they become new urban polarities able to attract city users. Therefore, urban commons are valuable forms of wealth arise from the interaction between social components and physical city to protect, to enhance and to support. For these reasons, the research will have to investigate how to start processes aimed to create urban commons and how to structure planning systems in order to foster these social resilience based phenomena.

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IMAGE SOURCES

Fig. 1: created by the author.

Fig. 2, 3, 4, 9: Flickr (www.flickr.com).

Fig. 5: ABQ Warehouse District (celladdition.wordpress.com).

Fig. 6: Muf architecture/art (muf.co.uk).

Fig. 7: R-URBAN (r-urban.net).

Fig. 8: Labyrinthonderzoek (www.labyrinthonderzoek.nl).

Fig. 10: Ecosistema Urbano (ecosistemaurbano.com).

Fig. 11: The reunion (reunionsouthwark.wordpress.com).

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MEAURING URBAN RESILENCE TO NATURAL HAZARDS

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ABSTRACT

Natural disaster is an undeniable fact, and preparing to cope with and respond to it is an essential necessity. A resilient city can survive after a traumatic blow to its physical infrastructure, its economy, or its social fabric. Lahijan City, like other cities, requires resiliency measurement. Research tries to survey the degree of resilience of Lahijan encountering natural hazards. The research method is descriptive-analytic; the descriptive method is used to develop theories and literature, and analytical method for the identification of causal relationships and correlations. The performed analyses arebased on the combination of inferential statistics techniques such as one sample t-test and the Delphi technique. The outcome revealed that Lahijan is totally in the low spectrum in terms of resilience (5 > 2.72 > 1), with theoretical median of three, which itself is the result of climate change, urbanization, and globalization. Support and strengthening of community-based activities, disaster risk reduction, and capacity increase of institutional adaptability can assist Lahijan residents to encounter to the human hazards, natural hazards, and increasing risks resulting from change.

KEYWORDS:
Resilience, Natural hazards, Capacity increase.

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城市自然灾害复原能力估量

摘要

自然灾害是一个不可否认的事实，必须作出应对和响应的准备。如果一个城市具有复原能力，在其有形基础设施、经济或社会结构遭到创伤性的打击之后仍然能够得以生存。拉希詹与其他城市一样，也需要进行复原能力方面的估量。本研究的目的是调查拉希詹在遇到自然灾害情况下的复原能力水平。采用的研究方法为描述性分析；描述性方法用于创立理论和文献，分析方法则用于识别因果关系和相关性。分析基于多种推理统计技术——如单样本检验和德尔斐技术——的组合进行。结果显示，拉希詹在复原能力方面`完全处于低水平（5>2.72>1，理论中位数为 3 的情况下），其本身为气候变化、城市化和全球化的结果。在以社区为单位开展的活动、减少灾害风险和体制适应性能力建设等方面的支持和加强措施，可以在出现人为灾害、自然灾害和变化导致的风险增加时为拉希詹居民提供帮助

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关键词:
复原能力，自然灾害、能力建设

1 INTRODUCTION

Resilience like sustainability is an intergenerational and over - generational approach. Seeking to enhance it, communities try to save the current generation from risks and to inform the future one. Hazards normally have the potential to turn to a disaster when there is no access to risk reduction systems. Since predicting these events perfectly has not been attainable yet, increase or improvement of the capacity of a system to resist and recover from the consequences of hazards is highly significant. An urban system is considered to be desirable when not only meets the needs of its inhabitants and improves the social, economic, environmental, and other qualifications, but also protect the city and its inhabitants against potential threats and, in critical cases, manages the crisis that have arisen. Resilience is a relatively new approach to create an urban system. The system must be resilient to potential risks and anticipate any measures in advance of the crisis, since survival is awareness-depended. These risks include not only natural disasters but also all the likely crises in the city.

Having a crisis in terms of being an accident-prone region as well as the crisis of confrontation with this issue, Iran every year is facing irreparable damages resulting from these events in different cities. It is therefore essential that reinforcing process of cities against natural hazards, reducing the vulnerability of critical infrastructure, managing disaster risk reduction, and finally resilience to be on the agenda in order to achieve the goals of sustainable urban development. In this research, the city of Lahijan for its high vulnerability to natural disasters has been chosen as the case. Research tries to survey the degree of resilience of Lahijan encountering natural hazards. For instance, the city encountered heavy snowfall twice in 2015 and in both cases problems such as water and electricity cutoff, long traffic jams, closed schools and even offices, cut trees and so on were witnessed. It must be mentioned that Lahijan is a medium city which is located in north-west of Iran. Further information would be described later. The main goal of this research is to survey that if Lahijan is a resilient city and if it has the needed capacities of resilience in dealing with natural hazards.

The most significant questions raised in such conditions are:

- Are the social, economic, institutional, and physical-environmental capacities of the study area in accordance with the needs of the community to demonstrate resilience in dealing with natural hazards?
- Is the study area considered resilient in terms of the dimensions and measurement criteria in the present study?

2 METHODOLOGY

The current research adopted a descriptive-analytical method, in which the development of the theoretical perspectives and the related literature were carried out through a descriptive method by searching for external and internal resources, and achieving causal relationships and the correlation was performed through an analytical method. The target group are experts in urban planning which have the knowledge about the subject and can opine about it.

Questionnaires and interviews are the source of statistics which are analyzed. The analysis of the study was performed using a combination of inferential statistics techniques such as one sample t-test using SPSS and the Delphi technique. Moreover, the criteria and sub-criteria have been proposed to measure the resilience of Lahijan. Since these criteria and sub-criteria are not of the same level of significance or, in other words, they do not have the same weight, the coefficient of importance, or weighting was taken into consideration. Because of the qualitative nature of the variables, the Likert spectrum was used to quantify and calculate the obtained data.

3 LITERATURE REVIEW

3.1 DEFINITIONS AND CONCEPTS

The identification of urban fragilities could represent a new first step in order to develop and to propose methodological and operative innovations for the planning and the management of the urban and territorial transformations (Papa, 2018). Climate change, resource scarcity, individual or concatenated risks, and environmental degradation are just some of the many and varied factors that threaten contemporary cities and are now the pressure factors capable of triggering processes and modifications of urban systems, altering or changing their status. These factors are characterized by different natures and impacts: some may induce long-term changes (lack of resources); others cause immediate shock (risks). The complexity of the various pressure factors, their close interactions and the characteristics of the urban systems, seem to suggest the need to analyze and manage the response of urban systems to potential impacts of these factors through a systemic approach (De Falco, 2018).

Several definitions of resilience are available, twenty-five of which were examined in this study, and some of them have been mentioned in Table 1. This table indicates that the definitions of urban resilience are contradictive and ambiguous. Since there are differences between two concepts of "urban" and "resilience" and due to various principles associated with their investigations (Da Silva et al., 2012), not surprisingly there are several definitions for this concept available. However, there is broad agreement that the essence or inherent feature of resilience include the "back to the past," the "degree to which the system is able to absorb risks and can organize itself." Many theoreticians recognize resilience as the criterion of returning to the pre-accident condition, as well as to improve it in accordance with further development in the systems (Amaratunga & Haigh, 2011). Resilience is the degree to which a system can absorb disturbance but preserve its condition, the capacity of a system in self-organization, and its ability to create and enhance the learning, and adaptive capacity (Carpenter et al., 2001). A resilient city is a city that could have a post-disaster recovery ability and to be able to maintain balance and to resume activities (Papa, 2012). A resilient city is able to survive a traumatic blow to its physical infrastructure, its economy, or its social fabric. The resilient city bends but does not break; it absorbs impacts without shattering (Campanella & Godschalk, 2012).

3.2 RESILIENCE DEFINITIONS

Different types of resilience, including resilience of ecological, social, economic, organizational, infrastructural systems and capability or qualification of the community, require different types of measurements.

3.3 ECONOMIC RESILIENCE

Resilience in the economy is the inherent adaptability and reaction of individuals and communities to the risks, so that they are able to reduce the potential damage caused by hazards. For the large macroeconomic interconnectedness, economic resilience depends not only on the occupational capacities of individuals but also on the capacity of all institutions (Rose, 2004). This resilience is consist of two components: Firstly, the community's capacity to return to pre-accident economic conditions and, secondly, the capacity of communities to reduce the risk of future accidents and hazards; either in response to an accident that society has experienced or in anticipation of accidents that are still experiencing (Forgette & Boening, 2009).

3.4 SOCIAL RESILIENCE

Social resilience is defined as "the ability of a community to revert back and use its own resources for recovery." Social resilience is planning on internal resources and their capacities to manage demands, challenges, and changes faced during a disaster (Ainuddin & Routray, 2012). Attention paid to social aspects in resilience, if not more important than the physical infrastructure in crisis management, is at least equally important (Lucini, 2013). Where crimes, homelessness, unemployment, inadequate nutrition, and insufficient education is obvious, disaster prevention can no longer be of great importance (Cutter et al., 2008: 7). Albeit there is still a lot of ambiguity in defining and indexing this concept (Sapirstein, 2006), all the definitions in the social resilience are concerned with capacities of individuals, organizations, or communities to sustain, absorb, adapt, and transform the social threat of any kind (Keck & Sakdapolark, 2013). Social resilience has different stages and significantly increases the durability and solidity of the community. The level of flexibility of different groups in a community and their responses are disparate in critical cases (Maguire & Hagan, 2007). The existence of social groups with different social, economic, and degrees of vulnerability in a community connotes that the resilience to one accident varies for different groups of a society. Socially vulnerable groups are likely to have less available resources and facilities to deal with disasters. In fact, social conditions make some members of society less probable to be affected by the calamity and some more (Oxfam, 2005).

No.	Author	Year	Definition
1	Chelleri	2012	Resilience should be within the framework of flexibility (system resistance), transition (incremental change of system), transformation (re-formation of the system)
2	Hamilton	2009	Ability to retrieve and sustain performance, life, business, industry, government, and social gatherings in dealing with disasters and catastrophes.
3	Brugmann	2012	The ability of systems, locations, and municipal assets to keep performance predictable (benefits and functions, leases, and other financial flows) in a wide range of conditions.
4	Coaffee	2013	Capacity to deal with malicious challenges and return to the previous situation
5	Desouza and Flanery	2013	Ability to absorb, adapt, and respond to changes in urban systems
6	Lu and Stead	2013	The ability of the city to absorb abnormalities while maintaining function and structure
7	Romero-Lankao and Gnatz	2013	Capacity of systems and communities to deal with disasters
8	Asprone et al.	2013	Ability to adapt or respond to unusual malicious events
9	Henstra	2012	Climate resistant city is a city that is capable of coping with the problems created by climate change to respond effectively to the dangers of the climate and quickly retrieve the remaining negative effects.
10	Thornbush et al.	2013	The general characteristics of cities' natural, economic, and social systems for effective future stability
11	Wagner and Breil	2013	The ability and capacity of the community to cope with stress, to restore, adapt, and return to the previous situation after a crisis or rapid passage from it.

Tab.1 Resilience definitions

3.5 PHYSICAL RESILIENCE

Campanella and Godschalk in 2012, pointed to the role of urban uses in mitigating the negative effects of disaster and making the city resilient to the dangers of accidents (Campanella & Godschalk, 2012). Designating similar applications together in a not problematic way at the time of the accident, as well as the identification of multi-functional open spaces within the dense texture of residential neighborhoods in cities, increases urban resilience against accidents. Additionally, the availability of appropriate accessibility in cities and highly permeable urban design, when accidents happens especially earthquakes with the possibility of wall destructions and route blockings, play an important role in increasing and decreasing the resilience rate of cities (Jalali et al., 2015).

3.6 ENVIRONMENTAL RESILIENCE

Adger (2000) believes in all ecological definitions the emphasis is on how much destruction a system can withstand without changing or disintegrating. In his opinion, focuses are often on stability and resilience against destruction and the rate of return to the initial equilibrium point (Rezaei & Rafiyan, 1391).

4 PROCESS ANALYSIS

In current study, the process of analyzing and measuring the resiliency of Lahijan is in accordance with Fig.1. So initially according to the criteria and sub-criteria, the current situation of Lahijan regarding these indicators have been determined, then using Likert spectrum in the opinions of a group of experts in urban planning each of the data were rated 1 to 5. Assumed the same in their level of importance, each of the indicators of the urban resiliency measurement was analyzed using the average score through Excel software. Finally, each indicator and criterion was weighted based on its importance in measuring the resiliency of Lahijan. After statistical analysis using one sample t-test, each dimension has been separately studied.

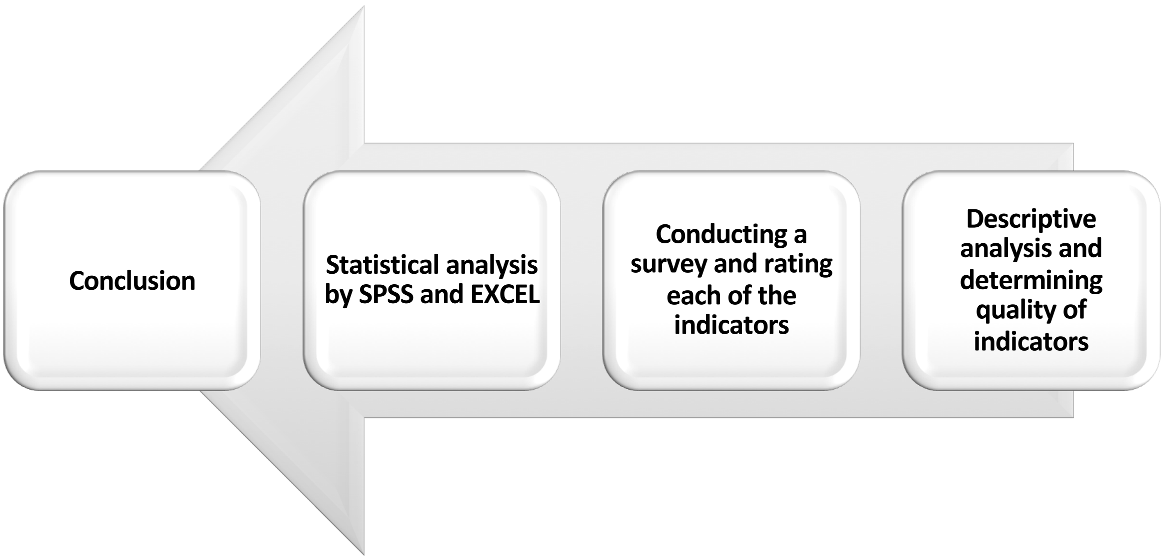


Fig. 1 The Process of resiliency analysis and evaluation

5 CRITERIA AND INDICATORS OF RESILIENCY MEASUREMENT

Since resilience models investigate the flexibility of communities to reduce vulnerability to the consequences of hazards, analysis and study of these models are required.

Most of the proposed models have considered the same factors (e.g. economic resources, capital, skills, information, knowledge, support and supportive networks, access to community services and shared values) which can reduce the vulnerability and increase the resilience of the community following threats such as natural disasters.

In other words, social capital can be regarded as the shared concept in all these models positively associated with social resilience. The limitation of these models, therefore, is focusing on one or more dimension of resilience with low interference and cooperation of local communities, and they do not extensively focus on this concept. Also, in terms of practicality, the proposed models mostly show the conceptual aspect of resiliency rather than its measurement, such as Tobin Model (Tobin, 1999), Sustainable Livelihood Model (DFID, 2005), Linear-Time Model (Davis, 2006), and the Meyunga Model (Mayunga, 2007) that point out certain aspects of resiliency.

Due to the multidimensional nature of resilience (social, economic, institutional, and physical-environmental) with a scientific consensus on it, it is therefore essential to offer and present models that consider all these dimensions as well as the role of local communities through participation. From among the presented models, the combination of cutter's locational model (2008 and 2009) and community-based model (CBDM[1]) is appropriate to assess and measure resilience against natural disasters. Cutter's locational model considers the above-mentioned dimensions and community-based model emphasizes on the key role of local communities and their cooperation in the management process of natural disasters.

In Cutter's model, resilience is a dynamic process depended on the previous conditions, the severity of accidents, the time between risks, and the impact of external factors. In his view, there are various hypotheses in the conceptualization of DROP[2]. Firstly, the model is designed to examine natural hazards, but it can be adapted to other incidents such as terrorism, technological hazards, and famine. Secondly, DROP focuses on resilience at the community level; it differentiates it from other models developed to assess resilience at micro and macro levels or models based on other sectors. Third, this model mainly focuses on the social resilience of places and is inseparable from social processes. This model represents resilience as a predicted or intrinsic condition or a process. The predicted conditions can be considered as images static in time and state; however, post-accident processes make this concept to be dynamic. Cuter in another study in 2010, presented a series of indicators for measuring the existing conditions effective on resiliency of communities against incidents based on DROP model (Rezaei & Rafiyane, 2012). According to the mentioned models, the final criteria and sub-criteria studied, measured, and analyzed in this research have been briefly presented in Tab. 2.

Criteria	Sub-criteria
Social Dimensions	Population literacy rate
	The number of higher education centers in the city
	Available education per capita
	The number of health centers and centers per capita
	The number of hospital beds per 1000 population
Economical Dimensions	Employment status
	The cost of defraying
	The unemployment rate
	Occupational diversity
Institutional Dimensions	The amount of responsibility and responsiveness
	The amount of state institutional diversity in the city
	The number of service centers in the city and region
Physical-Environmental Dimensions	Distance from the center of the province
	Available green space per capita
	Connection diversity with other areas (air, rail and road)
	Number of fire stations per 10,000 population
	City physical integrity (population density and balanced residential density)

Tab.2 Criteria and Sub-Criteria Discussed in Different Dimensions for Resiliency Measurement Studied in This Research

[1] Community Based Disaster Management, A project to achieve safety and sustainability of livelihoods for effective disaster mitigation, focusing on three key elements: self-help, co-operation, and education.

[2] Disaster Resilience of Place; A place-based model for understanding community resilience to natural disasters

6 CASE STUDY

Located in the northwest of Iran with an area of about 1433 hectares, Lahijan city has a mild and humid climate, and its population is 220,000 in 2017, which is the third most populous city in the province of Guilan after Rasht and Anzali.

Lahijan which is a touristic city was selected as the case study due to some crisis that has happened in it, for instance flood and heavy snowfalls. One who has lived in Lahijan, has experienced mentioned catastrophes entirely, in the conditions of the failure of municipality and the absence of city council to attract public participation.

Fig. 2 The location of Lahijan in Guilan province

6.1 LAHIJAN DEALING WITH POSSIBLE NATURAL HAZARDS

<u>THE RISK OF HEAVY SNOWFALL</u>

The study area is under the threat of heavy snowfall. This section outlines the amount of heavy snowfall in a 25-year interval in Lahijan. In the period under review, the first heavy snowfall occurred in 2005. Lasted for 18 days, the heavy snowfall reached a height of 1.2 meters leading to a lot of damage to the city.

Figure 3 shows this 18-day interval. The second relatively heavy snowfall, continued for an 18-day interval and reached the height of 0.6 meters, occurred in 2008. Fig. 4 shows this snowfall.

The next relatively heavy snowfall in this 25-year interval was in 2017. It is worth noting that this precipitation had fallen over a period of two weeks and consequently had a lot of damage. Following this heavy snowfall, roads were blocked and schools and offices remained closed for several days.

In parts of the city, also a failure of electricity and water and the telephone for several days had been witnessed. Fig. 5a and 5b show the snowfall in these two periods. As it can be seen, the interval between the date of the first precipitation and the start of the second precipitation was seven days. February 10, the first precipitation was over, and on February 17, snow just restarted.

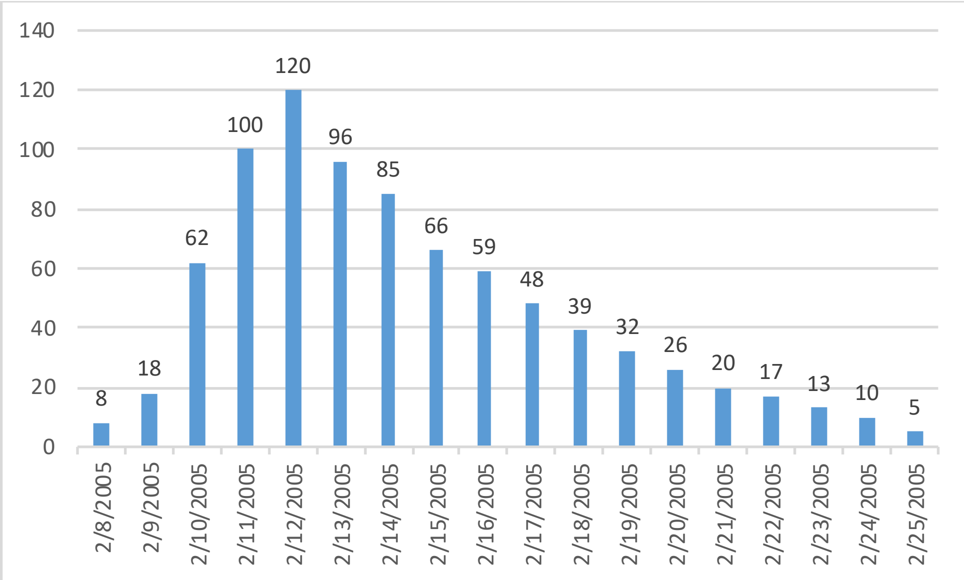


Fig. 3 Snowfall in 2005 in Lahijan

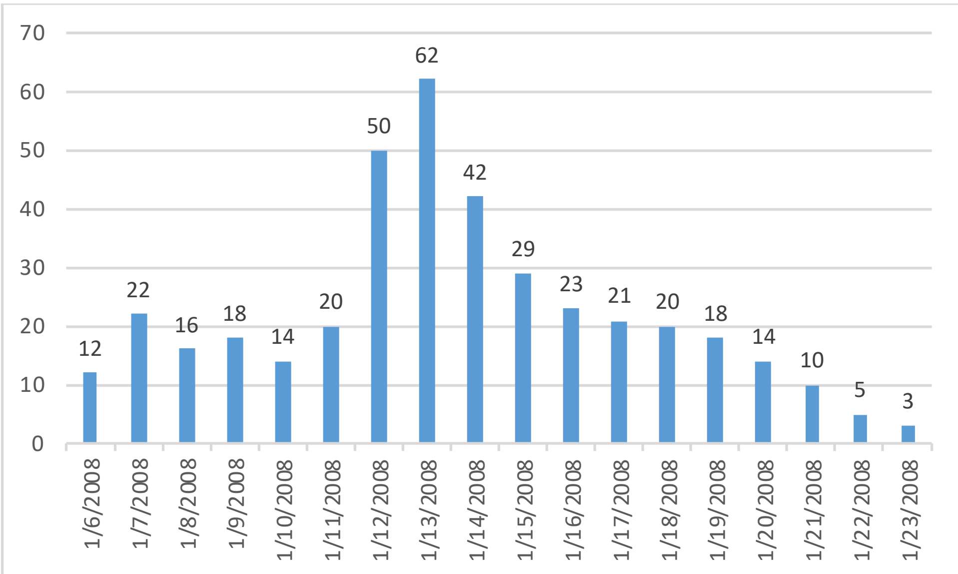
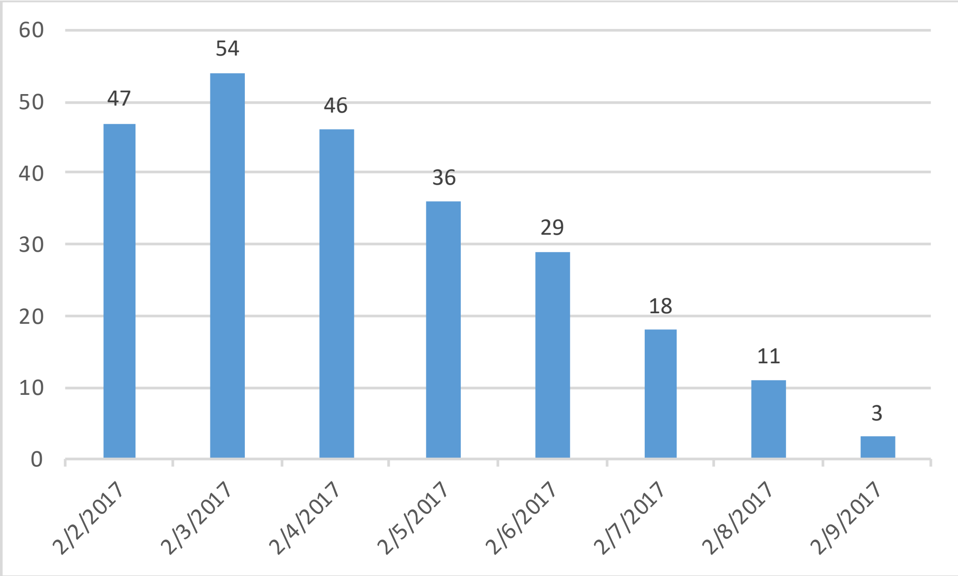


Fig. 4 Snowfall in 2008 in Lahijan



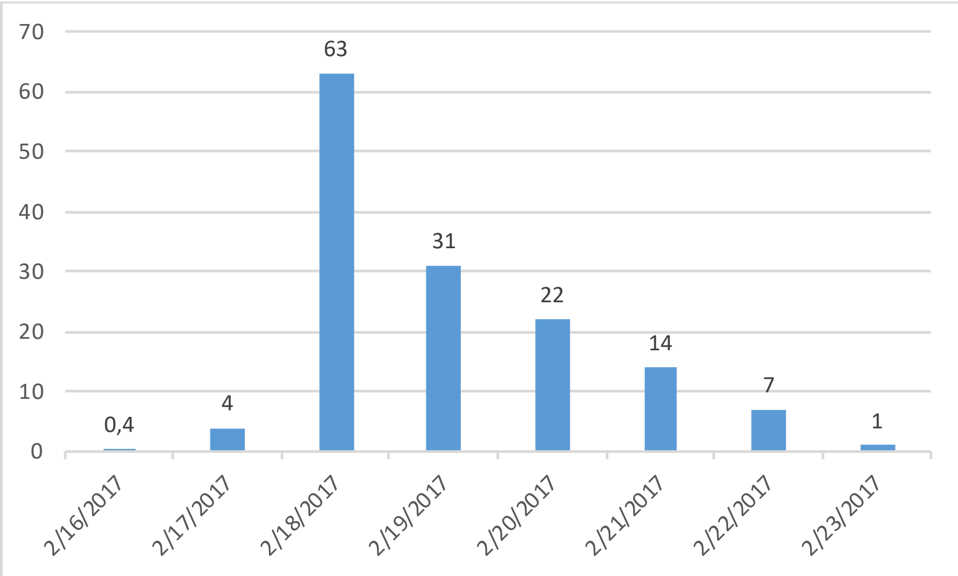


Fig. 5a & 5b Snowfall in 2016 in two dates in Lahijan

EARTHQUAKE HAZARD

In the east of Guilan, there are ten faults that mentioning all their names is time consuming. The most important fault that passes through the city of Lahijan is the Khazar fault with the east-west direction, which passes through Rasht and extends from northern Lahijan to the northern coast of Langroud. Fig. 6 shows these faults in the east of Guilan.

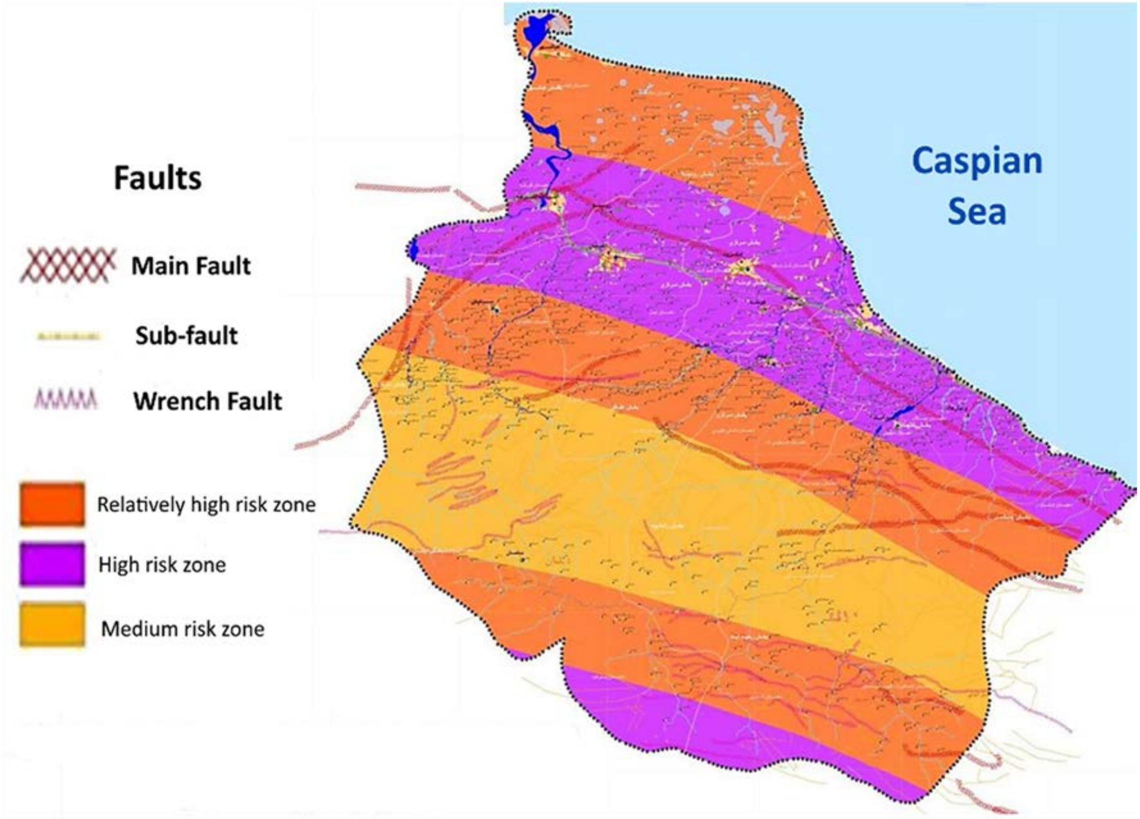


Fig. 6 Faults in the east of Guilan; Lahijan is located in a zone with high risk of earthquake, where the main Khazar fault passes through it.

6.2 RESILIENCY MEASUREMENT IN LAHIJAN

The following table (3) contains the proposed criteria and the sub-criteria to measure the resilience of the city of Lahijan. Due to the qualitative variables, the Likert spectrum was used to quantify and calculate the obtained data. This has been done using the existing standards for some of the sub-criteria and for some others it was based on in-depth interviews. The situation in the city of Lahijan has been compared to the standard situation and the weights of each of the different sub-criteria have been attached to them. In this spectrum, the low values, or those around and near one are considered to be the lowest comparing to the standard and the high values, or those near five, are the highest as compared to the standard. It should be noted that the standard condition is the same as the satisfactory average, and in the Likert spectrum, the value is numerically three.

Criteria	Sub-criteria	Lahijan City Situation
Social Aspects	Population literacy rate	92%
	The number of higher education centers in the city	3
	Available education per capita	1.7 m²
	The number of health centers and centers per capita	2 hospitals Health per capita 0.7 m²
	The number of hospital beds per 1000 population	1.3
Economic Aspects	Employment condition	Employment rate 88.2 (2006)
	The cost of defraying	3.2
	The unemployment rate	11.8

	Occupational diversity	Medium
Institutional Aspects	The amount of responsibility and responsiveness	Low
	The amount of state institutional diversity in the city	Available municipality and government
	The number of service centers in the city and region	Medium
Physical-Environmental Dimensions	Distance from the center of the province	45 km to Rasht
	Available green space per capita	32 hectares and 3.5 m² per capita
	Connection diversity with other areas (air, rail and road)	Road
	Number of fire stations per 10,000 population	2 centers 0.11 centers per 10000 population
	City physical integrity (population density and balanced residential density)	Gross population density 50.9 people per hectare Gross population density 50.9 people per hectare

Tab. 3 The Situation of Lahijan City in Assessing Criteria and Sub-Criteria for Measuring Resiliency

7 FINDINGS

The most important outcome of urban resilience measurement in Lahijan is as follows:
The results of one sample t-test regarding each of the involving criteria in resiliency in the study area is shown in the Tab. 4. This table is the outcome of scoring in the Likert spectrum by the experts, and comparing each of these criteria with the standard conditions as an accepted theoretical median to make them comparable. According to this table, the results is obtained at first, without applying different values of the criteria and sub-criteria involved in the resilience and the second, with the application of these values.

Aspects of study	Social	Economical	Institutional	Physical-Environmental
Without the application of the weights of criteria and sub-criteria				
The Score of Lahijan City	3.2	2.5	2.6	2.6
Theoretical Median	3	3	3	3
With the application of the weights of criteria and sub-criteria				
The Score of Lahijan City	0.64	0.59	0.52	0.5
Theoretical Median	1.05	0.6	0.9	0.45
Aspects of study	Social	Economical	Institutional	Physical-Environmental

Tab. 4 The Situation of Lahijan City in Assessing Criteria and Sub-Criteria for Measuring Resiliency

The results of one sample t-test without the findings of Delphi technique:

- In terms of resilience in the social dimension, the city of Lahijan with a score of 3.2 as compared to the theoretical median score is in the high spectrum;
- This situation is different in the economic dimension, as the city of Lahijan with a score of 2.5 in comparison with the theoretical median is in the low spectrum;
- In institutional dimension, Lahijan with the score of 2.6 as compared to the theoretical median is in the low spectrum;
- Finally, in the environmental aspect, Lahijan with the score of 0.64 was evaluated in comparison with the theoretical median and it is in the low spectrum.

The results of one sample t-test with the findings of Delphi technique:

- In terms of resilience in the social dimension, the city of Lahijan with a score of 0.59 as compared to the theoretical median score of 1.05 is in the low spectrum: 1.05, 0.6, 0.59;
- This situation is different in the economic dimension, as Lahijan with a score of 0.59 as compared to the theoretical median of 0.6 is in nearly medium spectrum;
- In the institutional dimension, Lahijan with a score of 0.52 as compared to the theoretical median score of 0.9 is in the low spectrum;
- Finally, in the physical-environmental dimension, Lahijan with the score of 0.5 was evaluated in comparison with the theoretical median of 0.45 and it is in the high spectrum.

Tables 5 and 6 shows the results of one sample t-test in each of the four dimensions. As follows, each of the dimensions has been separately investigated.

	N	Mean	Std. Deviation	Std. Error Mean
Social	5	0.6440	0.63862	0.28560
Economic	4	0.5975	0.38578	0.19289
Institution	3	0.5233	0.29838	0.17227
Physical	5	0.5000	0.33294	0.14890

Tab. 5 T-Test One Sample Statistics

	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Social	-8.249	4	0.001	-2.35600	-3.1489	-1.5631
Economic	-12.455	3	0.001	-2.40250	-3.0164	-1.7886
Institution	-14.376	2	0.005	-2.47667	-3.2179	-1.7354
Physical	-16.790	4	0.000	-2.50000	-2.9134	-2.0866

Tab. 6 T-Test One Sample Test (Test Value = 3)

7.1 THE STUDY OF SOCIAL DIMENSIONS AFTER WEIGHTING

As Table 5 shows, the average social dimension after weighting has been 0.64. Fig. 7 shows the difference between the social dimension of the city of Lahijan and the theoretical median. Since 0.64 is smaller than the social dimension (i.e. 1.05), it can be concluded that Lahijan has been evaluated in the low spectrum in terms of social resilience and needs attention and planning in this regard.

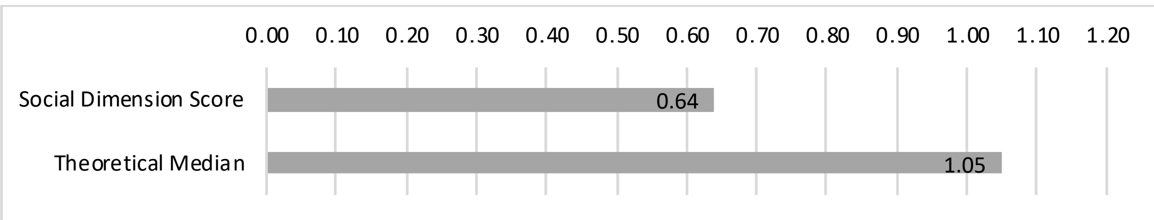


Fig. 7 The difference between the social dimension of Lahijan and the theoretical median

7.2 THE STUDY OF ECONOMICAL DIMENSIONS AFTER WEIGHTING

As Table 5 shows, the result of one-sample t-test showing that the average economic dimension score after applying the weights is 0.59. Fig. 8 shows that the economic dimension with a score of 0.59, considering the theoretical median of 0.6, is placed slightly in the medium spectrum in terms of resiliency and is in a better position than the rest of the studied dimensions.

Fig. 8 The difference between the economic dimension of Lahijan and the theoretical median

7.3 THE STUDY OF INSTITUTIONAL DIMENSIONS AFTER WEIGHTING

As Table 5 shows, Lahijan in institutional dimension, after applying the criteria's weight, has the score of 0.52. Figure 9 shows the difference between the institutional dimension score and the theoretical median. As it can be seen, the institutional dimension with a score of 0.52 is evaluated in the low spectrum in terms of resilience, as compared to the theoretical median 0.9.

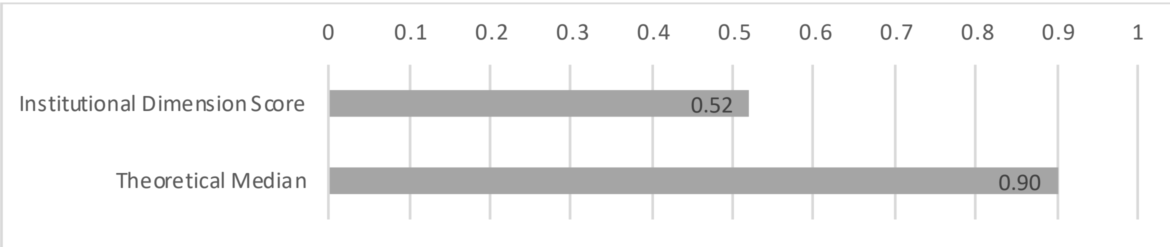


Fig. 9 The difference between the institutional dimension of Lahijan and the theoretical median

7.4 THE STUDY OF PHYSICAL-ENVIRONMENTAL DIMENSIONS AFTER WEIGHTING

As Table 5 shows, the average score of the physical dimension after weighting is equal to 0.5.
Figure 10 shows that the physical dimension with the score of 0.5 in comparison with theoretical median of 0.45 is in the high spectrum in terms of resilience.

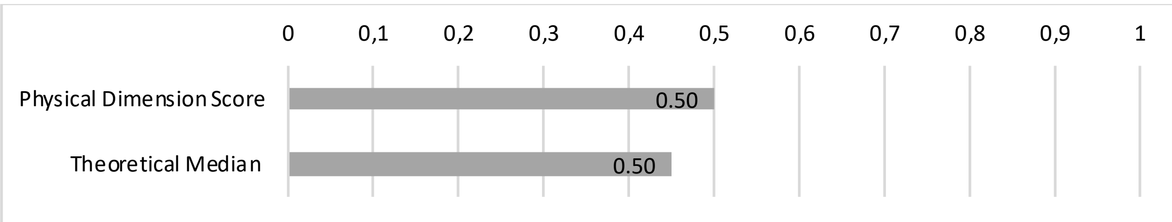


Fig. 10 The difference between the physical dimension of Lahijan and the theoretical median

As noted above, based on the results of the analysis and the obtained scores, Lahijan is totally in the low spectrum in terms of resiliency (5> 2.72>1, with theoretical median of 3). This level of resilience for a city like Lahijan is not satisfactory. Improving the resilience of the city depends on empowering its capacities to deal with natural hazards. In this regard, the final section, the conclusion, is devoted to providing solutions and recommendations.
It seems that the results obtained from the analysis of the study and compared to the existing conditions reveal that the Delphi technique- the use of different weights derived from experts' opinions for each dimension, criteria, and sub – criteria - provide better and closer to the reality measurements of the resilience in the study area. Therefore, the outcomes of the analysis through this technique have been used to answer the research questions.

- Are the social, economic, institutional, physical-environmental capacities of the study area in accordance with the needs of the community to demonstrate resilience in dealing with natural hazards?

- According to the results of the analysis of four dimensions of the study in the area of interest, the social and institutional dimensions of the city of Lahijan are in an unsuitable condition in terms of resilience and they are not sufficiently capable of coping with natural hazards. It has a better condition regarding the economic and physical-environmental dimensions than two social and institutional dimensions. As a result, based on the obtained scores in each of the studied dimensions, Lahijan, especially in social and institutional dimensions requires more attention, planning, and investment to improve the level of indicators and sub-indicators of resiliency.
- Is the study area considered resilient in terms of the dimensions and measurement criteria in the present study? Lahijan with a score of 2.72 as compared to the theoretical median is in the low spectrum in terms of resilience (in all studied dimensions). It means that the components and the capacities of the city do not currently meet the conditions of the area in terms of resilience against natural hazards and improvement of the resilience capacity of the city and providing fundamental plans should be considered.

8 CONCLUSION

Based on the research, the resilience of Lahijan encountering natural hazards is under average and this shows inappropriate conditions of the city. Lahijan has serious social and institutional problems. The city is in a modest condition in economic dimension of resilience however, its physical dimension is considered acceptable. In the social dimension, the main problem in the city is the inadequate number of hospitals and health centers and the inappropriate distribution of them. At the same time, the existence of illiterate citizens (8% of the total population) can also cause problems and create disturbance in crisis management.

In the institutional dimension, there is the issue of the weakness of responsive and accountable institutions. This refers to the structure of the state institutions, including the municipality and the government, where responsiveness is not a defined and organizational responsibility of them.

These suggestions, which are based on research findings, can improve resilience of Lahijan and lead to reduction of damages. Trying to eliminate the problems originated in deficiency of hospitals and health centers, the state can cooperate with private sector for building new hospitals and clinics. The important point is locating these centers according to resilience considerations. Training the citizens of Lahijan, in order to encounter with the natural crisis can be met in various ways including media.

Strengthening the institutions that increase the participation of citizens in the administration of the city and attract them to the wider area of the neighborhoods and their residents can be helpful. Despite the active presence of the people and their cooperation when crisis happen in our country (in case of earthquakes, for instance, the active participation of the people in aids), this presence has not been organized and cannot be considered in a hierarchy that ultimately leads to responsible institutions. The volunteered presence of helping people sometimes adds to the dimensions of the crisis and some other times focuses aids on unessential and subsidiary parts. Organization of people's presence through local councils and the establishment of a hierarchy of governance should be carried out in a normal and clam situation, so that in crisis, the empathy can be used correctly and where it is needed.

It was mentioned earlier that Lahijan is in the low to nearly moderate condition in economic dimension. The biggest reason is the cost of defraying (3.3). This figure shows that every employed person pays the cost of another 3.2 people, and this figure is regarded as a moderate and decent number in comparison with some other parts of the country. The unemployment rate of 11.8 % is also not a critical employment condition for Lahijan, and it can be said that Lahijan has modest conditions in terms of resilience in the economic dimension.

The city, in physical-environmental dimension has been evaluated in the high spectrum of resilience. This has several reasons. The relatively low distance from the center of the province (45 km to Rasht), the available green space per capita, and the physical integrity of the city, which includes a balanced demographic and residential density are of those reasons. In terms of the number of fire stations, these stations should be increased to meet the standard of a firefighter per 2500 people. Elimination of this weakness will be an important factor in improving the resilience of Lahijan. Particularly, when the predictable critical cases for this city are conditions such as heavy rain or snow, as well as earthquake that firefighters play a significant role in overcoming them. This study has featured weak points of Lahijan regarding resilience and has proposed suggestions to eliminate them. Further researches can focus on every one of the weak points. This means that an independent study can focus on social dimension of resilience in Lahijan which is the boldest weak point of this city regarding resilience. The number of needed hospitals and health centers according to the growth rate of population and the method of locating them in proper places of access hierarchy considering probable traffic jams of urban paths in the case of a severe crisis, would also be subjects of other researches.

Ways of persuading illiterate minority of lahijan to education and attracting others to social instructions would be other subjects of research, in order to improve social participation in a hierarchical and organized manner. In conclusion, it must be emphasized that resilience is a spatial approach. Prioritizing executive solutions varies depending on the location and conditions, but actually follows the same objective. The resilience of societies encompasses a wide range of goals in increasing resilience in all social, economic, institutional, and physical-environmental aspects and seeks to enhance the capacity of communities in all aspects to confront changes. Resilience in a general and long-term plan can achieve its aim, which is a resilient society with short-term executive plans.

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IMAGE SOURCES

Fig. 1: Author.

Fig. 2: Comprehensive plan of Lahijan.

Fig. 3, 4 , 5.1, 5.2: Author.

Fig. 6: Comprehensive plan of Lahijan.

Fig. 7, 8, 9, 10: Author

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THE VALUE OF URBAN DENSITY

AN EXPLORATORY OF THE RELATIONSHIP BETWEEN URBAN DENSITY AND HOUSING PRICES IN TRONDHEIM, NORWAY

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ABSTRACT

Urban density is considered a cornerstone of sustainable urban form, enhancing the potential for more sustainable lifestyles and fewer greenhouse gas emissions. Urban densification policies have thus become a pillar of the sustainability planning agenda in Norway. Although this strategy has been contested by some who see denser neighbourhoods as problematic, housing prices seem to contradict this view. This paper proposes the hypothesis that urban density is a well-accepted and valued quality reflected in the willingness-to-pay in the housing market. To explore the relationship between urban density and residential property prices in Trondheim, Norway, this analysis first evaluates 23 distinct urban areas with regard to average square metre price and three density measures – built coverage density, dwelling unit density, and population density. Initial correlation results based on 1,255 sales transactions from 2014 and 2015 indicate a positive relationship between the density measures and price per square metre. To investigate this first observation further, a simple hedonic pricing model was constructed, including characteristics such as property type and age of property; proximity measures, such as distance to the next school or bus stop; and the three density measures. It was run for the complete dataset as well as for the two subsets of Trondheim periphery and Trondheim centre. With regard to density, the model shows unexpected results. It indicates that an increase in dwelling unit density can lead to an increase in price, whereas the opposite can happen for increases in population density. This may be linked to local housing market conditions, such as the rise of high-income single-occupant and dual-income no-kid homes in central locations.

KEYWORDS:
Urban density; Urban densification policies; Sustainable city; Housing prices; Hedonic pricing.

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城市密度的价值关于挪

威特隆赫姆城市密度与住房价格关系之探索性研究

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摘要

城市密度被认为是可持续城市形式的基础之一。它能提高一个城市在更多可持续生活方式和减少温室气体排放方面的潜力。因此，城市密集化的政策必须成为挪威可持续发展规划议程的一个核心因素。虽然一些人看到密集居民区的一些问题，因而对此战略提出质疑，但这一观点似乎与住房价格背道而驰。本文提出了城市密度已被普遍接受及重视、且在有支付意愿的住房市场上有所反映这一假设。为研究挪威特隆赫姆的城市密度和住宅房地产价格之间的关系，本文首先评估了 23 个不同的城市地区的每平方米平均价格以及三个密度量度，即建筑覆盖密度、住宅单位密度和人口密度。2014 年和 2015 年的 1,255 宗销售交易数据显示的初步相关性结果表明，密度量度和每平方米价格之间呈正比关系。为了对此初步观察进行深入调研，构建一个简单的特征定价模型，其中纳入了房产类型和房产年限；邻近性量度，例如最近的学校或公交车站距离；以及上述三个密度量度。我们将这一模型运行于整个数据集特隆赫姆周边地区和特隆赫姆中心地区这两个子集。在密度方面，该模型显示了意想不到的结果。即：住宅单位密度的增加可能导致价格上涨，而前者的下降则可能是由于人口密度的上升引起的。这一结果可能与当地住房市场条件有关，例如高收入单一住户和中心地区无孩双收入家庭的增加。

关键词：
城市密度；城市密集化政策；可持续城市；住房价格；特征定价

1 INTRODUCTION

Urban density is widely accepted as a fundamental characteristic of sustainable urban form (Dempsey et al., 2012). This is built on the premise that more compact cities optimise the use of resources. Denser urban environments have the potential to reduce the use of land and optimise the flow of people, energy, and goods (Coppola, 2012, Vitale Brovarone, 2010). They also increase the proximity between dwellings, work places, and public facilities, and consequently demand fewer resources and produce fewer greenhouse gases (Fatone et al., 2012). Since the 1990s, sustainability targets have driven urban densification policies, especially in the cities of developed countries after decades of urban sprawl. However, the feasibility of densification has been questioned by many. In the context of market economies, several studies point toward the lack of social acceptability as a major barrier to the implementation of denser cities (Breheny, 1997; Garcia & Riera, 2003; Bramley et al., 2009; Xue et al., 2016). In such a context, the ideas of freedom of choice and self-interest are dominant forces shaping the way in which urban space is developed and used in everyday life. Thus, people should have the freedom to choose the type of urban environment they want to live in, which means of transport they use, or which housing types meet their aspirations (Høyer & Næss, 2001; Garcia & Riera, 2003; Sager, 2011).

Norwegian cities have applied urban densification strategies with different degrees of success. During the period from 2000 to 2012, Oslo and Stavanger experienced relatively large increases in urban density, in contrast to Trondheim and Bergen where increases were modest (Hernandez-Palacio, 2014). However, in the case of Trondheim, densification policies have been severely criticised by different actors in the public debate. The most common concerns relate to the decline of urban qualities highly valued by Norwegian society, such as the urban landscape, sun and shade, and the views (Hermann, 2015; Sved, 2015). Due to several factors, among them social acceptability, the continuation of a positive trend in the densification of sprawling Norwegian cities seems to be increasingly challenging.

The problem, however, does not seem to be urban density itself, but rather the perception thereof, which in turn also becomes a question of urban quality. Urban density is the result of multiple factors, which are materialised in numerous forms and produce very different environments (Berghauser Pont & Haupt, 2009). Thus, a high concentration of people and activities can result in very different urban typologies, especially when taking into consideration geographical and cultural values (Urhahn & Bobic, 1994). Indeed, the traditional Norwegian city centre, as found in the urban cores built before the 1950s, is notoriously denser than many of the areas developed after. Despite the higher-density environment, average property prices in inner-city locations seem to be higher than in the newer lower-density peripheral locations (Tab. 1). This seems to indicate that there is perceived added value to central yet denser locations. Moderately dense urban environments in proximity to urban services seem a well-valued alternative for house buyers.

To investigate this preliminary observation, property sales data for 1,255 transactions in 2014 and 2015 were collected for 23 distinct, yet representative areas of Trondheim and density measures were calculated. Based on initial correlation analysis of the average sales price per square metre and the density measures, the following working hypothesis was proposed: urban density is a well-accepted and valued quality in Norwegian cities, which is reflected in the willingness-to-pay in the housing market. Homebuyers are willing to pay more per square metre in well-integrated, denser urban areas than in low-density, disconnected locations. Among other things, they pay for the accessibility and proximity of urban services, but also for more intense urban environments such as the ones found in many traditional inner cities.[1]

Trondheim is taken as an exploratory case study to test how hedonic pricing as a research instrument can be used to analyse the impact of urban density on housing prices. Hedonic pricing has been used to assess the impact of different aspects of the built environment on real estate prices, but urban density is a rather

[1] Strictly speaking, the hypothesis to be tested in this study is: urban density has a significant effect on property prices. The null hypothesis accordingly is: urban density does NOT have an effect on property prices.

unexplored aspect. Trondheim was chosen as a critical instance because it provides a good example of a middle-sized city in Norway and other developed countries where urban densification has become a main strategy in planning for more sustainable cities. Despite the limitations that a single case study may have, this exercise shows the potential of hedonic pricing as a proxy instrument to explore the social acceptability of a contested planning strategy.

This paper is organised as follow: Section 2 presents Trondheim as the study area, describes the urban areas under investigation and gives some initial analysis. Sections 3 and 4 present the hedonic pricing model, analysis and results. Section 5 concludes this paper with a discussion of the results and recommendations for future research.

2 TRONDHEIM: STUDY AREA AND INITIAL ANALYSIS

The study area is the city of Trondheim, Norway. Trondheim, with a population of 178,833 in 2015, is the third largest city in the country, after Oslo and Bergen (SSB, 2015). It is located on Trondheim Fjord in central Norway and has an average population density of 3027.5 inhabitants per km², which is considerably less than the average urban density in European cities estimated at 4,345 inhabitants per km² (Dodman, 2009). Trondheim's urban area can be divided into two distinct urban environments: the inner city, comprising the pre-industrial core and its 19th and early 20th century developments, characterised by a denser urban fabric, formed mostly of compact blocks; and the less dense outer city, made up of different developments built during the second half of the 20th century and the beginning of the 21st century. A study of residential qualities in Oslo using hedonic pricing analysis defines these two basic urban environments: a denser inner city environment (*bymessige områder*) and a less compact collage of peripheral developments (*feltutbygginger*) (Sjaastad et al. 2007). This clear differentiation in urban form is also evident in many European cities. According to Benevolo (1993), the urban form of European cities is in general characterised by a dense network core spanning a fairly restricted area, which then grew through multiple additions over the course of the 20th century.

Historically, Trondheim remained a rather compact urban agglomeration, maintaining the dense pattern of the traditional European city, until the early 20th century (Trondheim byarkiv).[2] At this time, a new trend of expansion was set by wealthy families through the introduction of urban villas into the urban landscape. This new form of lower-density townscape was restricted to a small segment of the population. Compact housing schemes, such as terraced houses or courtyard blocks, provided housing solutions for the majority of urban dwellers. This traditional pattern of urban development was dominant until the mid-20th century, when new modernisation trends entered Norwegian cities with force; one of the main consequences was the abandonment of the compact housing scheme as the predominant urban typology. The modern city presents new urban typologies, such as slab blocks and towers. The former typologies, such as terraced houses and courtyard blocks, are still present in the newer parts of the city, but they have become more spacious, allowing for more green spaces and a less dense environment. The ideal of living in the 'green city' rather than in the crowded old city seemed to dominate the housing market during the second half of the 20th century and still is influencing some new developments in the early 21st century.

2.1 THE URBAN AREAS

Initial data on property sales transactions were collected on a case-by-case basis from finn.no, a very popular online marketplace in Norway. Data were compiled for 1,255 sales transactions from 2014 and 2015. The sample was drawn from 23 urban environments with diverse layouts and locations. The first 10 are in the older parts of the city, formed mostly before the mid-20th century, and are referred to in this section as

[2] These observations are based on historical maps from 1893, 1902, 1916, and 1940 available in the Trondheim byarkiv.

Trondheim city centre (Fig. 1). The remaining 13 areas correspond to newer urban developments, and are referred to as Trondheim periphery (Fig. 2)

These areas were selected to cover the most representative types of urban environment in Trondheim. They range from high-density, high-rise buildings in Midtbyen (1) to low density development in Singsaker (7), Ilabekken (11), and Ranheim (22, 23). They cover areas with a high percentage of historic wooden houses in Bakklandet (5) and Møllenberg (6), and areas of urban renewal with an important component of refurbishment of old buildings in Nedre Elvehavn (3) and Persaunet (18). They also include areas in close proximity to large institutions in Gløshaugen (9) and Ila (10), to the fjord in Ila (10), Nedre Charlottenlund (21), and Ranheim (23), to large parks in Ilabekken (11), and to the river in Øya (2), Bakklandet (5), and Sjetnemarka (13). Post-war residential areas, such as Kolstad (14), form another part of the sample, as well as a representative selection of newer residential areas in the periphery, such as Selsbak (12), Tiller (15), Kattem (16), Moholt/Eberg (17), Nardo (19), and Angeltrøa (20).

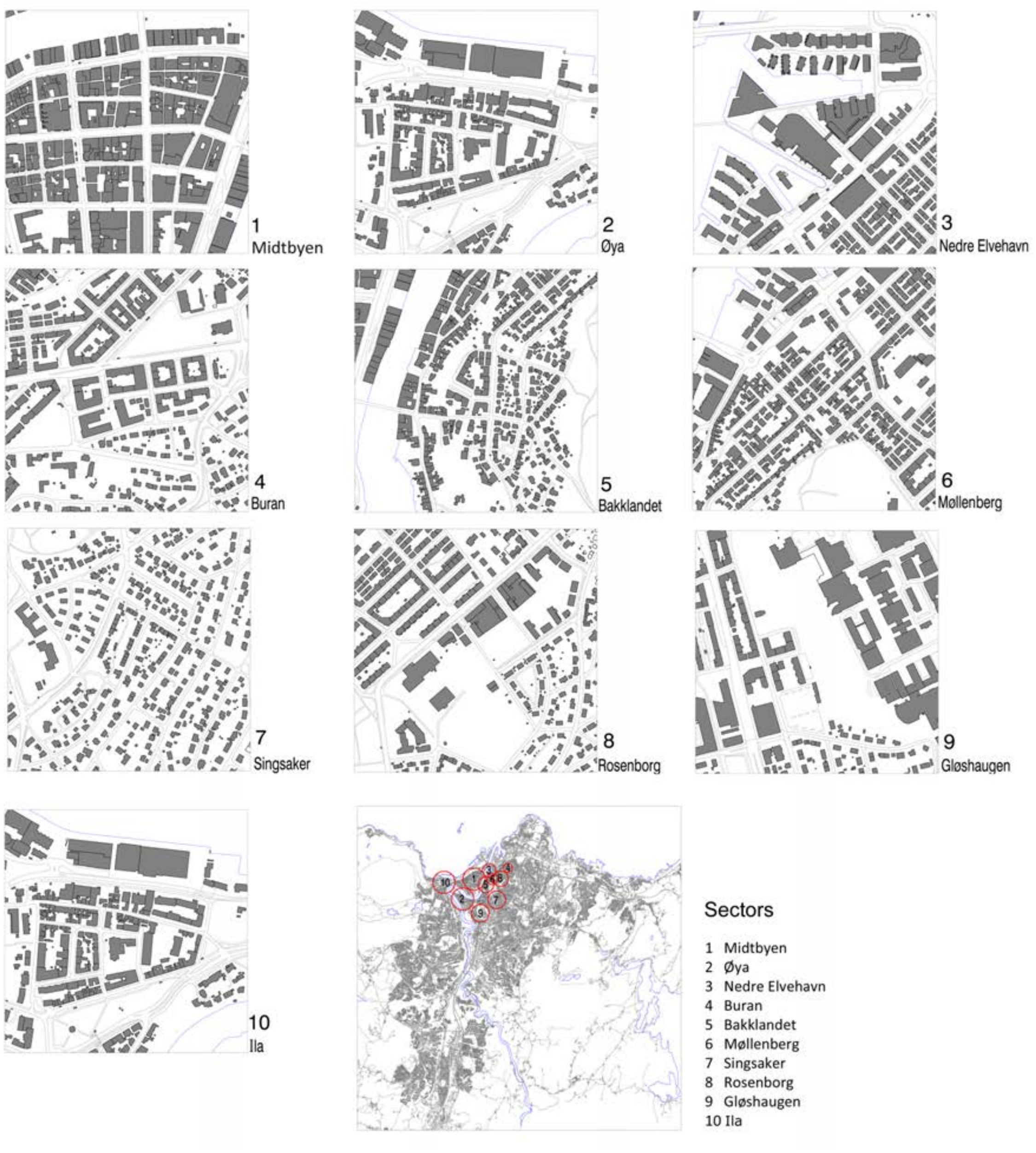

Fig. 1 Analysed areas in Trondheim city centre

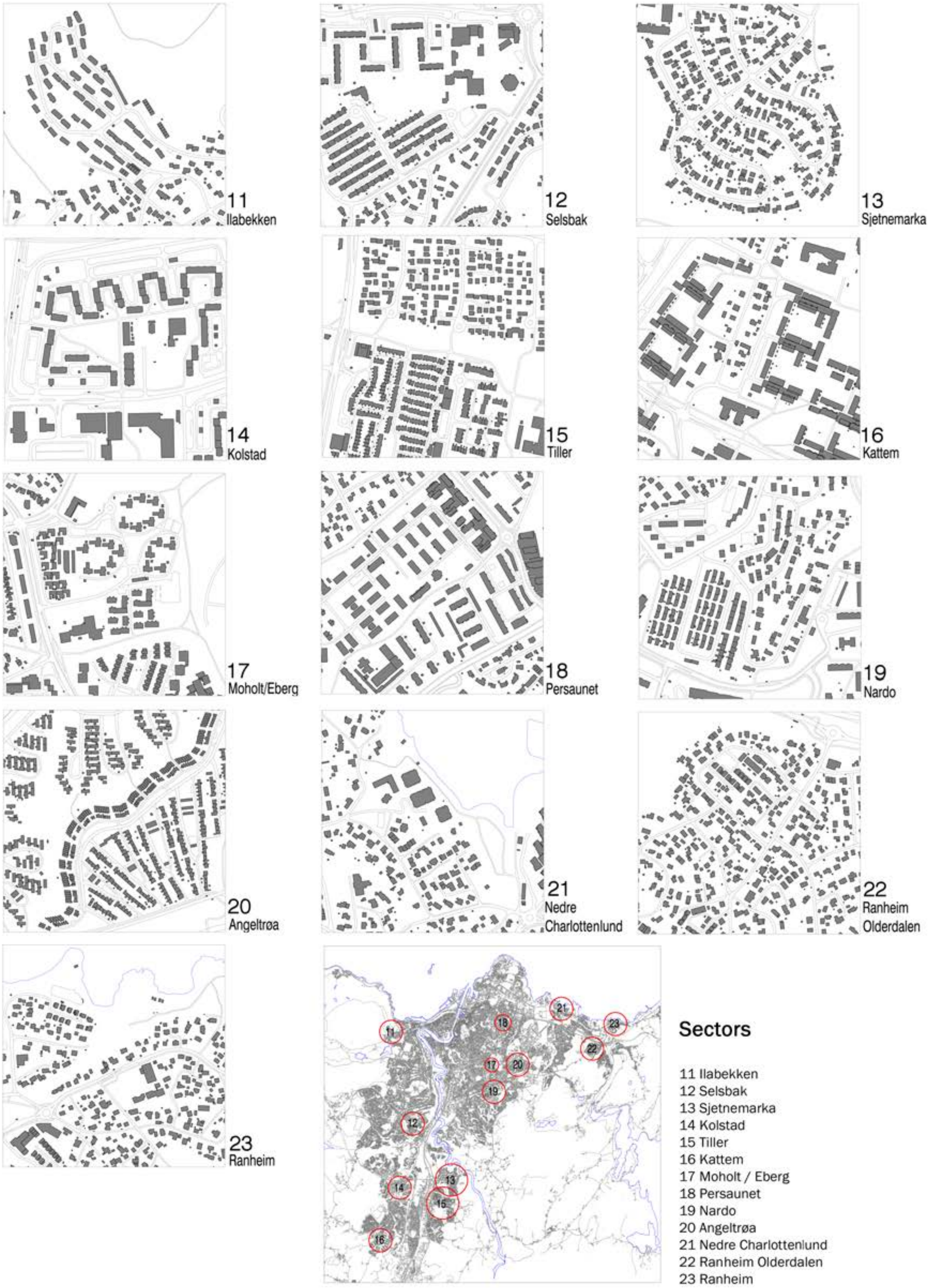

Fig. 2 Analysed areas in Trondheim periphery

urban area	average NOK price per m^2	*GRUNNKRETS*-BASED DENSITIES*			AVERAGE HECTARE CIRCLE-BASED DENSITIES**		
		built coverage density (% plot area)	dwelling unit density (units / ha)	population density (pers. / ha)	built coverage density (% plot area)	dwelling unit density (units / ha)	population density (pers. /ha)
1 Midtbyen	49,522.03	31.243	27.3	37.276	33.556	76.111	105.361
2 Øya	44,144.26	14.993	20.771	25.464	17.813	102.071	119.129
3 N. Elvehavn	56,624.62	28.863	64.061	70.345	22.767	187.493	208.377
4 Buran	43,305.11	33.853	134.598	158.137	22.831	143.588	176.029
5 Bakklandet	52,214.45	33.759	75.383	97.347	33.701	81.264	112.509
6 Møllenberg	43,461.24	33.58	94.721	115.937	26.426	107.365	121.987
7 Singsaker	44,375.01	16.508	18.16	36.471	17.139	53.515	61.091
8 Rosenborg	32,461.6	19.109	43.799	69.961	14.188	32.714	62.286
9 Gløshaugen	42,805.05	24.495	75.253	79.124	17.655	112.023	106.75
10 Ila	45,810.98	22.302	37.159	52.674	21.269	103.96	132.337
11 Ilabekken	33,018.1	8.691	10.429	24.334	11.774	20.2	45
12 Selsbak	36,012.84	13.404	15.112	29.231	9.319	47.61	80
13 Sjetnemarka	26,921.75	11.04	8.36	21.152	15.424	17.143	43.821
14 Kolstad	28,134.39	11.634	22.941	44.358	11.782	57.333	118.867
15 Tiller	30,741.61	18.895	19.993	50.794	16.976	34.402	75.753
16 Kattem	25,880.52	13.064	18.257	43.045	12.201	42.857	103.122
17 Moholt/Eb.	38,341.07	11.916	20.322	33.859	13.529	64.36	96.04
18 Persaunet	43,577.04	21.279	40.691	66.477	12.986	47.333	80.938
19 Nardo	42,775.44	16.843	19.36	32.803	8.954	32.698	53.279
20 Angeltrøa	38,896.6	16.451	15.178	42.968	14.862	40.467	76.4
21 Ned. Charlot.	40,773.57	12.079	13.712	23.966	16.876	28	65.545
22 Ranheim/Old	33,140.5	13.696	13.394	33.632	15.775	19.957	46.087
23 Ranheim	37,320.99	11.172	15.192	33.131	13.617	28.944	36.056

Tab.1 Average square metre prices and densities

* *Grunnkrets* are a type of geographic unit used to provide statistical information in Norway. These basic statistical areas are subdivisions of municipalities intended to cover a homogeneous area. They vary in size and population density.

** Average hectare circles are 1 hectare circles around each sales point. Their purpose is to calculate more detailed density measures in the immediate vicinity of each sales point.

3 HEDONIC PROPERTY PRICING

Hedonic property pricing is based on the assumption that property prices, housing unit prices in this case, are compound measures that reflect not only property characteristics, such as size or number of bedrooms, but also location, neighbourhood, as well as environmental characteristics (Freeman et al., 2014). Its most common functional form is linear or semi-linear regression analysis, whereby expenditures (price or rent) are regressed on housing and location characteristics (Malpezzi, 2002). Hedonic property pricing models have been used to assess the impact of a great number of environmental factors and neighbourhood characteristics on housing prices, such as the impact of air quality (Carriazo et al., 2013; Amrusch, 2005) or noise pollution (Chang & Kim, 2013; Dekkers & Van der Straaten, 2009), proximity to amenities (Cheshire & Sheppard, 1995; Xifilidou et al., 2012), accessibility (Srour et al., 2002; Bartholomew & Ewing, 2011, Tondelli & Scarsi, 2012), proximity to green areas (Bengochea Morancho, 2003; Jim & Chen, 2006), the value of scenic views (Jim & Chen, 2009), the value of urban wetlands (Tapsuwan et al., 2009), the value of urban tree cover (Sander et al., 2010; Vesely, 2007), or the value of cultural heritage in urban areas (Lazrak et al., 2014). However, to the author's knowledge, no such model has previously been used to focus on the value of urban density. In this analysis, a hedonic pricing approach is therefore used to estimate the marginal implicit prices of property, proximity, and density attributes. The marginal implicit price can be understood as the change in amount a person is willing to pay for an additional unit of an attribute (Freeman et al., 2014). The model regresses the log-transformed property prices per square metre on a combination of housing characteristics, distances to amenities, and density measures. It is computed for the complete dataset as well as for subsets of Trondheim centre and Trondheim periphery. The model can be specified as follows:

$$ln\ P_i = \beta_0 + \beta_1 H_i + \beta_2 DIST_i + \beta_3 DENS_i + \varepsilon_i$$

Pi is the price per square metre of property i. Hi is a vector of housing characteristics of property i, such as age of property, housing type, and ground floor access. DISTi is a vector of distance measures from property i, such as distance to nearest supermarket or distance from fjord. DENSi is a vector of density measures for property i. εi is the error term.

3.1 THE DATA

The sales data initially collected included information on sales price, size of property, age of property, years since last refurbishment, type of property (house or apartment), which floor(s) the property occupies, and the type of building the property is or is located in (for a complete list of variables, tab. 2). The 1,255 properties included in the dataset range in price from NOK 800,000 to 14,900,000,[3] and include small (less than 20m²) and large properties (more than 450m²), as well as new ones (built in 2015) and very old ones (more than 100 years old). The oldest property in the dataset was built in 1721 (Tab.3). Two basic types of residential unit are considered: apartments and houses, located in different building types, such as blocks, towers, or detached houses (explained below). The sample includes 23 areas, taken according to distinctive urban morphology patterns visually identified on the map of the city. The sales transactions were chosen to express the diversity of property types and property locations available in Trondheim. As the properties in the sample vary quite dramatically in size, it has been decided for this analysis to focus on the variation in price per square metre. Age of property (*AGE*) and years since last refurbishment (*YEARS_REFURB*) serve as proxies for the condition of the property. Both variables were computed by subtracting the year the property was built or refurbished from 2015. Type of property was dummy coded, taking the value 1 for houses and 0 for apartments (*HOUSE_APART*). The floor information was coded into two dummy variables: *GROUNDFLOOR* and

[3] At current exchange rate about USD 93,000 to 1,700,000.

MULTISTOREY. GROUNDFLOOR takes the value 1 if the property has ground-floor access, and *MULTISTOREY* takes the value 1 if the property spans across more than one floor. As building types are fundamental in the differentiation of urban environments and density distributions, Trondheim's large variety of buildings was reduced to seven basic building types for the analysis (illustrated in Fig. 3). Urban *villas* are single, freestanding dwellings surrounded by private gardens. They can have one, two, or three storeys, and basements. *Big house apartments* are apartment buildings in the settings of large detached houses, surrounded by gardens.

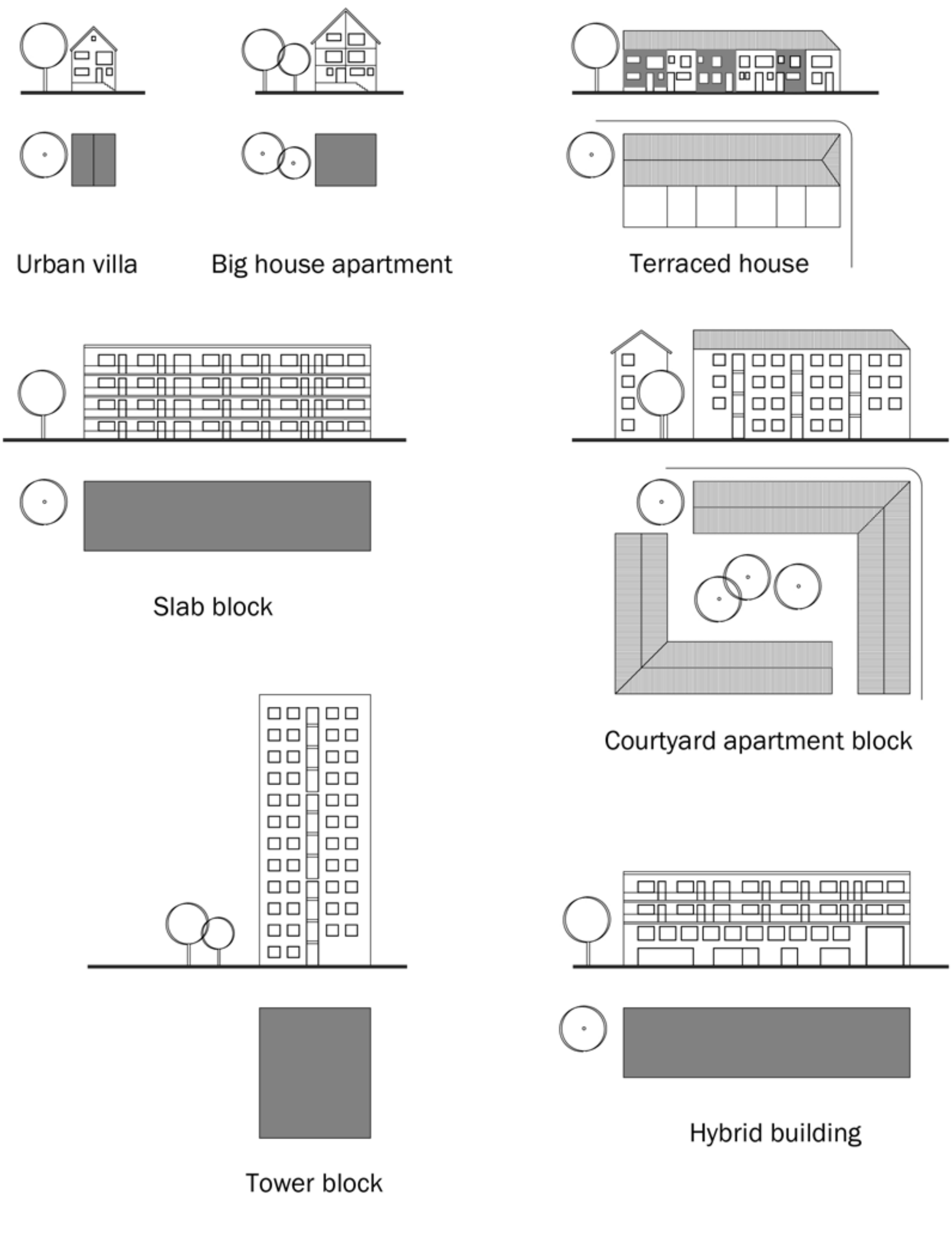

Fig. 3 Building types

In Trondheim, many former urban villas have been internally refurbished into apartment buildings. *Terraced houses* consist of similar residential units sharing side walls, usually forming blocks. They have separate entrances to the street and have gardens of different sizes, allowing natural lighting and cross-ventilation.
In Trondheim, they have normally one, two, or three storeys. *Slab blocks* are multi-storey buildings with lengthened form, in which the apartments are commonly set around a long corridor, or around several staircases and/or lifts with independent entrances. *Courtyard apartment blocks* are constituted by blocks of two or more wings, which fold around an open space.
L and S shape blocks, as well as atrium blocks around a patio are also part of this typology. *Tower blocks* are constituted by a multi-storey building with vertical proportions. They may have one or several dwellings per storey, organised around a central core constituted by staircases, lifts, and other technical components. *Hybrid buildings* correspond to a variety of buildings, mixing different uses and types. In some cases, they also correspond to the existing conditions of the context, such as the adaptation of former warehouses and other industrial buildings into new types and uses. For the purpose of the analysis, the dummy building type variables *BT_COURTYARD*, *BT_HYBRID*, *BT_SLABBLOCK*, *BT_TERRACE*, *BT_BIGHOUSE*, and *BT_TOWER* were coded against *BT_URBANVILLA*.
To compute geographical variables, such as distances to various amenities and density measures, the sales data were mapped in ArcGIS and additional data collected from Statistics Norway (the Norwegian Central Bureau of Statistics) and Norge Digitalt (a geographic information database). *ELEVATION* above sea level was computed for every sales address, depicted as points in ArcGIS, using a digital elevation model (DEM) of Trondheim. Euclidean distances were computed from the sales points to the nearest bus stop (*DIST_BUSSTOP*), supermarket (*DIST_SUPERMARKET*), higher education facility (*DIST_HIGHEREDU*), kindergarten (*DIST_KINDERGARTEN*), school (*DIST_SCHOOL*), shopping centre (*DIST_SHOPPING*) as well as to the fjord (*DIST_FJORD*) and to the recreational areas surrounding the city (*DIST_NATURE*).
Buses are an important mode of transportation in Trondheim. Approximately 10% of the population use them on a daily basis to commute (Hjorthol et al. 2014). Increasing the share of collective transport is a crucial aspect of the urban sustainability policies in Trondheim (Trondheim Kommune, 2008). Supermarkets are the main source of food for the majority of people in Norway. Easy access to them is therefore considered a plus for homebuyers. Close proximity to kindergartens and schools, referring here to elementary schools, middle schools, and high schools, can be an important factor when a young family is hunting for a new home. Trondheim is a university city and higher education institutions, such as the Norwegian University of Science and Technology (NTNU) and the University College of Sør-Trøndelag (HIST), are some of the biggest employers.
Being close to these institutions is therefore considered a desirable attribute for many homebuyers. As Norwegians have a high disposable income, shopping has become a favourite pastime for many. The shopping centres referred to are the biggest and most popular malls in the city. Norwegians also have a particular affinity for nature; not only do they enjoy the views that their country is famous for, they also spend a lot of time outdoors—hiking, skiing, fishing, and foraging. That is why the distances to Trondheim fjord as well as to the recreational green areas were also included in the list of variables.
As briefly mentioned above, for the density measure calculations, 1-hectare circles were drawn around each sales point. To calculate the percentage of built area or built coverage (*PERC_BUILT*), the sum of areas covered by buildings was divided by the total land area within the circle. Total land area excluded areas covered by water bodies, such as the main river Nidelva or the fjord. Number of people and dwellings were available on a building by building basis. Population per hectare (*POP_HA*) and dwellings per hectare (*DWELLINGS_HA*) were thus computed by adding all population and dwelling counts within a 1-hectare circle, respectively.

VARIABLE NAME	DESCRIPTION	EXPECTED RELATIONSHIP TO DEPENDENT VARIABLE
Dependent variable		
PRICE_M²	Price per square metre in NOK	
Property variables		
PRICE	Sales price of property in NOK	(incl. in dependent variable)
SIZE	Size of property in m^2	(incl. in dependent variable)
AGE	Year property was built subtracted from 2015	Negative
YEARS_REFURB	Year property was last refurbished subtracted from 2015	Negative
HOUSE_APART	Dummy variable indicating general type of property (1 for house / 0 for apartment)	Negative
GROUNDFLOOR	Dummy variable indicating whether property has ground floor access (1 for YES / 0 for NO)	Positive
MULTISTOREY	Dummy variable indicating whether property has multiple storeys (1 for multi / 0 for single)	Negative
ELEVATION	Elevation of the lot on which the property sits in m	Positive
BT_COURTYARD	Dummy variable indicating whether property is a courtyard block (1 for YES / 0 for NO)	?
BT_HYBRID	Dummy variable indicating whether property is a hybrid building (1 for YES / 0 for NO)	?
BT_SLABBLOCK	Dummy variable indicating whether property is a slab block (1 for YES / 0 for NO)	?
BT_TERRACE	Dummy variable indicating whether property is a terrace house (1 for YES / 0 for NO)	?
BT_BIGHOUSE	Dummy variable indicating whether property is a big house (1 for YES / 0 for NO)	?
BT_TOWER	Dummy variable indicating whether property is a tower block (1 for YES / 0 for NO)	Negative
BT_URBANVILLA	Dummy variable indicating whether property is a urban villa (1 for YES / 0 for NO)	?
Proximity variables		
DIST_BUSSTOP	Distance to nearest bus stop in m	Negative
DIST_SUPERMARKET	Distance to nearest supermarket in m	Negative
DIST_HIGHEREDU	Distance to nearest higher education facility in m	Negative
DIST_KINDERGARTEN	Distance to nearest kindergarten in m	Negative
DIST_SCHOOL	Distance to nearest school in m	Negative
DIST_SHOPPING	Distance to nearest shopping centre / mall in m	Negative
DIST_FJORD	Distance to Trondheim fjord in m	Negative
DIST_NATURE	Distance to recreational green areas / nature in m	Positive
Density variables		
PERC_BUILT	Percentage land area that is built area within 1-hectare	?
POP_HA	Number of people within 1-hectare circle	?
DWELLINGS_HA	Number of dwellings within 1-hectare circle	?

Tab. 2 Variable descriptions and expected relationship to dependent variable PRICE_M²

The variables PRICE and SIZE are used to compute the dependent variable PRICE_M². They are therefore not included in the regression model and no statements about the expected relationship of the variables to the dependent variable are made. For all other variables, the expected relationship is shown. A positive relationship indicates that an increase in the independent variable would likely be associated with an increase in the dependent variable, whereas a negative relationship indicates that an increase in the independent variable would likely be associated with a decrease in the dependent variable. A question mark indicates uncertainty with regard to the expected relationship.

VARIABLE NAME	MEAN	STANDARD. DEVIATION	MINIMUM	MAXIMUM
LN_PRICE_M²	10.59	0.3	9.73	11.28
PRICE_M²	41,366.13	11,771.49	16,889.76	79,513.6
PRICE	2,980,022.00	1,352,609.00	813,983.00	14,900,000.00
SIZE	80.14	46.73	15	481
AGE	49.85	39.31	0	294
YEARS_REFURB	31.02	31.45	0	173
ELEVATION	59.08	57.56	0.9	168.6
DIST_BUSSTOP	162.87	98.05	8.39	578.57
DIST_SUPERMARKET	298.81	199.86	0.16	1,102.05
DIST_HIGHEREDU	1,951.83	2,374.48	44.26	8605.3
DIST_KINDERGARTEN	230.68	142.56	0.03	742.54
DIST_SCHOOL	425.17	240.21	30.32	1,353.48
DIST_SHOPPING	1,208.8	898.38	53.2	3,602.85
DIST_FJORD	2,470.23	2,711.56	27.71	8,737.99
DIST_NATURE	300.92	220.48	0.00	958.38
PERC_BUILT	19.76	10.59	0.00	58.34
POP_HA	103.55	57.11	0.00	353.00
DWELLINGS_HA	74.07	55.73	4.00	333.00
HOUSE_APART	0.17	0.37	0.00	1.00
GROUNDFLOOR	0.43	0.49	0.00	1.00
MULTISTOREY	0.21	0.41	0.00	1.00
BT_COURTYARD	0.21	0.41	0.00	1.00
BT_HYBRID	0.09	0.28	0.00	1.00
BT_SLABBLOCK	0.33	0.47	0.00	1.00
BT_TERRACE	0.21	0.41	0.00	1.00
BT_BIGHOUSE	0.07	0.25	0.00	1.00
BT_TOWER	0.01	0.07	0.00	1.00
BT_URBANVILLA	0.09	0.29	0.00	1.00

Tab. 3 Summary statistics

4 ANALYSIS AND RESULTS

Tab. 4 presents the results of the model outlined above for the complete dataset as well as for the two subsets, Trondheim centre and Trondheim periphery. Fourteen observations that had a population and/or built coverage density of zero were excluded. A population and/or built coverage density of zero should not be possible in a populated built-up area, but due to data inconsistencies arising from different ages of the underlying datasets, i.e. the population data being slightly older than the building data, and the building data being slightly older than the sales data, it nonetheless occurred.

After heteroscedasticity was detected following some of the initial model runs, achieving significant results with White's general test (e.g., for the complete dataset, Global version 1 below, Chi2 = 183.97, p = 0.00) and occasionally with the Breusch–Pagan test that tests for linear forms of heteroscedasticity (e.g., for City centre version 1 below, Chi2 = 5.02, p = 0.03), (heteroscedasticity) robust standard errors were used in the subsequent analysis.4 A common problem in hedonic pricing models is multicollinearity, which arises when independent variables are highly correlated. To address this issue, a correlation matrix for all independent variables was computed. Five variable pairs were identified as highly correlated (r>0.8***): HOUSE_APART and MULTISTOREY, DIST_HIGHEREDU and ELEVATION, DIST_FJORD and ELEVATION, DIST_FJORD and DIST_HIGHEREDU, POP_HA and DWELLINGS_HA. As there are very few multi-storey apartments in the dataset, but houses generally are multi-storey properties, the variables HOUSE_APART and MULTISTOREY practically describe the same thing and consequently the variable MULTISTOREY was dropped. Most higher education facilities are located in proximity of the fjord, which means that for most of the dataset as distance to the fjord increases so does distance to higher education; and as elevation increases with distance to fjord, these three variables point in the same direction. That is why, for the analysis, only DIST_FJORD was included. Since the focus of this analysis is density, neither dwelling unit density nor population density was excluded, rather separate models were run, including one or the other. After further conceptual considerations and initial regression rounds, it became evident that the variable HOUSE_APART and the building type variables when coded against BT_URBANVILLA, which is the single-dwelling free-standing house in the dataset, effectively describe the same matter, the building type variables being the more detailed version. However, since adding the building type variables to the model, rather than HOUSE_APART, did not increase the variance explained by the model and the general conclusion remained the same, that is that apartments are overall more expensive than houses, the HOUSE_APART variable was chosen. Due to the clustered nature of the initial data collection, potential issues of spatially auto-correlated residuals were not explicitly addressed in this study.

The regression results of the model clearly show that there are substantial differences between the two subsets, Trondheim centre and Trondheim periphery. The R^2 –values, which measure the quality of fit of the models, are much bigger for the periphery (and the whole dataset) than for the city centre, indicating that the model as it is specified now explains more of the variation in property prices of the periphery dataset and the whole dataset than it does for the city centre dataset; which is a reasonable finding given the fact that there are likely many more factors contributing to property prices in the city centre than are included in this study. Taking a closer look at the coefficient estimates, one also finds considerable differences between what is and what is not significant in the different versions of the model. The only three parameters that are significant for the global, centre, and periphery versions of the model are age of property (*AGE*), house or apartment (*HOUSE_APART*), and distance to fjord (*DIST_FJORD*).

The parameter estimates of AGE in the global versions of the model (columns 1 and 2 in Tab. 4) seem to indicate that an additional year would result in a decrease in price per square metre of between 0.109 and 0.117%, ceteris paribus.[5] At a mean property sales price per square metre of NOK 41,366, this results in a marginal implicit price of between NOK -45.09 and -48.40. In the city centre (columns 5 and 6), the decrease in price per square metre is smaller for every additional year added (between 0.095 and 0.096% or between NOK -39.30 and -39.84 evaluated at the mean property sales price per square metre), whereas in the periphery (columns 3 and 4) it is greater (between 0.263 and 0.312% or between NOK -108.79 and -129.06). This might be due to different valuations of building age in the periphery and the centre. In the city centre, many buildings are historic and/or under heritage protection, whereas in the periphery many developments are newer and age is not seen as a positive attribute, but rather as a potential cost factor. With respect to years since last refurbishment (*YEARS_REFURB*), the estimates were only significant for the global and the city centre versions of the model. The marginal implicit price of increasing the time since last refurbished by one year, evaluated at the mean property sales price, ranges from NOK -37.68 to -38.09 for the global model and from NOK -

[4] In the presence of heteroscedasticity, which is a common occurrence when using cross-sectional data, the least squares estimator is still a consistent and unbiased estimator, yet it is no longer best (i.e., efficient). There is another estimator with a smaller variance. Moreover, the standard errors computed for the least squares estimator are incorrect. Confidence intervals and hypothesis tests based on standard errors may therefore be misleading. A common solution to this problem is the use of heteroscedasticity robust standard errors.

[5] For the remainder of this discussion ceteris paribus, i.e. all other variables held constant, is assumed.

30.36 to -30.44 for the centre model. As with age of property, the price per square metre decreases with an increase in time passed.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Global	Global	Periphery	Periphery	Centre	Centre
AGE	-0.00117***	-0.00109***	-0.00312***	-0.00263***	-0.000963***	-0.000950***
	(0.000180)	(0.000181)	(0.000554)	(0.000559)	(0.000195)	(0.000194)
YEARS_REFURB	-0.000911***	-0.000921***	-0.000909	-0.000969	-0.000736***	-0.000734***
	(0.000221)	(0.000221)	(0.000601)	(0.000592)	(0.000228)	(0.000227)
HOUSE_APART	-0.209***	-0.193***	-0.221***	-0.168***	-0.145***	-0.140***
	(0.0205)	(0.0206)	(0.0225)	(0.0230)	(0.0535)	(0.0540)
GROUNDFLOOR	-0.0180	-0.0126	0.0591***	0.0693***	-0.0199	-0.0201
	(0.0146)	(0.0146)	(0.0172)	(0.0170)	(0.0187)	(0.0187)
DIST_BUSSTOP	5.57e-05	5.24e-05	-0.000304***	-0.000314***	0.000227**	0.000216**
	(7.05e-05)	(7.04e-05)	(8.73e-05)	(8.58e-05)	(0.000105)	(0.000105)
DIST_SUPERMARKET	9.36e-06	3.60e-05	1.31e-05	6.90e-05	-1.22e-05	1.01e-05
	(4.04e-05)	(4.11e-05)	(5.03e-05)	(5.08e-05)	(6.89e-05)	(6.95e-05)
DIST_KINDERGARTEN	-9.03e-05*	-9.66e-06	-0.000167**	-0.000139*	-7.94e-06	2.99e-05
	(4.79e-05)	(4.83e-05)	(7.98e-05)	(7.95e-05)	(6.94e-05)	(6.76e-05)
DIST_SCHOOLS	1.59e-05	6.21e-07	0.000131***	0.000161***	-8.88e-05*	-0.000108**
	(3.14e-05)	(3.20e-05)	(4.95e-05)	(4.78e-05)	(4.92e-05)	(4.89e-05)
DIST_SHOPPING	-4.38e-05***	-3.74e-05***	-2.85e-06	3.81e-06	-0.000189***	-0.000188***
	(8.79e-06)	(8.97e-06)	(1.23e-05)	(1.20e-05)	(2.53e-05)	(2.51e-05)
DIST_FJORD	-5.08e-05***	-5.13e-05***	-4.54e-05***	-4.15e-05***	7.21e-05***	7.03e-05***
	(3.15e-06)	(3.18e-06)	(4.21e-06)	(4.24e-06)	(2.13e-05)	(2.10e-05)
DIST_NATURE	0.000205***	0.000175***	0.000282***	0.000322***	0.000132**	0.000105
	(3.81e-05)	(3.98e-05)	(5.49e-05)	(5.37e-05)	(6.25e-05)	(6.42e-05)
PERC_BUILT	0.00115	0.000491	0.00147	8.05e-05	-0.00166*	-0.00178*
	(0.000780)	(0.000776)	(0.00184)	(0.00183)	(0.000963)	(0.000923)
POP_HA	-0.000455***		-0.000267		3.97e-05	
	(0.000116)		(0.000238)		(0.000155)	
DWELLINGS_HA		0.000143		0.00143***		0.000243*
		(0.000118)		(0.000364)		(0.000141)
CONSTANT	10.86***	10.79***	10.78***	10.60***	10.89***	10.88***
	(0.0402)	(0.0397)	(0.0679)	(0.0722)	(0.0549)	(0.0543)
Observations	1,241	1,241	609	609	632	632
R-squared	0.537	0.533	0.540	0.550	0.253	0.256
Root MSE	0.203	0.204	0.199	0.197	0.186	0.185
Mean VIF	1.60	1.64	1.64	1.66	1.85	1.85

Dependent variable = LN_PRICE_SQM
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Tab. 4 Regression results

Looking at the property type parameter estimates, house or apartment (*HOUSE_APART*), the estimates indicate that buying a house rather than an apartment reduces the price per square metre, in the case of the global versions by between 19.3 and 20.9%, in case of the periphery versions by between 16.8 and 22.1%, and in the case of the city centre versions by between 14.0 and 14.5%. Calculating the marginal implicit prices (for the mean sales price per square metre), this translates to NOK 5,791.24 and 5,998.07 for the city centre, NOK 6,949.49 and 9,141.89 for the periphery, and NOK 7,983.64 and 8,645.49 for the global versions. The dummy variable *GROUNDFLOOR* is significant only in the periphery, where ground-floor access seems to be a valued commodity, increasing the price per square metre by between 5.91 and 6,93%.

With regard to the distance measures, proximity to a bus stop is a desirable attribute in the periphery, but not so in the city centre. In the periphery, the price per square metre decreases when the distance to the nearest bus stop increases. An additional 100 metres will reduce the price per square metre of a property sold at the mean sales price per square metre by between NOK 1,257.53 and 1,298.89. In contrast, an additional 100 metres distance in the city centre will increase the price per square metre of a similar property by between NOK 893.51 and 939.01. This could be due to the perception of a bus stop. In the centre, where many bus stops are frequented by multiple bus lines, a bus stop can be perceived as a noise pollutant and a nuisance;

whereas in the periphery a bus stop is an important access point to the public transport network and represents an improvement in the general accessibility of the property.

Easy access to supermarkets has not been significant for any of the versions of the model. That is perhaps because supermarkets are scattered all over the city, and food seems to be readily available everywhere. Distances to shopping centres, on the other hand, have proven highly significant at a 0.01 level for the global and city centre version of the model. Evaluated at the mean sales price per square metre, an additional 100 metres in distance to the nearest shopping mall will reduce the price per square metre of the property by between NOK 154.71 and 181.18 globally and between NOK 777.68 and 781.82 in the city centre. Living close to a school seems to be an attractive quality in the city centre, but not so in the periphery. In the city centre, an additional 100 metres in distance to the nearest school can decrease the square metre price between NOK 367.33 and 446.75, whereas in the periphery the square metre price can increase between NOK 541.89 and 665.99. A kindergarten, on the other hand, is valued only in the periphery, where an additional 100 metres in distance reduces the square metre price between NOK 574.99 and 690.81.

In considering proximity to the fjord (*DIST_FJORD*), estimates for all three versions of the model are significant. For the periphery and globally, an increase in distance away from the fjord results in lower property prices per square metre. An additional 100 metres decreases the price per square metre in the periphery by between NOK 171.67 and 187.80 and globally by between NOK 210.14 and 212.21, evaluated at the mean sales price per square metre. For the city centre, however, property prices per square metre seem to increase with an increase in distance to the fjord. An additional 100 metres away from the fjord adds between NOK 290.80 and 298.25 to the property price per square metre. This distinction might be due to Trondheim’s inner-city coastline characteristics. Much of Trondheim’s waterfront is industrial rather than residential, which could explain why homebuyers in the centre prefer to avoid proximity to the coast and the industrial areas. In the periphery, however, the fjord provides attractive views for many privileged dwellings.

With regards to proximity to green and recreational space (*DIST_NATURE*), parameter estimates for the global, periphery, and one of the city centre versions of the model are significant, indicating that an increase in distance away from the city boundaries and nature increases the price per square metre of a property. An additional 100 metres in distance to nature (and thus closer to the centre), again evaluated at the mean sales price per square metre, can add between NOK 723.91 and 848.00 globally, between NOK 1,166.52 and 1,331.99 in the periphery, and NOK 546.03 in the city centre. This is a plausible finding because properties close to green space (especially large ones) tend to be perceived as more isolated and far away from everything.

The parameter estimates of the density measures are not what one would have expected given the findings of the initial correlation analysis. Ideally, the estimates should have been significant throughout and all pointing in the same direction. However, they are not. Population density is only significant in the global model, where it indicates that adding 10 additional people within the 1-hectare circles would decrease the square metre price by NOK 188.22. Built coverage on the other hand is only marginally significant (at a 10% level) in the city centre, where according to the estimates a 10% increase in building mass would result in a square metre price reduction of between NOK 68.67 and 73.63. This could be due to the fact that above certain thresholds of building density spatial qualities such as natural lighting, ventilation, green spaces, and views are negatively affected. Where this threshold lies is dependent on the particular context, which is influenced by cultural and aesthetic values of the population. It seems that in Trondheim city centre where the larger values in build coverage exist, density is already perceived as high enough. The only variable that has a positive impact on square metre price in this model is dwelling unit density. The variable *DWELLINGS_HA* is significant in the periphery and the centre, where an additional 10 dwellings per hectare would add NOK 59.15 and 100.52 to the square metre price, respectively. These findings are somewhat hard to interpret. On the one hand, the model results seem to indicate that Trondheimers value spaciousness, i.e. space away from other people and from the next building. On the other hand, they also seem to value a certain degree of dwelling unit density.

This, however, correlates with the fact that apartments, which are usually located close to other apartments, are generally more expensive per square metre than free-standing houses.

5 DISCUSSION AND CONCLUSION

A preliminary analysis comparing the average sales prices per square metre with population density and dwelling unit density measures indicates a pronounced positive correlation between higher densities and higher prices per square metre. From this initial observation, the working hypothesis was proposed that urban density is a well-accepted characteristic in highly valued urban centres of Norway and that therefore the housing market would reflect the Norwegians willingness-to-pay for higher density well-located urban environments. The hedonic pricing model, however, even though it did not contradict this hypothesis, displays a more nuanced picture in which higher dwelling density per hectare positively influenced housing prices, but population density per hectare had a contrary effect. Multiple factors could have contributed to this finding.

The materialisation of density in the built environment involves a large variety of forms that influence urban and architectural qualities in different ways. How people value these qualities is a context-specific issue that influences the diversity of urban environments that exist, not only in different places but also through time. The variables of density and proximity used in this analysis are common measures, but they do not encompass all the spatial qualities affecting housing prices. The variables included in the hedonic model, as well as the size of the sample, do not allow for the explanation of the apparent inconsistencies between the positive influence of an increased dwelling density on housing prices and the negative influence of people per hectare. One would assume that if in a given area an increase in dwelling density positively affects prices, the same would hold true for population density, but this is not the case here. However, dwelling and population density do not necessarily increase at the same rates. The concentration of single-occupant and dual-income no-kid homes in a given location increases the dwelling density but not the population density. This is especially true when compared to areas in the periphery that are characterised by larger dwelling units, which are more popular among families with children. This fact could explain this paradox. If this is the case, even though the hedonic analysis does not confirm the initial working hypothesis, neither has it offered solid evidence to prove it wrong.

The sampling method, based on the visual identification of 23 representative urban patterns, may account for the diversity of urban environments of Trondheim, but it does not allow for the estimation of the extent to which the sales transactions are likely to differ from the total housing transactions in the city; that is, the housing transactions clustered in the 23 characteristic urban areas are not necessarily representative of the total housing transactions of the city. This represents a clear limitation for any generalisations drawn from this study and points towards the need of expanding the sample. Any future study of density and property prices in Trondheim should therefore either be based on a complete dataset of sales transactions over a certain period or on a random sample. What can be concluded from this study is that property prices and the measures of urban density correlate, indicating that properties are more expensive in denser locations. Yet it also shows that there is ample room to further study the relationship of urban density and housing prices. Is density indeed a quality reflected in property prices and thus socially accepted? Or is it a mere secondary object of consideration when buying a new property? Whilst the initial correlation analysis seemed to show that urban density is a valued quality in Trondheim's housing market, this study following the regression analysis cannot confirm this preliminary observation.

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IMAGE SOURCES

Fig. 1: Analysed areas in Trondheim centre: Own elaboration based on data from the Norwegian Mapping and Cadastre Authority https://www.kartverket.no/

Fig. 2: Analysed areas in Trondheim periphery: Own elaboration based on data from the Norwegian Mapping and Cadastre Authority https://www.kartverket.no/

Fig. 3: Building types: Own elaboration

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ANALYSING THE SPATIAL STRUCTURE OF THE STREET NETWORK TO UNDERSTAND THE MOBILITY PATTERN AND LANDUSE- A CASE OF AN INDIAN CITY - MYSORE

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ABSTRACT

Settlements grow and develop their unique spatial structure, subject to the factors (cultural, political, religious, etc.) influencing them. In course of time, the spatial structure starts influencing different aspects in the settlement like mobility, land-use, crime pattern, land values, etc. To understand the influences of spatial structure in a rational way, a scientific approach is required. So, space syntax techniques are chosen as the principal theoretical postulates for analysis, because of its quantitative and scientific approach. In this paper, an attempt has been made to analyse the spatial structure of the street network in an Indian city – Mysore – by a comprehensive application of space syntax techniques. The study has been conducted by breaking down the structure into components and by analysing the use of different measures, like integration and choice, using Depthmap software (Turner, 2012). The analysis is then related to the existing mobility pattern and land-use to construe how the spatial structure influences the mobility pattern and land-use.

KEYWORDS:
Spatial structure; Built environment; Urban street network; Mobility pattern; Space syntax; Patterns of movement.

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以了解出行方式和土地使用为目的的街道网络空间结构分析 研究对象：印度城市迈索尔

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摘要

人类定居点在逐渐增长的过程中，发展出其独特的空间结构，受到各种影响因素的制约。随之，空间结构开始对定居点的各种功能——如出行、土地使用、空间扩展等——产生影响。要合理了解这种空间结构及其影响的动态变化，有必要开展科学分析。因此，选用了具有定量科学方法的空间型构法则，作为分析的主要原理。本文试图通过综合性应用一种空间型构技术，来分析印度城市迈索尔的街道网络的空间结构。本研究中，作为研究对象的结构被拆解为多个部件，使用 软件通过不同方法——如整合与选择——实现分析。随后，将分析结果与现有的出行方式和土地使用相关联，以解释空间结构如何影响出行方式和土地使用。

关键词：
空间结构；建成环境；城市街道网络；出行方式；空间型构法则；运动方式。

1 INTRODUCTION

Built environments are human-made space in which people live, work, and recreate on a day-to-day basis. They are purely the creations of humans, subject to the existing factors and influences at any given time. Thus, collectively, the products and processes of human creation are called 'built environments' (McClure, Bartuska & Bartuska, 2007). Mobility spaces in any built environment can be visualised in two parts: (1) The space in and around the building where movement is associated with that building. Here, mobility has no effect on its surrounding areas; (2) The pathways that are connecting different buildings, which are called 'streets', form the basis for mobility from one building to another (City Form Lab, 2012). These individual streets are then connected to one another to form a network called 'street network' of the built environment. This street network forms the base in deciding the mobility pattern of a settlement. Movement is the essence of any settlement, and it creates the dense patterns of human contact (Tim Stonor, 2011). Patterns of movement and space use are fundamentally influenced by the configuration of space and by the location of activity generators and attractors (Space Syntax, 2011), and are also…shaped by the geometry of the street network, which, in turn, shapes the patterns of land-use. Patterns of crime and of land value are similarly affected (Tim Stonor, 2009a). So, there is a need to understand the inherent and composite relationships between 'street network' and 'pattern of movement'. Historic cities organise themselves (by) mixing land-uses in a natural way that people understand intuitively (Tim Stonor, 2010). Mysore is one of such cities which have physical, cultural, social, political and religious factors influencing the spatial structure of the settlement.

According to Mysore Urban Development Authority, Mysore is the second largest city in the State of Karnataka, India, with a population of more than 8 million, as per the 2011 census (MUDA, 2016a). It was the State capital and headquarters of the Princely State of Mysore (1399-1950). The city, built at the foot of the Chamundi Hill, boasts of natural and built heritage. The city's focal point for its punctilious planning and proportionate axis is the Ambavilas Palace which is the most magnificent and imposing building in Mysore. The well-defined central axis and long boulevards radiating from it are one of the finest examples of meticulous planning of those days (MUDA, 2016a).

Lack of scientific study of the urban street network creates a huge gap in understanding the relationship between form-mobility-landuse, and their impact on patterns of movement, land-use, land values, crime pattern, safety and spatial expansion. Streets with high mobility create points of land-use attractions since they attract more mobility and add more traffic to the existing ones, thereby generating a variety of problems related to congestion and mobility. Generally, problems arise with streets of lesser width attracting greater volumes of movement. In order to accommodate high volumes of mobility, these streets need to be widened; however, widening of the narrow streets may not be the solution in every case. In the case of fully-developed urban precincts/areas, road widening may not be a feasible solution because of physical, economic, political or historical constraints. So, here, there is the need to explore alternative solutions like flyovers or underpasses, etc., which are again major issues to consider. But, in newly-developing or partially-grown urban areas, anticipating high mobility on certain streets and, consequently, widening them and developing the related infrastructure, like parking facilities, etc., to meet future needs, will genuinely help in solving the problems arising from greater mobility. Restructuring the street network with necessary connectivity or detachments of streets might be a solution to change the preference for certain routes, but this has its own problems (Parthasarathi, 2014).

'Space syntax has the ability in capturing the trends of vehicular travel demands merely by analysing roadway accessibility embedded in urban morphology' (Penn et al., 1998; Karimi and Mohamed, 2003; Dawson, 2003, and many others). Research shows that 60-80% of the movement flows are due to the structure of the network, measured by spatial accessibility (Tim Stonor, 2014). Human movement was spatially guided by geometrical and topological rather than metric factors (Hillier & Iida, 2005). Lower movement-sensitive land-uses locate around the corner, higher movement-sensitive land-uses locate on movement-rich streets (Hillier & Vaughan ,2007). As cities evolve, land-uses exploit spatial accessibility (Tim Stonor, 2009b). Streets with high choice value will tend to attract higher mobility than the streets with less choice value, irrespective of the width of the road. This is due to the syntactical position of streets in the street network.

2 STUDY AREA

The study area shown in Figure 1 (MUDA, 2016b) includes Mysore city – an area of about 150 sq km. It includes the old city and the new neighbourhood extensions. To understand the evolution of the city in a better way, the spatial structure of Mysore city has been studied by collecting maps of the city as it was in 1865 (Karnataka Archives, 1865), 1897 (Rice. & B. Lewis, 1897), 1930 (Parsons & Constance, 1930) and 1976 (MUDA, 2016a).

Fig. 1: Study Area

2.1 GROWTH OF MYSORE CITY FROM 1865 TO 2016

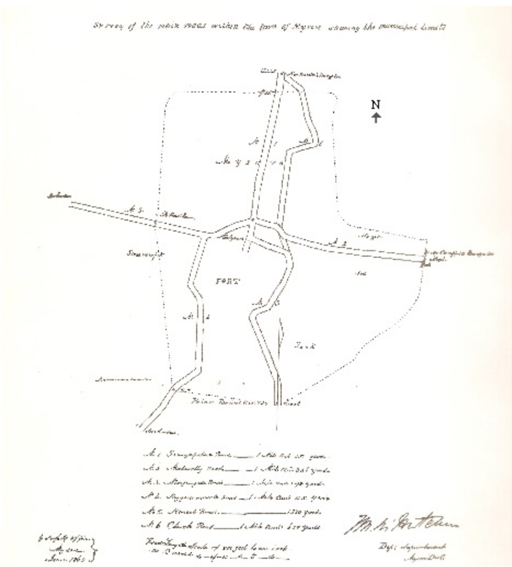


Fig. 2: Mysore City Map in 1865

Fig. 3: Mysore City Map in 1897

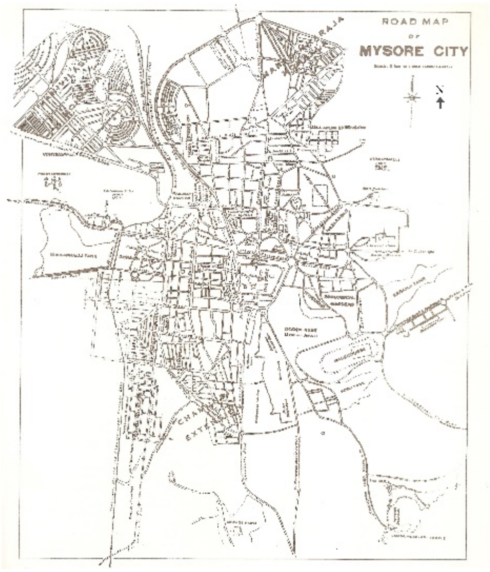


Fig. 4: Mysore City Map in 1930

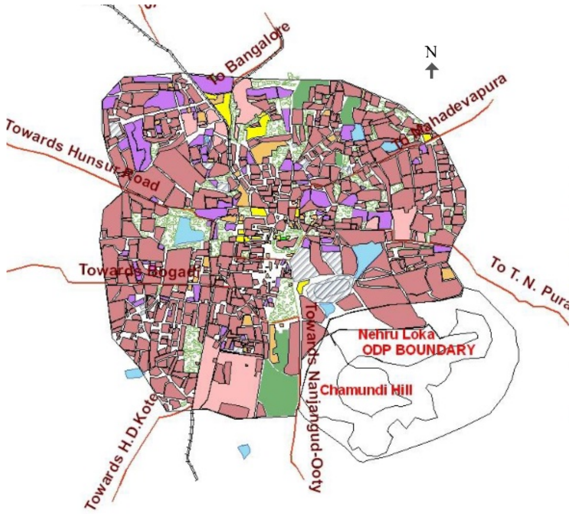


Fig. 5: Mysore Land-use Map in 1976

3 METHODOLOGY

The adopted methodology includes:

- To calculate the integration and choice graphs of the urban street network, using space syntax techniques;
- To investigate and analyse these graphs with the existing mobility and land-use;
- To determine the inter-relationship between the structure of the street network, mobility and land-use.

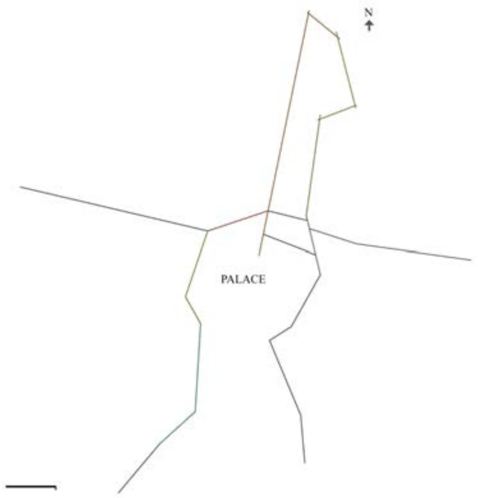
Space syntax is a set of techniques for analysing spatial layouts and human activity patterns in urban areas. It is also a set of theories linking space and society. Space syntax addresses where the people are, how they move, how they adapt, how they develop, and how they talk about it. (UCL Space Syntax,2017). It helps in explaining the relationship between the built environment and human behaviour. Depthmap is a software platform originally developed by Alasdair Turner at University College London (UCL) to perform a set of spatial network analyses designed to understand the social processes within the built environment (Space Syntax Network, 2017). Depthmap can demonstrate the spatial configuration of the street network in the vocabulary of Graphs and Data which makes it easy in interpreting the street network.

The integration and choice graphs of the urban street network of Mysore city are calculated using Space Syntax techniques in Depthmap software. Integration is a normalised measure of distance from any space of origin to all others in a system. In general, it calculates how close the origin space is to all other spaces, and can be seen as the measure of relative asymmetry (Hillier, B. & Hanson, J., 1984).

Choice measures how likely an axial line or a street segment it is to be passed through on all shortest routes from all spaces to all other spaces in the entire system or within a predetermined distance (radius) from each segment (Hillier et al.,1987). The integration and choice graphs generated are then investigated and analysed with the existing mobility and land-use. This helps in understanding the impact of street network on mobility pattern and land-use in a rational way. With the empirical study carried out, the inter-relationship between the structure of the street network, mobility and land-use can be established.

4 RESULTS

Integration and Choice Graphs of Mysore city from 1865 to 2016.



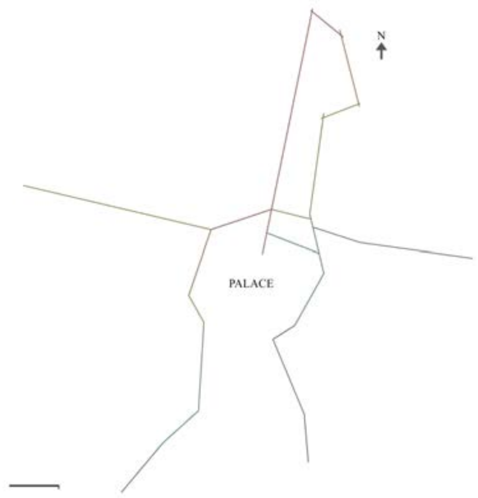


Fig. 6a: Integration - 1865

Fig. 6b: Choice - 1865

Fig.6a and Fig.6b show the Integration and Choice Graphs of Mysore City during 1865. The settlement started around the palace. Roads spread out in all four directions from the palace and they formed the initial base for the street network of the city.

Fig. 7a: Integration - 1897

Fig. 7b: Choice – 1897

Because of the Chamundi Hill on the south-east side, the city started growing towards the north and the west. Many public buildings, agraharas, and mohallas were constructed in the northern and western sides of the palace; so, roads leading towards these directions gained importance because of high choice and strong integration values (Fig.7a and Fig.7b).

Fig. 8a: Integration - 1930

Fig. 8b: Choice – 1930

Since the city is landlocked on the south-eastern side, it started growing towards the northern side with new extension layouts, but no such expansion is seen towards the southern or western sides (Fig.8a and Fig.8b).

Fig. 9a: Integration – 1976

Fig. 9b: Choice – 1976

Distinguished precincts were apparent by the streets with high integration to low integration value. The adjacent precinct towards the north of the palace has high integration value (Fig.9a). Hence, this precinct became the centre for many commercial and retail activities of the city, leading to formation of the Central Business District (CBD) of the city. Roads connecting the different precincts gained high choice value (Fig.9b) and gave the basis for the future direction of growth.

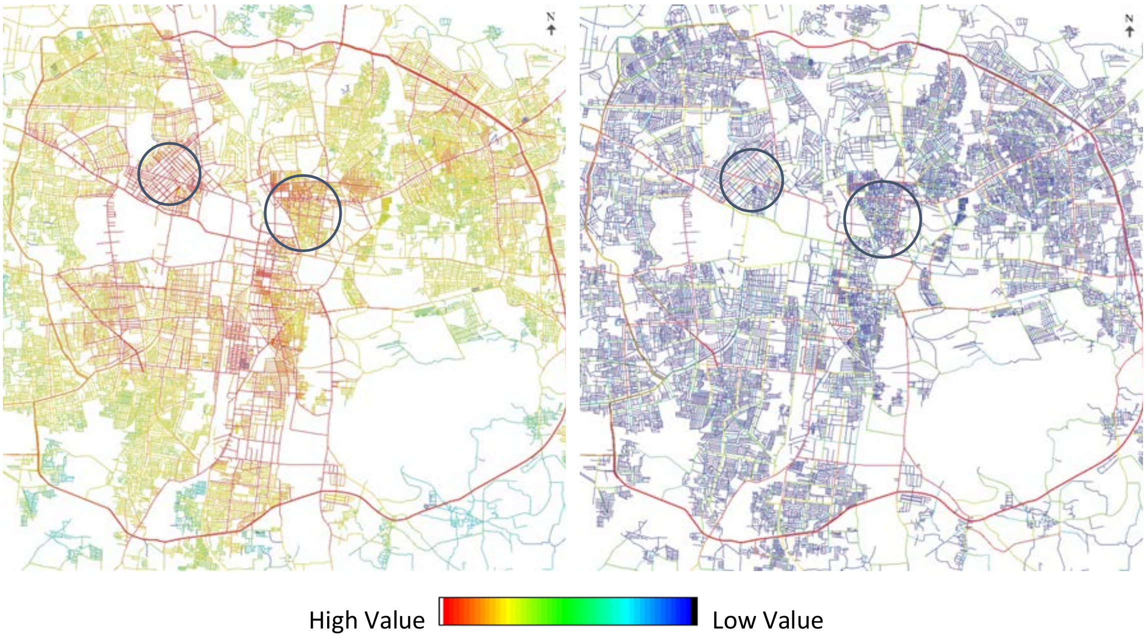


Fig. 10a: Integration Graph of Mysore City in 2016

Fig. 10b: Choice Graph of Mysore City in 2016

In 2016, the precinct located towards the north of the palace (which formed the base for the CBD) lost its high integration value as the city expanded (Fig.10a). So, the CBD area is not the most integrated area in the city. It seems that the integration power of the CBD area had slowly shifted towards the north-west side of the palace. The area is named as Centre C1. It includes the neighbourhoods of Vanivilas, Jaylakshmipuram, and Gokulam 2nd Stage area (Fig.10a and Fig.10b).

5 DISCUSSIONS

5.1 CBD AREA

The city started growing from this place. During the 1970s, the CBD area was the most integrated part of the city, but by 2016, the average integration value of the streets in the CBD had gone down (Fig.10a). However, it still retained its commercial land-use (Fig.11c) because of the previously established activities and the mobility pattern. 80% of the commercial land-use in the CBD area concentrated mainly on a few roads (Fig.11c and Tab.2).

The level of relative integration power percentage to that of the city can be calculated in the following way:

$$\text{Percentage of Relative Integration Power of CBD} = \frac{Average\ Integration\ of\ CBD}{Average\ Integration\ of\ Entire\ City}\ x\ 100 \qquad [1]$$

The average integration power of the CBD with that of the city was 14.8% stronger than the city in 1976, while in 2016, it was only 4.8% stronger (Tab. 1). This is because, as the city expanded, the structure of the street network changed; and hence, the lower integration power.

YEAR	AVERAGE INTEGRATION VALUE IN 2016	AVERAGE INTEGRATION VALUE IN 1976
CBD Area	4449	2596
Centre 1	5436	2288
Entire City	4244	2262

Tab.1: Integration values in 1976 and 2016

Much of the interior parts of the CBD area still have residential land-use (Fig.11c). This is because the interior roads are not much integrated with the street network, (Fig.11a) which makes accessibility difficult. The major commercial activities are happening on roads listed in Table 2 which have high integration and choice value. Apart from the few public and semi-public land-uses, 80% of the land abutting these roads have commercial land-use.

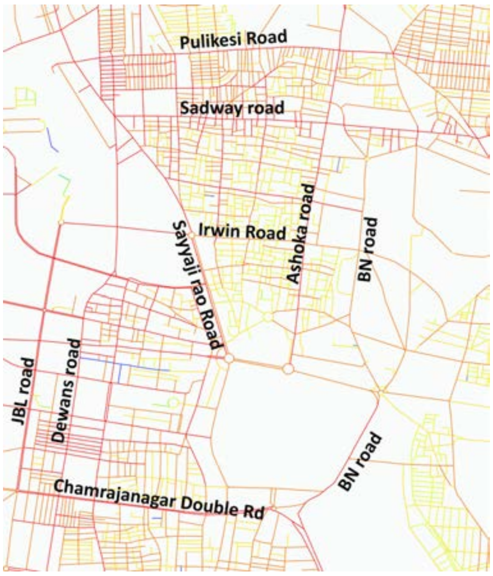


Fig. 11a: CBD Integration Graph

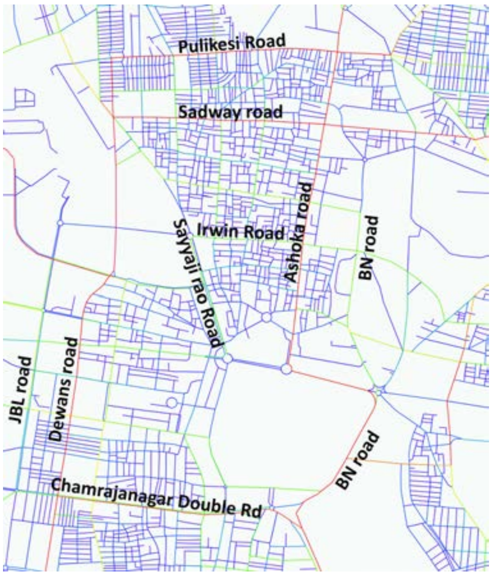


Fig. 11b: CBD Choice Graph

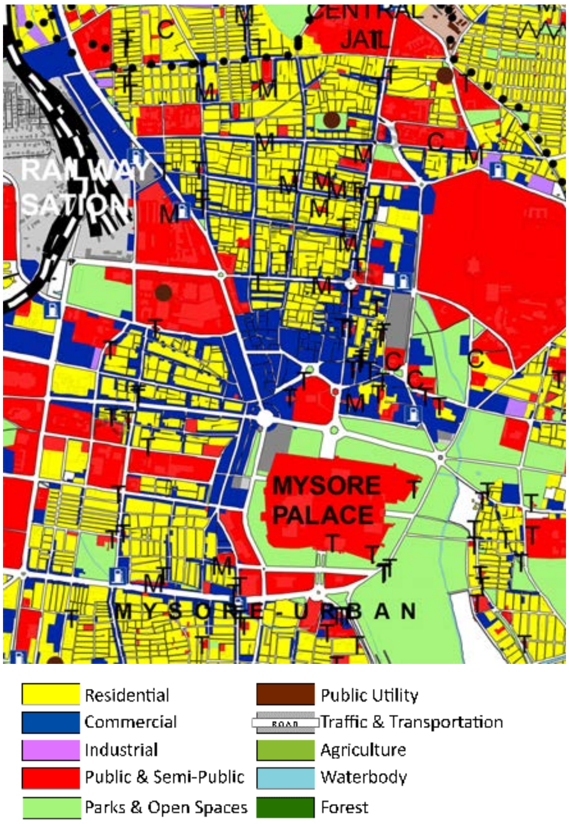


Fig. 11c: CBD Land-use Map (MUDA, 2016c)

Fig. 11d: CBD Circulation Map (MUDA, 2016b)

	STREETS	INTEGRATION VALUE	CHOICE VALUE	MAJOR LAND-USE
1	Irwin Road	5671	$1.84938\ X\ 10^{8}$	Commercial
2	Sawday Road	5333	$5.15944\ X\ 10^{7}$	Commercial
3	Ashoka Road	5383	$5.15742\ X\ 10^{7}$	Commercial
4	Sayyajirao Road	5221	$8.33283\ X\ 10^{6}$	Commercial + public & semi-public land-use
5	JLB Road	5167	$1.28762\ X\ 10^{8}$	Commercial + public & semi-public land-use
6	Dewan Road	5626	$1.50939\ X\ 10^{7}$	Commercial
7	Chamrajanagar Double Road	5239	$2.36761\ X\ 10^{7}$	Commercial

Tab.2: Integration Value, Choice Value and Land-use of important roads in CBD during 2016

5.2 CENTER 1

The most integrated area in the city, Centre C1 (Fig. 10a), has a much higher integration value than that of the CBD area. By 2016, it is 22% more integrated than the CBD area, which made it the most accessible centre from anywhere in the city (Fig. 10a and Tab.1). It has three strong choice routes (Fig.12b) passing through it. They are the Gokulam Road, the Maternity Road and the Kalidasa Road.

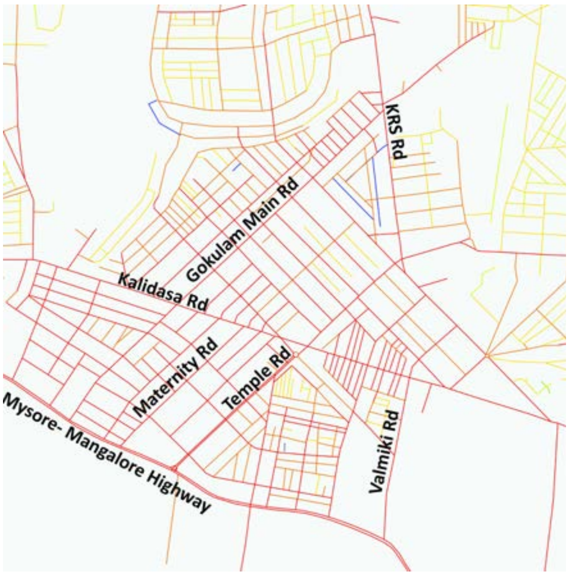


Fig. 12a: Centre C1 Integration Graph

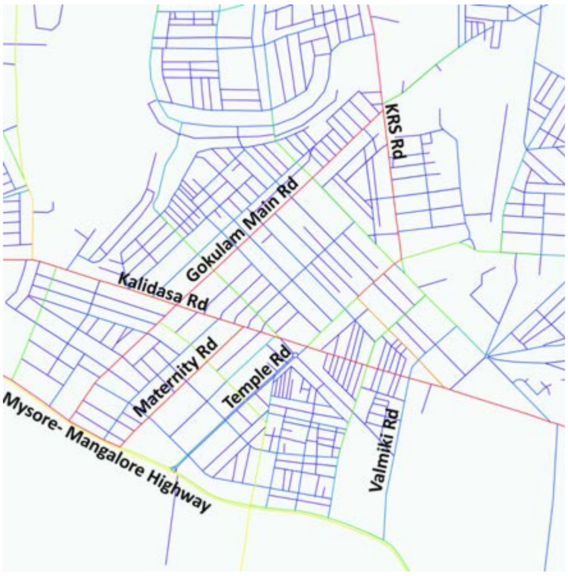


Fig. 12b: Centre C1 Choice Graph

The average integration of Centre C1 area was only 1% higher than that of the average integration value of the entire city in 1976, but in 2016 it was 28% higher, which is a very steep jump in value (Tab.1). This implies that the structure of the street network of this area (Centre C1) is strongly integrated with the rest of the city. The proposed intermediate ring road and two radial roads also passes through this area (Fig 12d). Because of the high integration power of this area, around 50% of which is under residential land-use at present (Fig.12c), it has the potential to attract more mobility and thereby get transformed to a movement-sensitive land-use in future.

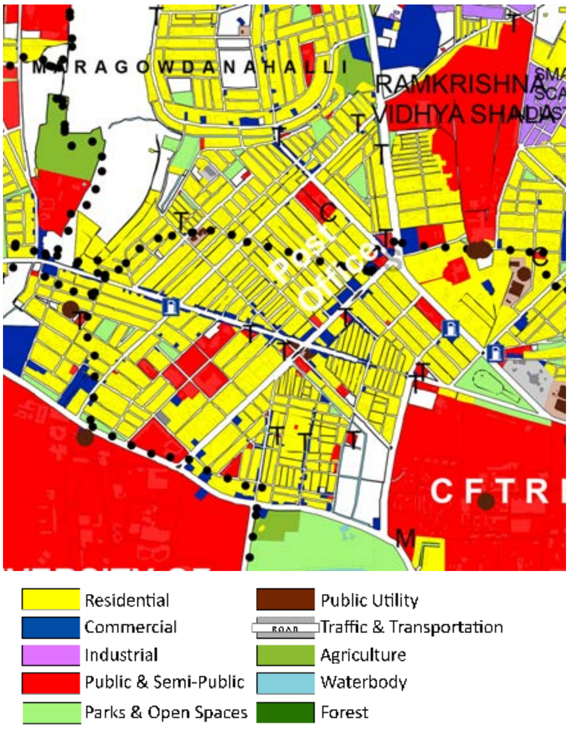


Fig.12c: Centre C1 Land-use Map (MUDA, 2016c)

Fig.12d: Centre C1 Circulation Map (MUDA, 2016b)

6 THEORY TO PRACTICE

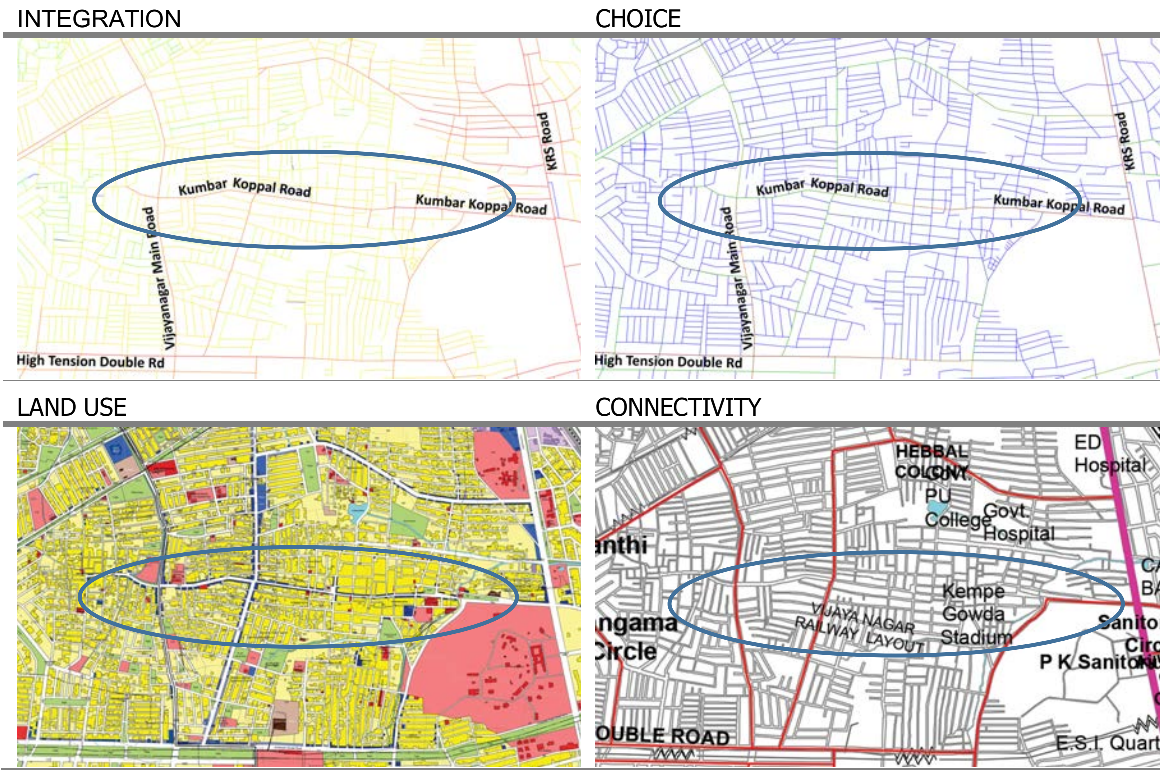
Kumbar Koppal Road and Tenali Rama Road are good examples to demonstrate how the syntactical position of streets in the street network affects mobility and land-use. In the proposed Master Plan Report of Mysore 2031, Kumbar Koppal Road is not marked as an important road (MUDA, 2016 c) while Tenali Rama Road is marked as such, although actual mobility and land-use speak differently (Tab.4 and Tab.5).

Kumbar Koppal Road which has 10% higher integration value and 10% higher choice value than Tenali Rama Road, has 67% more mobility volume (Tab.3). The land-use of Kumbar Koppal Road has 80% commercial, and 20% public and semi-public land-use, while Tenali Rama Road has 20% commercial and 80% residential land-use (Tab.4 and Tab.5).

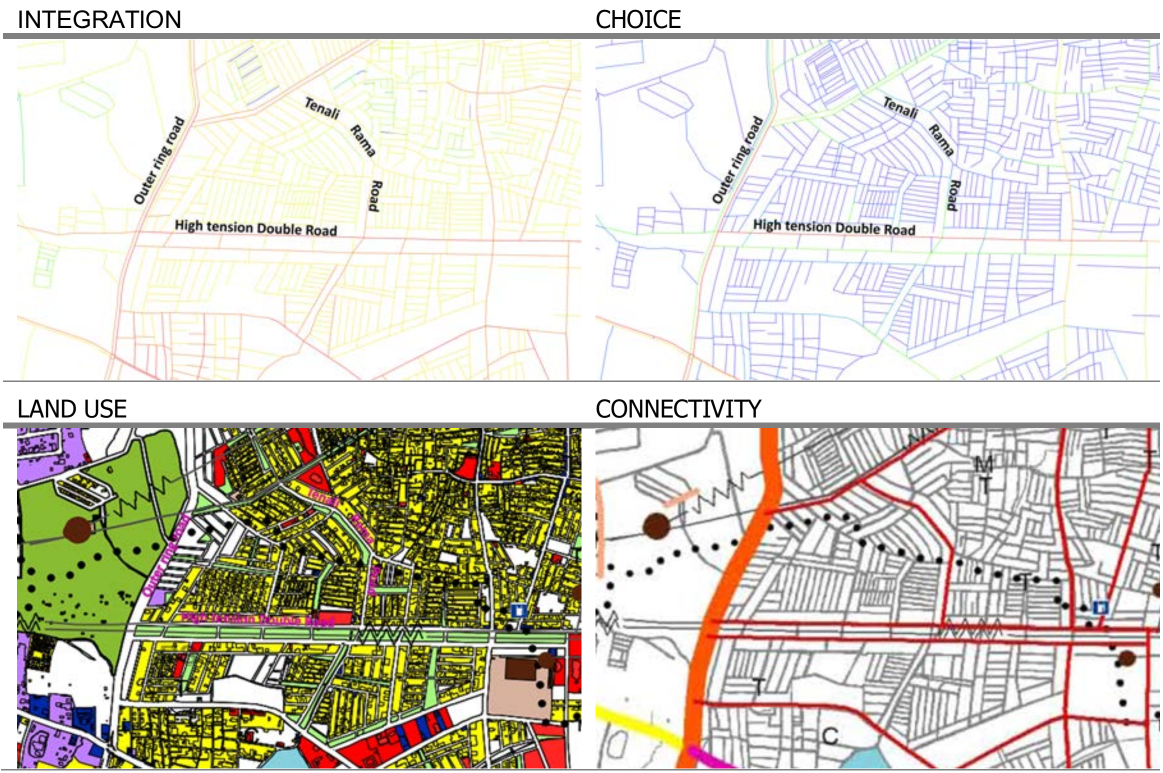
The comparative analysis of Kumbar Koppal Road and Tenali Rama Road:

	KUMBAR KOPPAL ROAD	TENALI RAMA ROAD
Integration Value	5,047	4,580
Choice Value	$1.93879\ X\ 10^7$	$1.91876\ X\ 10^6$
Average Road Width (in metres)	15	21
Mobility Volume (Motor Vehicle Count)	5000 (approx.)	3000 (approx..)
Major Land-Use	Commercial	Residential

Tab.3: Comparative Analyses of Kumbar Koppal Road and Tenali Rama Road



Tab.4: Kumbar Koppal Road's Integration Graph, Choice Graph, Land-use Map and Connectivity Map (MUDA, 2016b and MUDA 2016c)



Tab.5: Tenali Rama Road's Integration Graph, Choice Graph, Land-use Map and Connectivity Map (MUDA 2016b and MUDA 2016c)

Fig. 13a: Traffic at Kumbar Koppal Road, Mysore. May 18, 2016

Fig. 13b: Traffic at Tenali Rama Road, Mysore. May 18, 2016

7 CONCLUSION

The structure of the street network influences humans to take up the choicest route to reach their destinations. The choicest route is decided on the basis of the syntactical position of the streets in the street network. Hence, it can be concluded that the structure of the street network has an immediate effect on the mobility pattern and the land-use. This is confirmed by the above study and analysis. Two roads, Kumbar Koppal Road and Tenali Rama Road, each with a different syntactical position on the street network of Mysore, have different land-use and mobility.

In any city, a precinct with strong integration power with the rest of the city, potentially becomes the centre for business activities. This is generally observed in many historical cities, where the Central Business District (CBD) witnesses high mobility and business activity. But, as and when the city expands, with consequent change in the structure of the street network, the preferable destination will also get altered, thereby creating new precincts as the most preferable destinations because of their higher integration value. This phenomenon can potentially affect the mobility pattern and the land-use. It is evident from the above study that the CBD area, which was once the most integrated area in the city, lost this position to Centre C1 as the city started expanding.

It can, therefore, be safely concluded that a scientific analysis of the spatial structure of the street network using space syntax techniques, helps in understanding the influence of street network on mobility pattern and land-use.

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Fig. 1: Mysore Urban Development Authority (2016)

Fig. 2: Karnataka Archives (1865)

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Fig. 6a: Integration Graph of Mysore city in 1865, generated by author using Depthmap software.

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Fig. 10b: Choice Graph of Mysore city in 2016, generated by author using Depthmap software.

Fig. 11a: CBD Integration Graph in 2016, generated by author using Depthmap software.

Fig. 11b: CBD Choice Graph in 2016, generated by author using Depthmap software.

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TeMA

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REVIEWS PAGES

THE RESILIENCE CITY/THE FRAGILE CITY. METHODS, TOOLS AND BEST PRACTICES 2(2018)

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
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02_BOOKS
The books review suggests brand new publications related with the theme of the journal number.

author: Gerardo Carpentieri
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03_LAWS
The law section proposes a critical synthesis of the normative aspect of the issue theme.

author: Maria Rosa Tremiterra
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04_UBAN PRACTICES
Urban practices describes the most innovative application in practice of the journal theme.

author: Gennaro Angiello
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05_NEWS AND EVENTS
News and events section keeps the readers up-to-date on congresses, events and exhibition related to the journal theme.

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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，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，能够对与城市和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。

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03_LAWS
法律部分提供主题相关标准方面的大量综述。

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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
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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。

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01

THE RESILIENCE CITY/THE FRAGILE CITY. METHODS, TOOLS AND BEST PRACTICES 2 (2018)

REVIEW PAGES: WEB RESOURCES

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In this number

SOIL CONSUMPTION: DATA COLLECTION AND ANALYSIS

Soil depletion has now become a key issue in many disciplines in terms of environmental, economic, urban and social implications and it is certainly linked to the phenomenon of urban sprawl. The large number of issues involved reflects the difficulty of planners, technicians and political decision makers in addressing, defining and above all measuring the impact of such depletion. In fact, researchers are clearly concerned about the extent of the phenomenon. For this reason, they have shifted their attention to the tools used for measuring land consumption, and to monitor developments in the phenomenon (Munafò et al., 2013; Mazzeo & Russo, 2016). The monitoring phase is therefore extremely important in the analysis of soil consumption phenomenon.

To this aim, in 1985 the Corine program was implemented by the Council of the European Communities, which primary purpose is to verify the state of the environment over time. In particular, the Corine Land Cover project is intended for the detection and monitoring of land cover (Gardi, 2013). It involves the creation of a land cover map at a scale of 1:100,000, with a legend consisting of 44 entries and a minimum mapping unit of 25 hectares. This mapping unit limits the use of the same data to the national scale as they would not find monitoring or planning application at the local scale (Gardi, 2013).

In Italy, ISPRA research center – also part of the Copernicus program – has launched a plan for the implementation of Land Monitoring services, which provided for the acquisition of a European satellite coverage in 2012 and the production of 5 high-resolution layers relating to sealing of soil and built-up areas, forests, meadows, wetlands and water bodies (Munafò, 2013).

Another service provided by Copernicus is the Urban Atlas project, a powerful cartographic database with 20 categories of coverage and use relating to 32 Italian urban centers. This figure has a maximum resolution of 0.25 hectares.

These are just some of the projects that clearly express the will and the need to resolve the critical issues related to the measurement of land consumption at both European and Italian level. Moreover, knowledge about land use is of considerable interest in order to make the necessary assessments for protection, development and transformation of the territory. It is of particular importance the possibility of identifying with adequate accuracy the areas intended for agricultural crops and the areas characterised by the presence of more or less natural features in addition to the urbanized areas.

Corine Land Cover
http://land.copernicus.eu/pan-european/corine-land-cover

CORINE LAND COVER, a project started in 1985, is an inventory of land cover organized in 44 classes and in 3 hierarchical levels. Born at European level, its use is specific for the detection and monitoring of land cover and use, with particular attention to the environmental protection requirements. The first realization of the Corine Land Cover project dates back to 1990, while the subsequent updates were produced in 2000, 2006, 2012. Corine Land cover is a section of the Land Copernicus website, where it is possible to download the land use maps on a European scale produced in the years 1990, 2000, 2006, 2012. In addition, in the same section, Land Cover Change (LCC) maps are available with reference to the periods 1990-2000; 2000-2006 and 2006-2012. The LCC maps report changes in land use with reference to a specified time interval. Attached to these maps, a legend is available on the website for the correct reading and interpretation of the data. The use of Corine Land Cover Change is preferable for the changes between two surveys, because of its higher resolution than Corine Land Cover.

From the home page of the Corine Land Cover section, by clicking on the map of interest you can access the page where the following three subsections dedicated to the map of interest are displayed (on the left side):

- Map View;
- Metadata;
- Download.

By clicking on "Map View" will be displayed the land use map on a European scale, which can be consulted for a qualitative evaluation thanks to the zoom tool and the information reported in the legend. The subsection "Metadata" reports various information, such as data identification, classification of spatial data, geographic and temporal reference, as well as information about the quality and validity of the map. Lastly, in the "Download" subsection, you can access the area to download all the data. Corine Land Cover products are available in both raster (100 and 250 meter resolution) and in vector (ESRI and SQLite geodatabase).

Moreover, at the top of the Corine Land Cover section, you can easily access to several pages of the Copernicus website where you can consult other data, projects and information on the use of the territory. On the same page, on the right side, there is the user corner that gives access to the following sections:

- Contract opportunities;
- EAGLE;
- Use cases;
- Publications;
- Technical library;
- Looking for national products?

Lastly, at the top right side it is possible to connect to social media like Instagram, Facebook, Twitter and slideShare.

ISPRA
http://isprambiente.gov.it

ISPRA is the Italian National Institute for Environmental Protection and Research which deals with several environmental issues, including the phenomenon of soil consumption. By accessing the ISPRA portal, in the section Projects, it is possible to view all the projects in which the institute is involved – including those related to soil protection – financed by European Union Programmes related to research activities.
On the right side of the ISPRA home page there is a list of all the sections of the portal for an easy consultation of all the contents of the website. Examples of sections in this list are:

- Projects;
- Databases;
- Cartography;
- Publications;
- Copernicus program;

In the section Databases, ISPRA aims to facilitate the access to the databases implemented and managed by the Institute. In fact, by clicking on this section you can access to the different environmental issues the institute deals with. In this page you can also find the subsection "soil and territory" which provides the links to access the various databases available on the Portal of the Geological Service of Italy as the Geophysical database, the ISPRA indicator database, Territorial database – the Naples' Metro Area Anthropogenic Sinkholes database, CARG, national cave database, [...].
From the list of sections, it is possible to access the section Cartography, which proves to be very useful for data collection about the use of soil. In this section there are several links through which you can access and download the cartography of interest. The section Publications is very useful for users to find data too. Here it is possible to identify the volume of interest, by browsing the menu on the right side of the page, sorted by Editorial Series or using the "Search Publications" box, from which it is possible to find any publication of the institute by searching the full title or typing only the keywords. After finding the volume of interest, you can download it.
The most interesting publications on the measurement of the phenomenon of soil consumption include the Reports on Soil Consumption in Italy (annual update) and the yearbooks of environmental data. Within the reports on soil consumption in Italy the data are updated to the previous year; they include detailed information on a national, regional and municipal scale, thanks to the monitoring work of the agencies for the protection of the environment of the Regions and the Autonomous Provinces which, together with ISPRA, constitute the National System for Environmental Protection (SNPA). The mapping of land use drawn up by ISPRA is very useful for monitoring at a local scale, as the production of this mapping takes place through the improvement of the geometric and temporal resolution of the Copernicus monitoring services of the territory transformation. These documents also include quantitative data on the change in soil consumption through tables and charts and the measurement of indicators such as the sealing index and the marginal soil consumption.

Lastly, on the right side of the home page, the box "Information from ISPRA" can connect you to different channels such as YouTube, ISPRA TV, documentary, Streaming events and ISPRA pages on social networks such as Instagram, Facebook and twitter.

European Environment Agency

European environment agency
http://eea.europa.eu/data-and-maps/indicators

The European Environment Agency (EEA) is an agency of the European Union dedicated to the establishment of a monitoring network to control the European environmental conditions, including those regarding land use. Within the official portal, you can access a section entitled "Indicators" where the indicators managed by the EEA are listed in reverse chronological order (from the most recent to the oldest). The search for indicators can be done by inserting the full name of the indicator or proceeding by keywords in the box "find indicators". The user can also choose another way to search for the indicators, through the "Topics" list on the right side of the same page. The indicators for measuring the phenomenon of land use can be found in the topics "land use" and "soil". The main ones are four:

- Landscape fragmentation pressure from urban and transport infrastructure expansion;
- Imperviousness and imperviousness change;
- Land take;
- Progress in management of contaminated sites.

By clicking on the icon representing the indicator of interest, you can access to the page where all the specifications of the indicator and the metadata are available, in particular the indicator definition, the units of measurement, the rationale, the policy context and targets, uncertainties about measurements and all the scientific references. Exploring within the same page it is possible to consult indicator data in table and chart formats, i.e. the results obtained by the measurement of the indicator in European countries.
For each indicator, at the top of the reference page, there is the pdf icon you can click to get all the information on that page in one single file to download.
Returning to the page of the section Indicators, below the list of all the indicators of a given topic, there are links to additional articles and to social networks like Facebook, twitter and Instagram.

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IMAGE SOURCES

The images are from: http://land.copernicus.eu; http://isprambiente.gov.it; http://eea.europa.eu

02

THE RESILIENCE/THE FRAGILE CITY. METHODS, TOOLS AND BEST PRACTICES 2 (2018)

REVIEW PAGES: BOOKS

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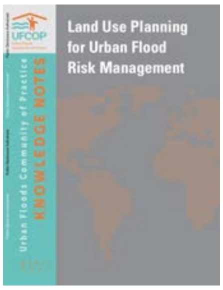
In this number

STRATEGIES AND POLICIES

The cities and urban areas provide important opportunities for the development of communities and nations. But risks caused by rapid and often improper urbanization compounded by natural hazards create some of the major challenges in the 21st Century. Aside from the negative impacts of improper urbanization on socio-economic development, the risks and humanitarian consequences of rapid urbanization are alarmingly increasing. The disasters in the past decade have created more losses and damages in cities than in other areas. It is well recognized that strengthening resilience to disasters includes disaster management as well as being an essential component of all emergency and development programming. Communities and households with sustainable livelihoods, good levels of health care and access to strong and accountable civil society are less susceptible to hazards and recover more quickly from disasters.

Working towards urban resilience requires multi-dimensional and multi-sector approaches to address the underlying drivers of risk such as migration, violence, climate change and cultural changes. Ensuring that its activities work towards strengthened urban resilience will require the movement to work holistically, encompassing multi-dimensional and cross-sector methodologies which may in some cases require a change in the existing approach. Updated and accurate knowledge and information on the extent of the climate problem at local level, including emissions inventories, climatic risks and vulnerabilities, provide a sound basis for policymaking (Balaban & Şenol Balaban, 2015). One of the best and most appropriate planning tools based on this approach, using the method of restoration of ecosystem services and therefore adaptation to climate change (Salata & Yiannakou, 2016). The frequency and severity of risk events have increased in the last two decades and has begun to affect areas where was once rare. In particular, the flood events are also becoming less predictable due to climate change. Flood risk is comparatively high in urban centers, and the rapid growth of cities, especially those located along rivers and coasts, increases the exposure of people and assets to flooding. Flood risk increases when urban growth compromises natural drainage and storage areas, increases impervious cover, and reduces the infiltration capacity of soils; the resulting acceleration of runoff challenges the capacity of cities to manage drainage infrastructure. According to these themes, this section suggests three books and reports that help to better understand the issue of this number: Land Use Planning for Urban Flood Risk Management; Building urban resilience: A guide for Red Cross and Red Crescent engagement and contribution; and Smart Planning: Sustainability and Mobility in the Age of Change.



Title: **Land Use Planning for Urban Flood Risk Management**
Author/editor: Jolanta Kryspin-Watson
Publisher: Urban Floods Community of Practice (UFCOP)
Publication year: 2017
ISBN code: -

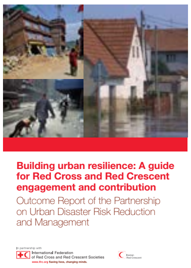
This note offers policy makers and practitioners an overview of the key aspects of land use planning used to manage flood risks in cities across the world. It includes examples from developed and developing countries to provide insight into what has worked in different contexts. It does not provide prescriptive solutions or step-by-step methodologies since approaches will vary by context. Because the application of correct solutions and methodologies will depend on local land use challenges and institutional capacities, on the scale at which land use planning is undertaken, and finally on the local land use planning culture and land tenure regime, apart from technical and financial capacities.
Cities across the globe are gearing up to address flood risks through land use planning; many are in the initial stages of lobbying for commitment, and many have made significant strides in risk assessment. But the adoption of land use planning for flood risk management remains challenging.
A comprehensive approach to flood risk management combines structural measures that protect against flood risk with non-structural measures that manage flood risk. Historically, cities have chosen structural measures, which are designed for two different purposes: they either safeguard development from an estimated flood risk (through flood defences such as levees and floodwalls) or direct flood waters away from developed areas (by increasing drainage capacity with pipes, canals, and storage basins). However, structural measures alone have proven to be inadequate, for several reasons:

(i) they are based on finite predictions of risk that may not account for uncertainty due to climate change or unplanned urban growth and expansion;
(ii) risk may be transferred downstream if the structures do not allow adequate space for the flood volume;
(iii) high up-front cost of sophisticated engineering design and building materials may not be affordable;
(iv) such measures induce complacency since communities tend to over-rely on them. Most structural measures minimize damage, but may not prevent damage. There will always be residual risk that needs to be managed with non-structural measures.

In particular, this note reviews how land use planning is used to manage flood risks identifies challenges in implementation and offers recommendations for including land use planning in an integrated approach to flood risk management.

- Section 1. outlines the key land use principles that guide land use planning for flood risk management;
- Section 2. presents an overview of land use solutions for managing flood risk;
- Section 3. describes entry points for incorporating flood risk in the land use planning process with case studies;
- Section 4. identifies the challenges to developing and implementing flood risk–sensitive land use plans and highlights common barriers faced by decision makers and practitioners;

Finally, the note ends with conclusions and offers recommendations for policy makers and practitioners.



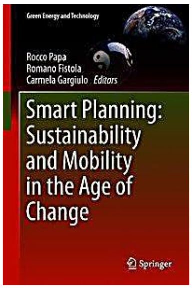
Title: **Building urban resilience: A guide for Red Cross and Red Crescent engagement and contribution**
Author/editor: Partnership on Urban Disaster Risk Reduction and Management
Publisher: International Federation of Red Cross and Red Crescent Societies
Publication year: 2017
ISBN code: -

The International Federation of Red Cross and Red Crescent Societies (IFRC) and its members have always been present in cities to respond to crises and disasters and provide relief and humanitarian assistance. But rapid urbanization and the increasing complexity in urban contexts require a better understanding of risk factors and sources of vulnerability and exploring innovative ways for effective disaster risk reduction and response and cooperation with other stakeholders. Developing community resilience in relation to disasters in cities has also been a new challenge for the Red Cross and Red Crescent Movement in view of the multifaceted and new causes of vulnerability in urban environments. There is a clear role for National Societies in supporting urban communities to achieve resilience both through integrated Red Cross Red Crescent programming on community preparedness, health and first aid, food security, and livelihoods and also by influencing local development and urban planning through advocacy, strategic alliances and active partnering. Working towards urban resilience requires multi-dimensional and multi-sector approaches to address the underlying drivers of risk such as migration, violence, climate change and cultural changes. Ensuring that its activities work towards strengthened urban resilience will require the Movement to work holistically, encompassing multi-dimensional and cross-sector methodologies which may in some cases require a change in the existing approach.
Within this context, there are a number of operational challenges in the design of urban risk reduction programmes and the delivery of the humanitarian response. These challenges include:

- The complexity of undertaking urban risk assessments due to a number of factors including multiple and secondary hazards such as big fires and interruption in lifelines;
- The need to ensure awareness and coverage of multi-sector needs;
- The presence and involvement of multiple stakeholders with different mandates and approaches.

This guide is one of the outcome documents of the Partnership on Urban Disaster Risk Reduction and Management and has been prepared to share the key findings of the partnership and to contribute to the effective engagement of National Societies in responding to urban risks and enhancing urban resilience.
This document aims to highlight potential approaches to be taken into account to build resilience and highlights some of the key challenges hindering effective National Society engagement for the planning and the actions on urban. Examples of different approaches to the five thematic areas covered in the guide (context and engagement, capacity strengthening, awareness-raising, programme implementation, and advocacy) will be provided and tips for more effective engagement are featured where possible. Based on the understanding that there is an existing urban knowledge gap on urban resilience this guide has been developed in order to achieve the following:

- Highlight key issues for National Societies to consider when engaging in urban resilience discussions and activities;
- Pinpoint a number of the key challenges identified in relation to urban resilience;
- Provide tips to be taken into account when National Societies are planning to engage or engaging in urban resilience activities;
- Showcase lessons learned from the five pilot city projects and regional workshops;
- Promote the essential elements for Red Cross Red Crescent urban resilience building.



Title: **Smart Planning: Sustainability and Mobility in the Age of Change**
Author/editor: Rocco Papa, Romano Fistola, Carmela Gargiulo
Publisher: Springer International Publishing
Publication year: 2018
ISBN code: 978-3-319-77681-1

This book is a collection of twenty-one contributions on a subject of considerable interest in the ambit of studies on managing urban change by the main research groups active in the field of urban sciences from the various schools of engineering operative in Italy. The objective of the research publications collects in this book is to show that smartness in managing urban and territorial changes may be implemented with interventions which ultimately aim at sustainability, implemented by solutions on the mobility of people, goods, and information. This consideration provides to divided the contributions published in this book within two large thematic areas: sustainability and mobility. In particular, the contributes published in this book offer an overview of sustainability by urban planning Italian scholars and provides an up-to-date review of urban mobility approaches in the context of urban planning. Including contributions by urban planning scholars, this book provides an up-to-date picture of the latest studies and innovative policies and practices in Italy, of particular interest due to its spatial, functional and social peculiarities. Sustainability and mobility must form the basis of "smart planning"- a new dimension of urban planning linked to two main innovations: procedural innovation in managing territorial change, and technological innovation in the generation, processing and distribution of data (big data) for the creation of new "digital environments" such as GIS, BIM, models of augmented and mixed reality, useful for describing changes in human settlements in real time. The contributions are structured as follows: the innovative methodology is first described, and procedures and tools are then proposed for urban interventions with specific reference to real cases within the Italian context. As already highlighted in the volume entitled: "Smart Energy in the Smart City", published in the same series in which this publication represents a natural evolution, the Italian context represents, also in this case, a test bench of major interest due to such specific aspects as geography, socio-economic variability between the North and South of the country, differentiated local development potential, climate and exposure to various conditions of risk for urban systems.

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Papa, R., Fistola, R., & Gargiulo, C. Smart Planning: Sustainability and Mobility in the Age of Change. ISBN: 978-3-319-77681-1. doi: https://doi.org/10.1007/978-3-319-77682-8

03

THE RESILIENCE CITY/THE FRAGILE CITY. METHODS, TOOLS AND BEST PRACTICES 2 (2018)

REVIEW PAGES: LAWS

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In this number

INCREASING THE FLOOD RESILIENCE IN THE EU MEMBER STATES

In the last ten years, climate change impacts have been very severe and intensive (Papa et al, 2014). In particular, flood events have become very frequent, hitting mainly cities, especially ones near to the coastline or rivers. Moreover, the scale and frequency of floods are likely to increase not only for the climate change phenomena (with consequent higher intensity of rainfall and rising sea levels) but also for the inappropriate river management and the lack of areas capable to absorb flood waters. Considering also that the number of people and economic assets located in flood risk zones is increasing, European Union sought a strategy to deal with flooding with the awareness that not all floods can be prevented or avoided with physical infrastructure but their impacts can be reduced (De Gregorio Hurtado et al., 2015).

As a consequence, the European Union defined the Directive 2007/60/EC, known as the "Floods Directive", aimed at "*reducing the risk of adverse consequences, especially for human health and life, the environment, cultural heritage, economic activity and infrastructure*" (art.1), thus increasing the urban resilience to flood events. According to this Directive, the EU Member States are required to adopt prescriptions included in this document. In particular, three main steps need to be carried out by EU States:

- the preliminary flood risk assessment to identify the river basins and associated coastal areas at risk of flooding;
- the development of flood risk maps for the zones subjected to the risk of flooding;
- the establishment of flood risk management plans focused on prevention, protection and preparedness.

Specifically, the European Commission shall evaluate the implementation status of the Floods Directive and, as it arises from the EU Report "EU overview of methodologies used in the preparation of Flood Hazard and Flood Risk Maps", in 2015 most of the EU Member States have presented information on their flood hazard and flood risk maps.

However, even though "*the Flood Directive obliges to take into account flood risks as all the EU territory is supposed to be likely flooded, in some EU countries, flood risk is even now not clearly addressed*" especially with regard to urban planning policies and practices (Serre et al., 2018).

Therefore, in this number, it will be illustrated how three states – the Netherlands, England and France – are implementing the provisions of the EU Floods Directive and if and how they are integrated in the urban spatial planning.

THE NETHERLANDS – WATER ACT

The Netherlands is one of the most vulnerable countries with regards to flooding since past times, considering "*its long and eventful history of dealing with and recovering from changing physical circumstances, especially regarding floods*" (Wiering & Winnubstb, 2017). However, considering the increasing flooding events, a new strategy has been developed grounding on the cooperation between spatial planning and flood management. In particular, with regard to the flood risk management and spatial planning there are four main levels of government, which share responsibilities (Slomp, 2012):

- the European level, where the issue of floodings is addressed with the Floods Directive and the Water Framework Directive;
- the national level, where the Ministry of Infrastructure and Water Management is responsible for spatial planning (National Spatial Strategy) and environmental management (Environmental Management Act), and where the Rijkswaterstaat (executive agency of the Ministry of Infrastructure and Water Management) is responsible for flood protection and water management (National Water Plan and National Flood protection program);
- the provincial level, where 12 provinces are responsible for land-use planning (Spatial Planning Act) and flood protection (Provincial Water Plan);
- the municipal level, where 400 municipalities are responsible for local spatial planning and building permits through the Spatial Planning Act. At the same level, there are 25 water boards, which are the regional water authorities responsible for water management and flood protection in all minor waterways (Water Management Plan). This legislative framework aimed at the cooperation between spatial planning and flood management was set in 2010 thanks to the Water Act – the Dutch law for the adoption of the EU Floods Directive – that is accompanied by a number of legal instruments summarized in the Water Decree.

Specifically, the Water Act, the Spatial Planning Act and the Environmental Management Act allow municipalities and regional authorities to have the possibility to use set of policy instruments that enable them to deal with the effects of climate change, in accordance with the higher provincial, national and European legislative framework. In particular, municipalities have three main duties of care: to collect and process rainwater (Art. 3.5 Water Act), to prevent "a structurally adverse influence by the groundwater level" (Art. 3.6 Water Act) and to effectively collect and transport urban wastewater (Article 10.33 Environmental Management Act). As an instance, in order to respond to these duties of care, the municipality of Rotterdam has identified the following areas of responsibility for each department involved in urban planning and water management:

- Department of Municipal Works as responsible for drainage systems, public spaces, urban infrastructure and groundwater management;
- Department of Urban Planning as responsible for spatial planning, housing and urban functions;
- Department of Economic Development and Project Development as responsible for project development, economic development, real estate management and development

By means of the collaboration among these three departments, Rotterdam developed a climate adaptation strategy based on water-sensitive urban development, thus integrating water and spatial development since the early stages of urban planning.

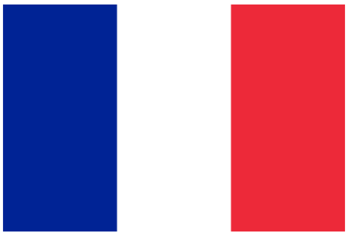
ENGLAND – FLOOD AND WATER MANAGEMENT ACT

After the widespread flooding that took place in England in June and July 2007, in 2010 the "Flood and Water Management Act" was introduced in England and Wales. It represented a response to the need to develop better resilience to climate change effects, to reduce the vulnerability of critical infrastructure, as well as to enhance the emergency response, emergency planning and the recovery phase.
In particular, the Flood and Water Management Act consists of four main parts:

- Flood and Coastal Erosion Risk Management, that set the basis for introducing strategies for flood and coastal erosion risk management for England and Walles;
- Miscellaneous part, related to several aspects such as the need to include in the Building Act 1984 the statement that building interventions shall be realized in accordance with the purpose of increasing the resistance and the resilience in respect of flooding, or the guidelines for the development of regulations about the provision of infrastructure for the use of water undertakers or sewerage undertakers;
- General disposition about the legislative framework related to flood and coastal erosion;
- Schedules, which contain documents about the amendment of other acts, the introduction standards for the design, construction, maintenance and operation of new drainage systems and the introduction of novel reservoir safety rules, among others.

What is interesting to note is that the Lead Local Flood Authorities are established to "develop, maintain, apply and monitor a strategy for local flood risk management", thus recognizing the need for a local-based approach. In addition to this, in the Flood and Water Management Act, it is stated that "the Environment Agency must develop, maintain, apply and monitor a strategy for flood and coastal erosion risk management". Therefore, in 2011 the National Flood and Coastal Erosion Risk Management Strategy for England has been published as the reference for management authorities and communities to understand their different roles and responsibilities (Defra and EA, 2010).
In detail, it arises the key role of spatial planning, that shall ensure that "new developments take flood and coastal erosion risk fully into account, and are safe from, do not increase, and where possible reduce risk over their lifetimes" (section 2.3). Indeed, the possibility to reduce flooding impacts during the planning stages for new developments or infrastructure is recognized as a great opportunity.
This is also declared in the National Planning Policy Framework (NPPF), where it is stated "when determining planning applications, local planning authorities (LPAs) should ensure flood risk is not increased elsewhere". However, when urban development needs to be realized in areas characterized by the risk of flooding, LPAs and developers should ensure the following points, which are described in the NPPF:

- perform an appropriate assessment of flood risk;
- "ensure policies steer development to areas of lower flood risk as far as possible";
- "ensure that any development in an area at risk of flooding would be safe, for its lifetime taking account of climate change impacts";
- "be able to demonstrate how flood risk to and from the plan area/ development site(s) will be managed, so that flood risk will not be increased overall, and that opportunities to reduce flood risk, for example, through the use of sustainable drainage systems, are included in the plan/order".



FRANCE - NATIONAL COMMITMENT FOR THE ENVIRONMENT ACT

After the publication of the EU Floods Directive in 2007, the existing policy for flood risk management, that was previously incorporated in the national disaster risk reduction policy, has been renovated and included in the national legislation under the Environmental Law of 12 July 2010, finalized definitively only in 2014. In detail, the main objectives of the national strategy are: (i) improve the safety of the exposed population, (ii) to reduce the cost of flood damages in the medium term, and (iii) to shorten the recovery period for the areas subjected to flood. Under the governance perspective, flood risk management is at three levels: National level, with a Joint Flood Commission (CMI) which consists of representatives of the state, local authorities and civil society; River basin level, with a Flood District Commission (CIB); and Local level, with the Local Public River Basin Establishment (EPTB) and Local Public Water Management Establishment (EPAGE).
Apart from the main objectives, the national strategy does not provide information for the effective implementation of flood risk policies. Indeed, only the local flood risk management strategies developed for the Areas with Potential Significant Flood Risk (PSFR) included operational indications, together with the Flood Risk Management Plans and the Flood Prevention Action Programs. In addition to this, also the municipalities have a role because through the Flood Risk Prevention Plan they have to take into account flood risks in planning (Morel et al., 2016).

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04

THE RESILIENCE CITY/THE FRAGILE CITY.
METHODS, TOOLS AND BEST PRACTICES 2 (2018)

REVIEW PAGES: URBAN PRACTICES

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In this number

PLANNING FOR RESILIENCE IN TWO MEDITERRANEAN CAPITALS

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 centres, 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, and in partnership with the global design firm Arup, 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 honour 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 37 Resilience Strategies (with nearly 1,900 concrete actions and initiatives) have been developed.
This contribution presents two relevant Resilient Strategies, developed in two Mediterranean capital cities, within the 100 Resilient Cities framework: ii) the Rome (Italy) Resilient Strategy and ii) the Athens (Greece) Resilient Strategy. The two case studies have been selected according to the following criteria: i) they

represent two notable example of historical cities ii) they pertain to the same geographic area (i.e. Mediterranean Europe); iii) they share a great portion of physical, social and economic challenges, including: a) a rich cultural heritage that requires intense preservation efforts; b) increasingly aging urban infrastructures; c) serious difficulties in managing climate-related risks; d) a lack of employment opportunities combined with a general cut in public services; e) a fragmented government structure.

ROME

Rome is the capital city of Italy and has an urban population of 2,872,800 inhabitants. This city is struggling to reverse decades of poorly regulated development, inadequate infrastructure provision, and urban sprawl. These activities have made Rome highly vulnerable to flooding and other disruptions, which threaten to undermine social cohesion and prosperity in this city. In order to face these and other relevant urban challenges, on June 2018, the city of Rome released its Resilience Strategy with the support of the *100 Resilient Cities* initiative. The strategy is based on 4 main pillars, 18 goals and 58 tangible actions:

- *Pillar I: An efficient city at the service of its citizens.* This pillar deals with making the administration of the city more efficient, transparent and participatory, while incentivizing centralized governance actions. A number of coordinated actions are proposed to meet this goal. These include: i) revisiting the mechanisms that regulate the formation of the annual program and budget in order to ensure consistency between project costs and funding for project implementation ii) intervening on the municipal "Macrostructure" to improve administrative workflows and facilitate communications between different municipal offices and iii) creating a one-stop information desk in order to facilitate the two-way communication between the city administration and its citizen and business. Another important part included in the first pillar concerns with the implementation of different technological initiatives, such as the creation of an open-data platform, investments in free Wifi in public areas, the creation of squares of innovation and new public access points throughout the region.
- *Pillar II: A dynamic, strong, and unique city.* This pillar focuses on promoting the cultural life of the city, improving its attractiveness and safety, while preparing, at the same time, the city for the impacts of the changing climate. This pillar is supported by different initiatives, ranging from the relaunch of the River Tiber areas to the reorganization of the management of the cultural sector. A quite interesting aspect concerning the second pillar is the interdisciplinary approach undertaken, i.e. an approach able to address different challenges in the same holistic intervention. For instance, in the case of the relaunch of the River Tiber area, a combined mix of action will address at the same time: i) the urban regeneration of the costal part of the city; ii) the implementation of hydraulic engineering work aimed at preventing flooding iii) the redevelopment of a number of parks along the banks, as well as iv) the establishment of cultural and social hubs along the river.
- *Pillar III: An inclusive, open city, that shows solidarity with everyone*. This pillar addresses the social dimension of urban resilience and it is aimed at making Rome a city that respects diversity and promotes the cultural growth of the vulnerable population. To reach this aim, a specific program to strengthen and extend the support network for vulnerable communities has been envisioned. Furthermore, the city plans to increase the economic efforts devoted toward the realization of social housing project. Another

interesting part of the strategy is the assignation of public spaces under concession to NGOs, associations and organizations that promote social inclusion, education and sustainability.

– *Pillar IV: A city that protects and enhances its natural resources*. This pillar focuses on protection of the ecological system and the restoration of the value of water resources. It also addresses the promotion of the use of renewable energy sources and the implementation of a zero-waste circular economy. Actions associated to the fourth pillar include: i) the implementation of a sustainable urban forestry masterplan aimed at protecting biodiversity and enhancing parks and nature reserves; ii) the acquisition of new electric buses to satisfy the increasing travel demand of the population and iii) the implementation of waste-management measures aimed at reducing the volume of waste produced in the city.

ATHENS

Athens is the capital city of Greece and has an urban population of 655,780 inhabitants. The city is currently facing serious socio-economic problems: austerity measures have indeed cuts essential social services, while employment has recently reached its peak. Furthermore, the city faces risks from ongoing environmental pressures, since, in recent years, heat waves have increased in intensity and frequency, straining healthcare, emergency response services, and the electrical grid. In response, the city of Athens released its Resilience Strategy on June 2017. The Strategy is framed by 4 pillars, 65 main actions and 53 supporting actions:

– *Pillar I: An open city.* The first pillar deals with making the Athens' administrative structure more transparent and accountable, while fostering at the same time citizens' collaboration and engagement. The Athens' city Council and administration are indeed perceived as remote and obscure to the citizens. In order to change this negative image, the city has planned different initiatives such as i) opening new channels of communication; ii) implementing a platform for sharing and analyzing city's data; iii) creating thematic platforms to engage citizens and businesses in different aspect of the decision-making process; iv) improving the collaboration between the city administration and the universities and research centers located in the city.

– *Pillar II: A green city.* Athens suffers from heatwaves, flash floods and poor air quality, and has historically wasted, misused and mismanaged its natural resources. Actions included in the second pillar are thus aimed at providing a response to these issues by integrating natural systems into the urban fabric, promoting sustainable mobility, fostering a sustainable food system and establishing a sustainable and equitable energy system. In particular, the City intends to target investment into green infrastructure and nature-based solutions such as pocket parks, parklets, green roofs and vertical gardens in public, private and abandoned properties. Furthermore, in order to promote sustainable mobility, the City intends to put in place a coordinate mix of actions, such as the development of new bike-lanes, the extensions of some pedestrian zones in the city center, and the establishment of new electric bus lines. A sustainable food system is also envisioned in the strategy and is supported by the development of new local market areas, investments in food logistic and waste management actions. Finally, in order to establishing a sustainable and equitable energy system, the city will lunch different initiatives targeting the reduction of energy consumption in the public sector as well as in the commercial and residential sector.

- Pillar III. A *proactive city*. This pillar focuses on enhancing planning in the face of serious challenges, empowering the municipal representatives as well as the voice of the local community. A main part of this pillar concerns with the development of a crisis preparedness and management plan able to provide a coordinated response in case of natural and man-made disasters. The plan includes the definition of escape routes to open areas and shelters, the installation of a real-time earthquake monitoring system in partnership with the National Observatory of Athens, the development and assessment of mock disaster scenarios. A second part of the pillar deals with empowering the municipal representatives as well as the voice of the local community. This will be achieved through a program of municipal capacity building as well as through the development of structures of participatory governance. Furthermore, legislative and policy making reforms are envisioned in the plan. These include: i) readjusting the municipal taxation system to be able to provide specific incentives or disincentives to local entrepreneurs; ii) providing a legal framework for spatial and temporal land use within the city jurisdiction; iii) provide the right to municipalities to facilitate digital access to labor coupons in order to mitigates the black economy and iv) developing a new participatory budgeting regulatory framework.
- *Pillar IV: A vibrant city.* Actions included in the fourth pillar are aimed at fostering well-being, creativity and entrepreneurship, while creating a new and attractive city identity. Actions included in this pillar will primary focused on the creation of a new city identity by enhancing some underdeveloped city assets. To this end a coordinated mix of action will took place, including: i) the development of a creative economy strategic plan aimed at attracting capital investment as well as improving the global position of Athens as a creative capital; ii) the development of green and walkable urban corridors aimed at creating new cultural and leisure opportunities and increase the dynamicity of some city's neighborhood and iii) the restoration and change of use of vacant building and abandoned train stations that will be converted in creative and cultural hubs.

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IMAGE SOURCES

The image shown in the first page is from: 100resilientcities.org. The images shown in the second page is from: lonelyplanet.com The image shown in the third page is from: nashville.com.

05

THE RESILIENCE CITY/THE FRAGILE CITY. METHODS, TOOLS AND BEST PRACTICES 2 (2018)

REVIEW PAGES: NEWS AND EVENTS

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In this number

BIG DATA AS TOOL FOR URBAN ANTIFRAGILITY

Resilience is "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" (Rockefeller Foundation, 2014)"; the concept is closely connected to the ability to manage an event or any kind of change in an ordinary mechanism although it never happened before; It can be possible thanks to the transmission of collective experience (knowledge) and to the presence of a collective organization able to intervene in case of accident (system structure). Even if you never experienced an earthquake you could know exactly what to do when the shock happens, because for example you learned it at school and because there is a system of intervention on which you can rely; therefore, we could say that a city is as resilient as bigger is its capacity to learn from the collective experience and to recognize the phenomenon to be replied.

However, especially in an age where disruption is going to become the new rule in ways that we can't even predict, it can be possible to have to face with phenomena that have not yet been experienced before or that occur so quickly that the urban system is not able to give the right answer on time.

Therefore, what happens if the phenomenon is unforeseen or it is the result of a concomitance of known phenomena occurred for the first time simultaneously?

A possible solution comes from Taleb theory of antifragility in which the previous dilemma is exceeded with the capacity of being able to live in uncertainty, more than on the intent of being able to prevent disaster: "antifragility is beyond resilience or robustness. The resilient resists shocks and stays the same; the antifragile gets better" (Taleb, 2012).

However, nowadays the intents of using the Taleb theory in the field of urban planning appear still weak; the reason probably relies in the paradox that the Taleb theory, focused on the incidence of individual attitudes rather than on the scientific analysis of phenomena, would go against the same strategic role of urban planning and would question with the responsibility role of those who are designated to take decisions both in case of emergencies and in driving city's development policies.

Is it therefore possible to define policies founded on a solid scientific groundwork able to include the ability of a system to respond quickly to something unpredictable?

A possible answer could lie in the potential of the growing Big Data technology; the ability to collect and process billions of information, many of which geo-localized and acquired in real time by devices spread over the territory, could in fact be used to achieve a double goal:

- reducing the analysis times of an ongoing phenomenon by knowing in real time the reaction of the elements of the system to the shock both in quantitative (eg number of people per territorial unit distributed in the territory) and qualitative (eg spatial distribution of perceived danger) terms;
- Finding solutions to unpredicted event through machine learning mechanisms applied on the analysis of billions of data. The system would be able, in real time, to suggest optimal solutions through different query on a sort of a huge database containing the experiences of billions of "differently analogous" information daily collated over the time.

A Big data approach to urban phenomena could than change the attention span from longer to shorter time periods in which interventions can take place, because big data is largely based on massive volumes of data – terabytes – over very short time spans – seconds – at very precise spatial scales – centimeters.

It means theoretically the possibility to receive on time enough information to not be unprepared and accordingly fragile if an unexpected event happens.

In continuity with what has been discussed promoted and implemented in the last years about the concept of resilience and its application in the urban planning practice, the following selected conferences could represent a fertile ground of confrontation on the scientific advances about this topic, contributing to find out methods and tools to reconcile long-term adaptation and mitigation development strategies (Balaban & Balaban, 2015) with new more focused tools for dealing with short terms changes.

INPUT 2018

Where: Viterbo, Italy
When: 5-8 September 2018
https://sites.google.com/view/input2018/home

The 10th International Conference on Innovation in Urban and Regional Planning, will take place this year in Viterbo and will be organized by the Tuscia University. The main scope of the conference is to face the complexity of the current socio-ecological systems through the lens of modelling approaches employed in urban and territorial planning. Even if resilience is not explicitly mentioned among the main themes of the conference, its possibility of implementation passes through a full and complete knowledge of urban phenomena that is becoming more and more in-depth thanks also to the integration between urban planning and computational sciences, distinctive feature of INPUT since its inception.

The conference is articulated in 8 main session and 3 special session; the main ones are the following:

- Territorial modelling state-of-art and future development;
- Environment, planning and design: the role of modelling;
- Rural landscapes and well-being: towards a policy-making perspective;
- Smart planning;
- Maintenance, upgrading and innovation in cultural heritage;
- Urban and environmental planners: who is the client? the planners jobs in a new millennium;
- Big data and data mining;
- Ict & models: planning for communities.

CITYLAB 2018

Where: Detroit, USA
When: 28-30 October 2018
https://www.theatlantic.com/live/events/citylab-2018/2018/

Regardless to the tools and methods used other important elements to improve antifragility strategies in urban policies could came from the study of cases in which the response to an external shock occurred very quickly. It is the case of Detroit that in 2013 became the largest American city to file for bankruptcy and with the largest amount of debt in US history; A lot of focus has been put in trying to understand how the city got into its current situation, but few have talked about the impressive advances the city has shown in a little more than two years. Therefore, it is not a case that this year the CityLab 2018 will be held in Detroit where the world's leading mayors, urban experts, business leaders, artists and activists will convene to share ideas and the latest innovations on what makes cities more livable but also able to rapidly change their structure in case of socio economic deep changes.
In fact, nowadays Detroit's inspiring quest for revival captures the imagination of many, and its narrative offers insights and inspiration to urban leaders in both post-industrial and developing cities across the world.
As the world's leading mayors, urban experts, business leaders, artists and activists convene to share ideas and the latest innovations on what makes cities more vibrant and livable, the host city provides a rich backdrop for conversation and collaboration across disciplines.

RESNEXUS 2018 CONFERENCE

Where: Wageningen, Netherlands
When: 7-8 November 2018
https://www.resnexus2018.org/

With over half the world's population now living in cities, urban resilience has become one of the leading global challenges as can be seen in the Sustainable Development Goals and the New Urban Agenda. Cities are complex networked spaces where access to key services is often unevenly distributed among city dwellers. In light of projected climate change impacts, resource constraints and growing populations, the provision of basic services and commodities such as food, water and energy is increasingly problematic for many cities. The interactions between water, energy, food and environment within cities (termed the urban 'Nexus') are seen as key for the development of sustainable and resilient cities. Yet these interactions are poorly understood due to the sectoral approaches to water energy and food often taken in most cities. Much of the current discussion on urban resilience and the urban Nexus of water, energy, food and the environment (WEFE) in academic and policy circles focuses on building resilience of 'urban systems' through cross-sectoral initiatives among others. However, such an emphasis on system-level urban resilience leads to a neglect of vulnerabilities at the actor level, especially in poorer and marginalized communities. Urban nexus practices with potential for real contributions to resilience remain hidden and disconnected from urban level policy. Furthermore, even when resilience is conceptualized at the community level, it can often fail to address processes that engender vulnerabilities. This disconnect between resilience approaches and the making of vulnerabilities presents an opportunity for seeking ways of linking up resilience policy instruments with user practices and providers of basic services. Starting from these premises the conference aims to engage a wide range of urban researchers and practitioners from various socio-economic contexts in rethinking resilience and its application in the context of the urban nexus especially regarding the following questions:

- How are cities tackling the challenges found at the urban nexus?
- What opportunities exist for the integrated management of, and improved access to, water, energy, food and the environment in pursuit of resilient cities?
- What vulnerabilities do the poor face at the urban Nexus and what coping practices do they engage in?

REFRAMING URBAN RESILIENCE IMPLEMENTATION

11TH INTERNATIONAL FORUM ON URBANISM (IFOU) CONGRESS 2018

Where: Barcelona, Spain
When: 10-12 December 2018
http://2018reframingurbanresilience.org/

The conference is organized by the Urban Resilience research Network (URNet), the School of Architecture Universitat Internacional de Catalunya (UIC Barcelona) and the UN Habitat City Resilience Profiling Program (CRPP). Many "resilient city" initiatives are failing to integrate local communities or sustainability goals within their strategies. In some cases, this has induced environmental and climate gentrification, or reinforced 'business as usual' and unsustainable patterns of developments, while tackling and reducing specific risks and vulnerabilities. Therefore, experiences of "building resilient cities" remain fragmented, characterized by a variety of resilience trade-offs. These considerations highlight the need for a more integrated and inclusive approach to design and manage urban resilience, addressing climatic, environmental, socio-economic challenges while minimizing trade-offs among them, and maximizing synergies between resilience and sustainability (Papa et al., 2014). On these premises, the conference will tackle issues related to urban resilience theory development, frameworks, principles, indicators and metrics. In particular, the contributions will focus on the following four main aspects of urban resilience:

- Post-Disaster and Post-Conflict Resilience (TOPIC 1);
- Climate Resilience Governance and Planning (TOPIC 2);
- Urban Design and Management: Infrastructures and Services (TOPIC 3);
- Community Resilience (TOPIC 4).

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IMAGE SOURCES

The image shown in the first page is taken from:http://www.paginaq.it/2015/01 /26/torna-il-master-s ui-big-data-per-diventare-scienziati-del-futuro/index.html

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EDITORIAL PREFACE: TEMA JOURNAL OF LAND USE MOBILITY AND ENVIRONMENT 3 (2018)

THE RESILIENCE CITY/THE FRAGILE CITY. METHODS, TOOLS AND BEST PRACTICES

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The 11th volume of TeMA Journal consecrates the three issues of 2018 to promotes the scientific debate on the fragile/resilience city that represents a topic collecting itself all the issues related to the urban risks and referred to the different impacts that an urban system has to face with. Studies useful to improve the urban conditions of resilience represent the aim of our editorial work of this year. The identification of urban fragilities could represent a new first step in order to develop and to propose methodological and operative innovations for the planning and the management of the urban and territorial transformations.

The section "Focus" contains two articles. The first article, titled "Land Use Conflicts in the Energy Transition: Dutch Dilemmas" by Mark Koelman (Utrecht University, Nederland), Thomas Hartmann (University of Wageningen, Nederland and Universiteit Jan Evangelista Purkyně, Czech Republic) and Tejo Spit (Utrecht University, Nederland). The central question for this contribution is therefore: how can governments cope with the dilemmas underlying the land use conflicts of renewable energy development? By using Dutch examples, these dilemmas will be further examined. The Dutch energy transition is characterized by complex land use change because every inch of land already has a certain function assigned to it through land use plans. Finally, by exploring the underlying dilemmas of land use conflicts, the complexity of governing land use conflicts will be revealed, and a land use management approach will be discussed as promising.

The second article "A Methodology for Urban Sustainability Indicator Design" by Ricardo Alvira Baeza (Universidad de Murcia, Spain), explains a methodology for sustainability indicator design that allows understanding what these indicators should measure and how aiming to set a common framework that will enable to use by the scientific community.

The section "Land Use, Mobility and Environment" collects three articles. The first article, titled "Limit Condition for the Intermunicipal Emergency", by Luana Di Lodovico, Donato Di Ludovico (University of L'Aquila, Italy), deepens the issue of the Emergency Plan (EP). As the result of study about risk for each context, it allows to identify potential emergency scenarios. The paper illustrates model of analysis of Intermunicipal Emergency Plan (I-EP) through Limit Condition for the Intermunicipal Emergency (I-LCE), with the purpose of large-scale assessment and mitigation of the seismic risk. The proposed methodology is applied in the area of Sele, in the district of Salerno (Southern Italy), territory characterized by high levels of seismic and hydrogeological vulnerability.

The second article, titled "Cyclability in Lahore, Pakistan: Looking into Potential for Greener Urban Traveling", by S. Atif Bilal Aslam (University of Engineering and Technology Lahore, Pakistan), Houshmand E. Masoumi (Technische Universität Berlin, Germany), Muhammad Asim (University of Engineering and Technology Lahore, Pakistan), Izza Anwer Minhas (University of Engineering and Technology Lahore, Pakistan), presents the results of a survey about cyclability in Lahore, Pakistan, focusing on human perceptions rather than the built environment. The overall sample included a total of 379 respondents from three socio-economic classes: those from lower socio-economic backgrounds accessing traditional/older bazaars, respondents from the middle socio-economic class accessing uptown bazaars, and respondents of higher socio-economic status accessing pedestrian shopping malls.

The third article, titled "New water footprint indicators for urban water cycle", by Rossana Varriale (University of Naples Federico II, Italy), investigates the possibility of using the water footprint indicators in order to have common values on the uses of water in urban areas, where "value" means a measurement of water used and subtracted from the natural environment for anthropic uses. First of all, a general framework will be made of the studies that have dealt with "value" to water flows in the urban and non-urban context. In paragraphs 3 and 4, footprint indicators have been proposed to assess the variability of water consumption within urban territories. Then, the Blue Water Footprint and the Green Water Footprint were calculated only for the water flows consumed in the Italian cities, like drinking water and domestic water. In paragraph 5, it was argued on the links between UWF values and urban planning instruments and how the UWF indicators can address urban transformations towards sustainable approaches.

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 on the subject of the Resilience City and the Fragile City. In particular, the Web section by Rosa Morosini describes three web resources of: (i) World Atlas Desertification; (ii) Soil Map and (iii) United Nation Environment Programme. The Books section by Gerardo Carpentieri briefly reviews three relevant books related to the Issues' theme: (i) Open Data Infrastructure for City Resilience. A Roadmap, Showcase and Guide; (ii) Transformation towards sustainable and resilient societies in Asia and the Pacific and (iii) Transport and Climate Change Global Status Report 2018. The Law section by Maria Rosa Tremiterra keeps readers up to understand in which way the European Union is addressing the integration between Climate Change Adaptation and Disaster Risk Reduction with a specific reference to the urban planning implications. The Urban Practices section by Gennaro Angiello presents two case studies for planning for resilience in in two South-American capitals, (i) the Quito (Ecuador) Resilient Strategy and (ii) the Santiago (Chile) Resilient Strategy. 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.

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LAND USE CONFLICTS IN THE ENERGY TRANSITION: DUTCH DILEMMAS

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ABSTRACT

The transition from fossil to renewable energy requires changes in land use. The development of renewable energy sources introduces extra and sometimes new externalities, such as shadows, noise, and changes to the landscape. Several governments are experiencing difficulties when developing renewable energy sources, especially when existing land owners (and others) start anticipating externalities. Therefore, land use conflicts have become a major issue for governments in meeting renewable energy policy objectives. This paper explores how three dilemmas—tiers of government, mode of governance, and norm-setting—are approached by public authorities, using policy document reviews, interviews, literature research, and examples of the Dutch energy transition.

KEYWORDS:
Energy Transition; Land Use Change; Externalities; The Netherlands

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能源转型的土地利用冲突 荷兰困境

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摘要

从化石向可再生能源转型需要改变土地利用。可再生能源的发展带来了额外的、有时是新的外部因素，如阴影、噪音和地形变化。一些国家政府在开发可再生能源方面遇到困难，特别是当现有的土地拥有者(和其他人)开始预测外部因素时。因此，土地利用冲突已成为各国政府实现可再生能源政策目标的一个重大问题。本文通过政策文件审查、访谈、文献研究和荷兰能源转型的实例，探讨了政府当局如何处理三重困境-政府、治理模式和规范制定-的问题。

关键词:
能源转型；土地利用变化；外部因素；荷兰

1 INTRODUCTION

Energy transitions change how land is used. Renewable energy sources need land to be built on and sources such as wind turbines, solar plants, and biomass produce externalities (Wüstenhagen et al., 2007). These externalities include noise, shadows, air pollution, or changed landscapes. The development of renewable energy sources therefore interferes with existing land use and land use plans. This interference is increasing because renewable energy systems require more land to produce the same amount of energy as fossil fuels do (Boyle, 2004). For example, a traditional gas or coal plant can generate over 400 MW of electric energy a year while a single wind turbine can generate up to 7 MW of electric energy a year while using almost the same amount of land. Consequently, land use for energy transition increasingly interferes with current land use, resulting in land use conflicts.

Public authorities experience difficulties coping with land use conflicts because existing land use plans and land owners anticipate renewable energy source interference with their land use (Deppisch & Dittmer, 2015). There is a tendency to solve these land use conflicts on the local level, however most land use issues are complex and encompass a wide variety of stakeholders (Foley et al., 2005). This level of complexity makes it challenging for local governments to cope with land use conflicts and develop renewable energy sources within their municipality boarders. To cope with land use conflicts, local governments could consider changing their land use plans. This is traditionally the work of local authorities. But it is not clear if land use conflicts from energy transition are any different in comparison to traditional land use issues. We argue that land use conflicts from energy transition are more complex, due to three reasons: differentiation, fragmentation, and level of urgency.

- Differentiation of renewable energy sources encompasses a variety of sources such as wind turbines, solar panels, biomass, and so on. Within traditional planning, such differentiation plays a role in what functions can be planned near each other. Just like residential, industrial, and recreation areas, renewable energy sources also impact their surroundings. However, the technical issues (enough wind and sun in the area), safety issues (wind turbines cannot be placed near residential and infrastructural areas), and personal issues (people tend to dislike renewable energy sources nearby) increases the complexity of building renewable energy sources in comparison to more traditional land uses;
- Renewable energy sources are built as single objects, multiple objects, or in large numbers. This variety makes governmental instruments such as land use plans inefficient. The effect that renewable energy sources have on the surroundings depend on the number being built. Consequently, a single wind turbine or a large wind turbine park needs different planning instruments with different time spans. This fragmentation is a major issue for implementing instruments to change land use;
- Governments all over the world have agreed upon the urgency to become fossil free before 2050. The energy transition is therefore one of the most urgent global issues today. Traditional land use planning doesn’t have such urgent planning issues with such a large impact on all kinds of land uses. Most land use issues, such as housing shortages, are local or at large regional.

Traditional land use planning deals with all three of the issues as described above. Land use planning is used to change the use of land. However, the scale and urgency of the energy transition is tremendous and therefore more complex in comparison to other land use issues. Another factor linked with differentiation, fragmentation, and urgency is the number of end users that play a role in the energy transition, most of whom are local actors. Renewable energy sources can be built by local, regional, and national governments, or by companies and citizens. Due to the link between different actors and their responsibilities, when building renewable energy sources, current energy policies and coherent traditional planning approaches aren’t effective enough (Verbong & Loorbach, 2012). Whenever a citizen, farmer, company, or local government wants to build one or more renewable energy source(s), there are land use plans to be recognized, but also local and regional policies which require environmental and building permits. The current approach towards development of renewable energy sources limits the number being developed, nearby cities but also in rural areas (Papa et al., 2015; Wolsink, 2007). Therefore, the quest to find solutions for energy transition land use issues is rather interesting. Before the solution can be found, understanding the complexity and underlying difficulties is of high importance.

The complexity of mobilizing land use change is increased by three dilemmas: the tier of government, mode of governance, and norm-setting. These dilemmas exist out of choice issues such as a top-down or bottom-up approach, local (regional) or national decision-making, and short- or long-term solutions. All these options have advantages and disadvantages and are therefore defined as dilemmas. Consequently, it is important to not only govern land use conflicts through changes in land use but also by working through the underlying dilemmas. Change of land for energy transition (considering externalities, assigning land use, and acquiring land for renewable energy developments) are urgent but at the same time difficult to govern, which puts pressure on governmental renewable energy objectives. The central question for this contribution is therefore: how can governments cope with the dilemmas underlying the land use conflicts of renewable energy development? By using Dutch examples, these dilemmas will be further examined. The Dutch energy transition is characterized by complex land use change because every inch of land already has a certain function assigned to it through land use plans. Finally, by exploring the underlying dilemmas of land use conflicts, the complexity of governing land use conflicts will be revealed, and a land use management approach will be discussed as promising.

2 METHODOLOGICAL APPROACH: EXPLORATIVE RESEARCH OF DUTCH GOVERNMENTAL ENERGY POLICIES

The research methods used in this contribution are mainly explorative. As such, multiple case study analyses on energy policy implementation, semi-structured interviews with government officials, and private actors and literature research gather the information for these contributions. In this contribution, the governmental energy policies of different tiers in the Netherlands are a starting point. The Dutch cases are chosen because the Netherlands is a dense country, in the sense that every piece of land has one or even multiple uses attached to it. Due to the land use claims of renewable energy sources, the issues with building renewable energy sources are very clear within the Netherlands. The policy analysis, interviews and literature review are therefore exemplary for other (European) countries experiencing land use conflicts with energy transition.

The cases which are the subject of the governmental policy analysis vary from the national government project 'Wind op land' (3500 MW of wind energy scattered on land over 12 provinces) and municipal projects in regional areas of Noord-Holland and Groningen. The case study analysis allowed examination of the role of spatial planning in general energy policies as well as those specific to the energy transition. Both these research methods show indications of three dilemmas: the tier of government, mode of governance, and norm-setting. These dilemmas underpinned the existing difficulties described by government officials that they face when using land for renewable energy. Based on empirical findings we found that regional policy is both obstructing and supporting local developments in different ways, thus creating a dilemma of tiers of governments. We also came across the mode of governance dilemma where some tiers of governments applied a top-down steering policy while other tiers of government applied a more bottom-up approach, both showing successes and failures. The norm-setting dilemma was found in competing policies of tiers of government and further explored during interviews with government officials. This analysis is complemented by secondary data from other studies and an extensive literature review. Semi-structured interviews were selected as research methods because they are well suited for the exploration of the perceptions and opinions of government officials and private actors and at the same time allow further exploration of sensitive issues (Louise Barriball & While, 1994).

As can be concluded from chosen research methods and material, this study does not pretend to be all-encompassing. However, we think this study provides a new perspective on three dilemmas (tier of government, mode of governance, and norm-setting) and the underlying difficulties of implementing policies for renewable energy development.

3 DILEMMAS OF COPING WITH LAND USE CONFLICTS

Recent events have increased the discussion about the need for a different perspective on governing the energy transition (section 1). Governments all over the world are increasingly acknowledging that the transition to a renewable based, more bottom-up, and decentralized energy system, is a complex one, due to the impact of renewable energy developments on its surroundings (Breukers, 2010; Devine-Wright, 2014; Larsson, 2014). During our literature research, three dilemmas were found underlying land use conflicts rising from renewable energy development. In this section the underlying differences between tiers of government are explored by introducing three dilemmas: the tier of government, the mode of governance, and norm-setting.

3.1 FIRST DILEMMA: TIERS OF GOVERNMENT

To change renewable based energy systems, participation of different tiers of government is needed to "*redesign infrastructure, buildings and equipment*" (Bridge et al., 2013). The traditional way of governing the energy system is top down. National governments are active on the international level for formulating energy objectives and national policies but decide that lower tier governments are responsible for meeting national objectives. The dilemma here is the question of which tier of government should be responsible for renewable energy development? There are two issues that impact this dilemma.

First, more land is needed. Generating the same amount of energy that fossil energy generates with renewable energy sources requires much more land. As described in the introduction, the energy density of renewable sources is lower than fossil energy alternatives (Smil, 2010). Thus, land use conflicts arise from the multiple locations needed for energy generation. This generation takes place through wind turbines, solar parks, and other renewable energy sources. The land needed for such developments has other potential uses or already-existing uses that compete. Through land use plans, local tier governments can cope with competing uses. However, depending on the size of renewable energy projects, local tier governments don't have the means (financial or instrumental) or authority (plans exceeding municipal borders) to cope with the conflicts that arise. Second, with the new responsibility and difficulties faced, lower level governments are increasingly relying on developments led by private parties for meeting energy policy objectives (Upreti & van der Horst, 2004; Westerink et al., 2016). This has led to a certain attitude where local concerns and interests concerning renewables have been brushed aside by private parties (Breukers, 2010; Westerink et al., 2016). In turn, this attitude has increased local opposition towards renewable energy developments (Ellis, 2004; Gross, 2007; Wolsink, 2000). Therefore, local governments are struggling to make suitable land for renewable energy production available, whereas higher tiers of governments are holding tight onto existing approaches, such as coping with local opposition by using traditional instruments such as buying land voluntarily or compulsorily. By using these traditional (top-down) instruments for enabling renewable energy developments, lower governments must change existing land use plans, which can take up to six months or longer depending on the nature of the change (Rijkswaterstaat, 2018). These two examples show two major difficulties found in interactions between different levels of government. While on the one hand, local governments are given the responsibility to meet objectives for local issues, they are not given the right means or support to cope with such complex issues. The performance-based approaches of national government and the more condition-based approach of the regional tier compete both with each other and also with the local approach which addresses concerns of renewable energy developments. As such, the competing approaches between tiers of government results in delayed or cancelled projects.

3.2 SECOND DILEMMA: MODE OF GOVERNMENT

The top-down steering by tiers of governments on implementing energy policy is also present in the next dilemma, the sectoral approach towards the energy transition. The energy transition is still being approached as a top-down sectoral issue instead of as an integral (planning) issue (Verbong & Geels, 2007; Verbong & Loorbach, 2012). Governments and private parties work together in vertical (top-down and bottom-up) and horizontal ways (sharing responsibilities) modes of governance. The governmental policy approach defines the mode of governance in which the development of renewable energy sources take place. Driessen et al. (2012) wrote about how to cope with different modes of governance and discusses that the mode of governance "*refers to the means by which society determines and acts on goals related to the management of (…). It includes instruments, rules and processes that lead to decisions and implementation".* The mode of governance dilemma is found in the current sectoral approach and integral alternative approach of how governments and private parties cope with land use conflicts.

Major actors like utility companies, infrastructural companies, and regulators still have a large influence on the management of the current energy system. Therefore, economic, social, and energy issues are being addressed separately, which have a major impact on the effectiveness of executing energy policies. This approach has increased competition between different governmental departments (housing, retail, industry, leisure, etc.) in acquiring land for their own objectives. The current Dutch situation is in some cases closely related to the one Runhaar et al. (2009) studied. Runhaar et al. (2009) argue that the absence of environmental planning in urban and regional developments has led to missed opportunities to improve environmental quality, "*because the incorporation of environmental aspects often only occurred in a later stage of the planning process*".

The mode of governance dilemma which different tiers of government are facing is mainly created by the lack of a successful approach for coping with land use conflicts with renewable energy developments. Although new policies are still based on the already-existing centralized mode of governance and our society is still heavily relying on fossil fuels, a successful integral approach has yet to be found (Verbong & Loorbach, 2012). A new mode of governance is needed with a focus on 'how do we cope with land use conflicts surrounding renewable energy developments' and settle the differences between a sectoral and integral mode of governance. Such an integral alternative approach could help governments internalize externalities of renewable energy developments, but also other complex issues such as mitigation of climate change effects (Papa et al., 2014). This internalization of externalities gives governments the ability to use other instruments (economic and social focused) and means to cope with the impact of renewable energy developments. A possible issue with applying an integral approach is that it becomes increasingly complex. Creating a solution for a sectoral issue is already complex. Finding a solution which includes several other sectors only makes the issue more complex because of increasing and conflicting interests. This makes choosing the 'right' mode of governance a real dilemma.

3.3 THIRD DILEMMA: NORM - SETTING

The norm-setting dilemma is about weighing renewable development objectives against other urgent issues, such as local health department reforms, resettling of refugees, or protection of landscape. Another characteristic is that changing and developing land use or zoning plans are time consuming issues and smaller municipalities deal with a lack of means, without a clear path of how to address the challenges. Therefore, local governments aren't always capable of integrating renewable energy initiatives in their main land use management policies (Wegener, 2012). Because of the high costs and time needed for developing land use plans, lower governments are more interested in a facilitating role, which can be a risk because private parties are mainly focused on making profits. In certain situations, the change to a facilitating role has led to the interests of local citizens being left out in planning and decision making, igniting local opposition as result

(Breukers, 2010). Due to such land use conflicts, renewable alternatives (especially wind projects) have increasingly been confronted by negativity, which in turn, have led to delays and cancellation of projects (Krohn, & Damborg, 1999; Wolsink, 1996). To influence the role of governments and the market in the energy transition, persistence and continuity of energy policy is needed (Grubler, 2012). In Grubler's (2012) view, long term policies are consistent and therefore attracting investors and companies wanting to finance or develop renewable energy projects. Additionally, approaches to renewable energy development should be free from contradictions by aligning land use and energy policies to promote shared norms between all stakeholders.

Another issue of the norm-setting dilemma is the short time cycle for appointing government officials. The opportunity for officials to be re-elected is therefore an important factor in norm-setting on the local level. For example, Healy and Lenz (2014) argue that voters assign higher weight to the conditions of the election-year economy. Sitting officials can therefore be incentivized to *"…take action to inflate election-year growth even at the cost of larger long-term economic damage"* (Healy & Lenz, 2014). This implies that for government officials in short-term positions, meeting short-term objectives does have a more positive effect for re-election than working on long-term issues, such as local opposition towards renewable energy developments. So next to the urgency challenges, it is possible that the political agenda of government officials also influences the way norm-setting takes place between tiers of government.

4 LAND USE CONFLICTS IN THE NETHERLANDS

The Netherlands are known for its traditional windmills, which were built to use wind power for grinding grain to flour and manage drainage of the so called 'polders'. These windmills aren't used for this work anymore, but they are still a welcome sight in traditional Dutch landscapes. In contrast to these traditional windmills, modern wind turbines aren't seen as welcome sights, especially not near living areas. While in the 70s the Netherlands was one of the pioneers of building these wind turbines and making use of this sustainable energy source, in the 20th century this has completely changed. Dutch governments have experienced difficulties, resulting in a second to last place on generating renewable energy in Europe (Eurostat, 2016). This section will elaborate on why the Dutch government is having these problems by examining and discussing the three dilemmas. The Dutch government has agreed on the need for a transition from the current fossil-based energy system to a renewable based energy system. The challenges and associated coping strategies with making this energy transition happen in the Netherlands are documented in an agreement called the 'Energieakkoord'. This 'Energieakkoord' is an agreement between the Dutch government and forty organisations, including employers and employee organisations, nature and environmental organisations, civil organisations, and financial institutions. The main goal of this agreement is to strengthen the economic structure by making investments in our society with a focus on energy challenges of today and those of the future (S.E.R., 2013). This agreement should have ignited a new incentive for renewable energy projects to be developed. Despite the effort to successfully execute the agreement, in 2014, the Netherlands was still 8,5 percent removed from its national objective to reach 14 percent of renewable energy as part of all energy generated by 2020, which is less than the 16 percent objective (Eurostat, 2016).

<u>Tier of government dilemma</u>

In the Netherlands, all tiers of government can have a renewable energy policy, however regional policies overrule local, and national policies in turn overrule regional policies. Existing policies and laws can also overrule local policies and development plans. The tier of government dilemma becomes visible in the province of Friesland where so-called small wind turbines may only be replaced by wind turbines that are of the same height. Even though municipalities want to build new or replace old wind turbines, the coalition accord of the province of Friesland obstructs such developments due to protection of the landscape (Province of Friesland, 2015). In Groningen, a province next to Friesland, these smaller wind turbines are allowed and encouraged by the province and are a success with more than 50 being built in 2017 already. Different levels of government have their own energy objectives which compete with other policy objectives. Based on empirical findings from interviews with government officials, choices are made between meeting renewable energy objectives and other policy objectives. For example, the province of Friesland and Groningen both have the same dilemma with developing solar fields. Municipalities in both provinces want to develop such fields as far away from residential areas as possible while provincial policy terms state that, to protect cultural agricultural land, these solar fields need to be built near residential areas. This is also a norm-setting dilemma where choices must be made between different and often competing policy objectives.

The recent 2016 energy report (Ministry of Economic Affairs, 2016), states that a reversal in transport and generation of (fossil fueled) energy can only happen when new developments are integrated in and accepted by its surroundings (Ministry of Economic Affairs, 2016). However, in the Netherlands, the traditional top-down sectoral approach of the national energy policy doesn’t seem to cope with land use conflicts of renewable energy developments, resulting in delayed and cancelled projects. The land needed for renewable energy sources isn’t always available due to opposition towards these developments (Breukers, 2010) and existing land use plans (Ministry of Economic Affairs, 2016). Besides, as the Amsterdam harbour cases shows, even when there is land available and local support for development plans, higher level governments can still prevent development of renewable energy sources through extra-legal policies.

Mode of governance dilemma

The importance of an integral approach instead of a sectoral approach can be discussed through the ambitious, mainly private paid, project ‘Wind op Land’ as an example. This project intended to develop 3500 (MW) of wind energy scattered on land, is stalled because the impact on its surroundings weren’t included in the cost-benefit analyses (CPB, 2016). The same happened with the IJsselmeer project which has been stalled because of the impact on surrounding land uses (Gemeente Súdwest-Fryslân, 2014). Due to local resistance, the government stopped the project for further research on this subject. For both these projects, problems of externalities and issuing land were enough to postpone the project after a sectoral approach during the first stages of development. The land needed to develop two to twenty-eight thousand wind turbines on land and sea, and more than one-hundred-thousand sun boilers and panels and other renewable energy sources is a lot more than the fossil-based energy system requires (PBL, 2013; Verbong & Loorbach, 2012). The energy transition can no longer be seen as a sectoral technical challenge.

As sustainable energy initiatives are left out of planning policies (section 3.2), their land claims are competing with already-existing interests (Runhaar et al., 2009). This top-down approach steering can be found in the Amsterdam harbour case where the regional government implements top-down policy to prevent local development. However, based on empirical findings of the interviews with government officials, smaller and local private parties are together developing more renewable energy plans and are accomplishing these plans without the major traditional private parties. As one government official said, “large private parties such as NUON, a large energy company in the Netherlands, do not have a large role in the development of wind turbines in our province”. This suggests that new smaller parties also successfully invest in wind turbines.

Norm-setting dilemma and tier of government

Based on empirical findings from interviews with Dutch government officials and private actors, the norm-setting dilemma makes relations between different actors more complex, creating conflicts between governmental norms and ambitions. The subsidiarity principle within the Netherlands has left lower level governments responsible for policy that was traditionally a national government subject. Youth healthcare, the housing of refugees, and other policy subjects have increased the workload of municipalities. The responsibility for renewable energy developments is therefore seen as an issue for the long term and less politically important in comparison with other policy subjects. How does this norm-setting impact renewable energy sources developments? Norm-setting is the weighing of the spatial consequences of developing renewable energy sources against other functions and public interests like health, safety, defence, and water management. As such, difficulties of acquiring and assigning land suitable for renewable energy sources governments are visible in the Dutch energy transition.

This dilemma can be found in the development plans of the municipality of Amsterdam and private led initiatives and several municipalities in the province of Friesland. These initiatives gained high amounts of support in the region, however the provinces of Noord-Holland and Friesland have denied most of the building permits because of different objectives on preservation of landscapes (NOS, 2016). Both the Province of Friesland and Noord-Holland appointed certain areas for wind turbines to be build, to gain control over the sprawling, and at the same time protect certain historical landscape sights, which have social-cultural and economic worth (Wolsink, 2007). However, renewable energy development of nearby cities is needed to supply cities with enough energy (Barresi & Pultrone, 2013).

These examples of policy implementation and renewable energy development in the Netherlands raise questions about why land use conflicts aren't addressed well enough in (national) energy policy. In some cases lower governments do not have the means to effectively cope with these concerns. However, the examples also show that when lower governments do have the right means, higher governments can obstruct local development of renewable energy sources. The other two dilemmas, the sectoral mode of governance and norm-setting, are also found in the Dutch cases.

5 CONCLUSION

To overcome the dilemmas, a different approach is needed. In our analysis we found successes and failures of certain approaches and accompanying policies. In some cases, a certain policy approach can be useful to accomplish a project while in another case it will only obstruct the development of renewable energy sources. Existing literature about the spatial impact of the energy transition lacks the spatial perspective on how governments approach renewable energy developments. Increasing land use claims, created through development of renewable energy sources close to land users and owners, result increasingly in 'hard conflicts' between different land claims. Governments, such as the Netherlands, are failing to cope with these conflicts, putting pressure on meeting renewable energy objectives. The differentiation, fragmentation, and urgency addressed in the introduction shows that traditional land use planning cannot deal with all land use issues. This paper adds knowledge to the existing body of literature about land use conflicts, dilemmas of tier of government, mode of governance, and norm-setting, and identifies future research questions on these subjects.

Based on our empirical findings, we conclude that land use conflicts and the underlying dilemmas make development of renewable energy sources a complex issue. We have discussed the level of government, the mode of governance, and norm-setting. The way these dilemmas are intertwined with and mutually dependent on each other increases the complexity for governments to implement energy policy to meet renewable energy objectives. The interviews with government officials confirmed the existence of these dilemmas and that addressing only one of these will only partly solve the real problem. The dilemmas are substantiating why a gap between (inter)national decision-making and local implementation exists. Local governments aren't always capable of meeting (inter)national objectives and try to transfer their responsibility to the market. The issue is that the government is responsible for energy security and availability, while the market is more focused on the financial aspect of renewable energy developments. This mode of governance doesn't seem to be effective for coping with opposition and is also maintained because of the differences in norm-setting. The norm-setting dilemma asks for a long-term approach. Although governments are sensing the urgency to build renewable energy sources, the energy transition is a long-term challenge. Because of this long-term character, local governments tend to cope with more urgent issues and leave the implementation of renewable energy policy to the market.

Based on our analysis we conclude that differences exist in various tiers of government in the Netherlands and therefore a new way is needed to overcome land use conflicts. There are multiple problem owners that need different instruments to solve their problems. Who are these problem owners and what are their interests in the energy transition? Governments that apply one single instrument to change land use are likely to fail because of the number of actors and the limited ability to include the actors in the direct surroundings of owners that are affected by development plans. The local character of the energy transition asks for a more (but not exclusively) bottom-up integral decentralized approach to cope with or prevent hard conflicts created by new and existing land claims.

A solution to some of these issues can be found in land use management. The role of land use management in governing land use conflicts has been significant, even though it is less applied by solving local issues surrounding the development of renewable energy sources (Breukers, 2010; Verbong & Loorbach, 2012). An integral land use management approach is therefore relevant because of two important aspects. The first aspect is that thousands of wind turbines on land (and sea), solar panels, sun boilers, thermal systems, and so on, have to be built and need a certain amount of often privately-owned land to be developed. Secondly these developments have a major impact on their surroundings. This impact consists of noise, shade, sight-blocking, and so on and affect the lives of citizens and other stakeholders (rights) living nearby renewable energy developments. Both these aspects relate to how land is used. An integral approach concerns the internalization of externalities, and because land use conflicts are mainly about externalities created by certain land uses on other land uses, such an approach is assumed to be promising to introduce solutions for land use conflicts surrounding renewable energy developments. Now that we have added these insights to the existing body of literature, for future research we can ask: how can a land management approach include local interests, overcoming dilemmas, and successfully meet energy transition objectives?

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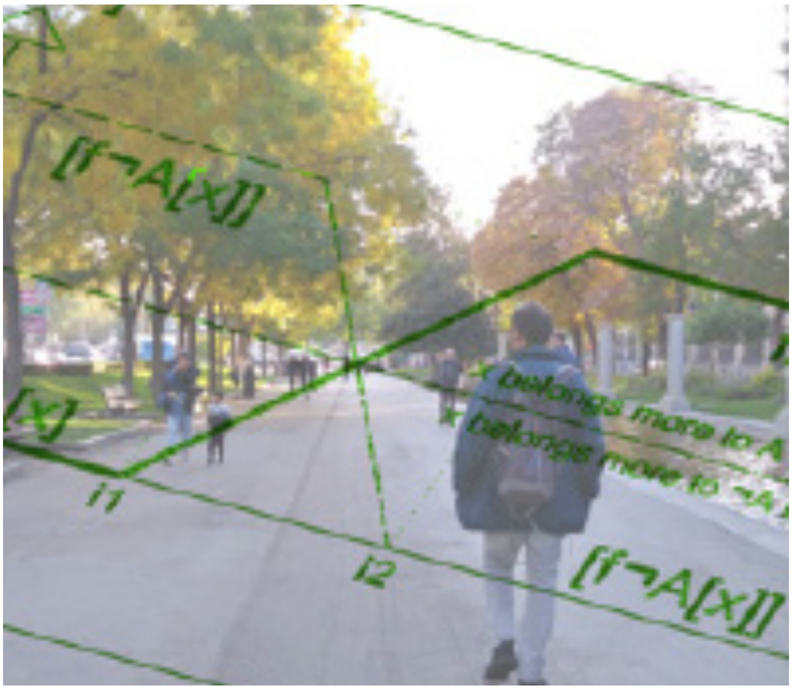

A METHODOLOGY FOR URBAN SUSTAINABILITY INDICATOR DESIGN

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ABSTRACT

In recent times we have witnessed proliferation of indicators and models for measuring sustainability. This reveals both the importance of the issue and the lack of common and shared scientific paradigm/ framework.
With the aim of advancing towards such common framework which enables quantitatively assessing the sustainability of our cities and societies, in this article it is explained a formal methodology for designing urban sustainability indicators based on Fuzzy Sets Theory. The interest of this methodology is threefold:

- Firstly, formal procedures enable testing, a most fundamental issue forgotten in many current proposals of sustainability indicators.
- Secondly, a formal procedure can become a common language allowing shared use of the indicators and facilitating their continuous improvement.
- And thirdly, fuzzy logic is widely used in computing and artificial intelligence, thus facilitating progressive automation of our sustainability monitoring models.

To help understand the procedure, the design of two indicators is reviewed, showing the applicability and easiness of the methodology.
Therefore, herein proposed methodology stands as an easy procedure, which generalization could allow us to increase the accuracy [testability] and shared used [efficiency] of our scientific research in sustainability as well as integrating it into artificial intelligence systems, increasing our capacity of successfully confronting current extremely high unsustainability of our society.

KEYWORDS:
Sustainability Measurement; Urban Sustainability; Indicator Design; Climate Change

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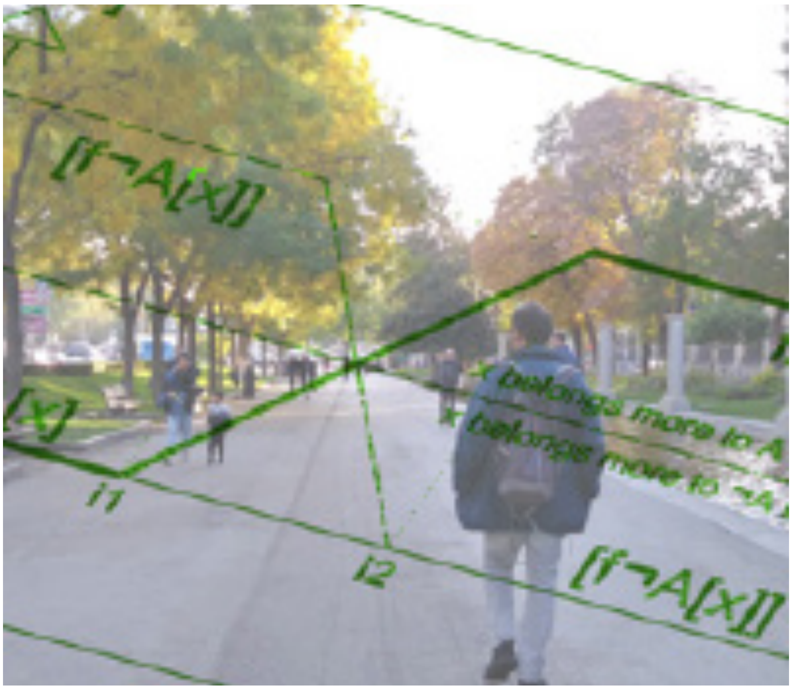

城市可持续性指标设计方法论

摘要

最近，我们目睹了衡量可持续性的指标和模式激增。这既表明了这一问题的重要性，也表明缺乏共同和共享的科学范式/框架。
为了实现城市和社会可持续性定量评估的共同框架，本文阐述了一种基于模糊集理论的城市可持续性指标设计的正规方法。该方法的优点有三方面：

- 第一，正规程序能够允许进行测试，这是目前许多可持续性指标提案中常常容易忘记的一个最根本的问题。
- 第二，正规程序可以成为一种共同的语言，允许共享使用指标并促进其不断改进。
- 第三，模糊逻辑在计算领域和人工智能中得到了广泛的应用，从而促进了可持续发展监测模型的逐步自动化。

为了帮助明白该程序，对两个指标的设计进行了回顾，并说明了该方法的适用性和易用性。
因此，本文所提议的方法是一个简单的程序，其泛化性可以使我们提高可持续性科学研究的准确性[可测试性]和共享使用[效率]，并将其整合到人工智能系统中，从而提高我们成功应对当今社会极高不可持续性的能力。

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关键词：
可持续性度量；城市可持续性；指标设计；气候变化

1 INTRODUCTION

Our current concern in relation to the increasing unsustainability of our society and development model, in conjunction with the increasing importance of cities to define such unsustainability, has taken to an everyday increasing number of different proposals for modeling and measuring urban sustainability. These proposals take the form of sustainability indexes or sustainability indicators dashboards, and their importance is that sustainability measurement stands as prerequisite for being able to increase it.

This constant increase of indicators and indexes for quantitatively assessing sustainability can be understood as something positive, as it increases the number of available tools for helping us moving towards sustainability. But it also conceals two negative issues:

- the lack of a common framework for sustainability measurement[1] leads to every new proposal defining its own framework, which often cannot be linked to most existing knowledge. This implies great effort and forgets two important issues: connection to previous proposals makes scientific research more efficient and usually enables its easier testing, the last being an often forgotten yet fundamental issue for science: an untested proposal is unscientific by definition;
- contradiction between statements made by different models generates lack of consensus greatly hindering making the required decisions for advancing towards sustainability. Most of these decisions are collective decisions; i.e., decisions that need to be made by consensus among many agents with different preferences/interests. Which model should we use then if different models suggest different courses of action that imply different utility for different agents?

Advancing towards shared/consensual knowledge in Sustainability currently stands as prerequisite for advancing towards Sustainability. With this goal, in this article a methodology for sustainability indicator design is explained that allows us to understand what these indicators should measure and how, aiming to set a common framework that enables their shared used by the scientific community.

To define this framework, a review of Sustainability conceptualization is undertaken from the two approaches to *logic* from Set or Class Theory[2]:

- Classic Set Theory or Boolean Logic (Boole, 1854; Hacking, 1995) allows us to conceptualize the class of sustainable Cities [S] as opposed or complement to that of Unsustainable Cities [¬S];
- Fuzzy Sets Theory or Fuzzy Logic (Zadeh, 1965) allows us to conceptualize the sustainability degree of a city as its Grade of membership to the set or class of sustainable cities [S].

The second approach is better fitted to our objectives; therefore, we build the methodology for designing the indicators on Fuzzy Logic/Fuzzy Sets Theory. For greater clarity, two urban indicators are reviewed using herein proposed methodology. Prior to the review, it is convenient to state two easy definitions of sustainable city built on two perspectives:

- from a probabilistic perspective, a sustainable city is that maximizing its probability of indefinitely enduring;
- from an optimality perspective, a sustainable city is that maximizing the degree to which it is in its optimal state[3].

Let us start by reviewing the conceptualization of sustainability according to Classical Sets Theory.

[1] Beware by common framework we do not refer to a unique context-independent model to be used anywhere around the world, but to the logical framework underlying the models. Different contexts may imply the relevant variables and indicators for sustainability (their sustainability thresholds) are different.

[2] There is a difference between a set and a class (i.e., a set is a class that belongs to another class) yet for the present work both terms are considered to be synonym and equivalent to class.

[3] Although this definition is somewhat redundant, it could be more briefly stated as "a city which is in its optimal state" (Alvira, 2017), it help us to easier understand herein explained approach.

2 CLASSIC SET THEORY OR BOOLEAN LOGIC: SUSTAINABILITY AND UNSUSTAINABILITY AS COMPLEMENTARY SETS[4]

Classic Set Theory *groups* objects into different classes by assigning each object to each set or class by a binary membership function. Given an object x and a set or class A, a value *zero* means that x does not belong to A (therefore, it belongs to ¬A), and a value *one* means that x belongs to A.

$$f_A[x] = \begin{matrix} 0\ if\ x\ \notin a \\ 1\ if\ x\ \in a \end{matrix}$$

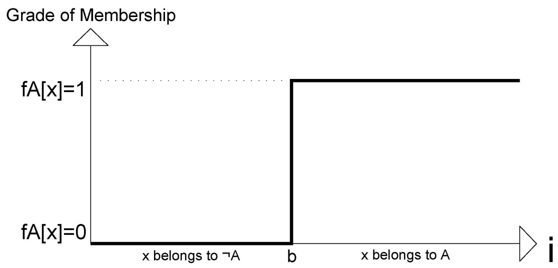


Fig.1 Binary Membership function, where b is the value of some variabl i describing x, which separates null from full membership of x to class A

Membership as conceptualized by Classic Set theory or Boolean logic implies therefore the idea of mutually exclusive classes or concepts that can be defined as those whose intersection is empty and their union provides the universe of discourse:

$$A \cup \neg A = \Omega\ [R] \tag{1}$$

$$A \cap \neg A = \emptyset \tag{2}$$

This last statement expresses the *Duality Law* (Boole, 1854) as a condition for the interpretability of logical functions, which is a formalization of *Aristotle's Non-contradiction Principle*. It is possible building a first conceptualization of Urban Sustainability on above statement. If we consider the set that includes all cities and we divide it into two subsets:

- we designate S or *Sustainability* the set composed by all sustainable cities;
- we designate ¬S or *Unsustainability* the set composed by all non-sustainable cities.

Following above criteria the union of S and ¬S (sustainable and non-sustainable cities) must contain all cities, while their intersection must be empty:

$$\begin{gathered} S \cup \neg S = 'Cities' = \Omega\ [R] \\ S \cap \neg S = \emptyset \end{gathered} \tag{3}$$

We can represent it as:

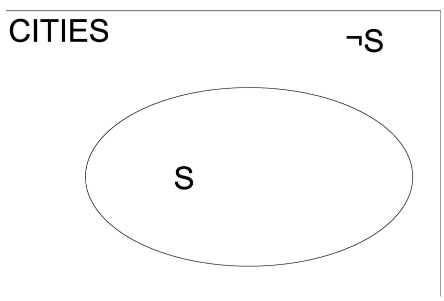


Fig.2 Sustainability [S] and Unsustainability [¬S] sets are complement in the universe Cities

[4] This chapter and the following are a reformulation and update of Alvira (2018 [2013])

The drawback of this approach from Boolean logic is that though being theoretically correct (in the long run a binary approach is the only possible; a city endures or not) it does not fit above proposed definitions:

- a city may have a *continuum* range of probabilities to indefinitely endure;
- a city may be *closer or further* from its optimal state.

Being able to characterize cities consistently with above two definitions requires confronting it from Fuzzy Sets Theory or Fuzzy Logic.

3 FUZZY SET THEORY AND LOGIC: SUSTAINABILITY DEGREE AS GRADE OF MEMBERSHIP

A Fuzzy set is a class characterized by a membership function $f_A[x]$ that associates to each element x of a universe X a number in the range [0,1]; i.e., a class with a continuum of grades of membership[5]:

$$a = \{[x, f_A[x]] | x \in X\}$$
$$f_A[x] \to [0,1] \quad (4)$$

Fuzzy Logic is a development of Boolean logic to confront intermediate situations that allow *grades of membership and exclusion*; widening the applicability of the Non-contradiction Principle.

While classical logic can only be used with mutually exclusive concepts (i.e., concepts that must be true or false applied to an object) *fuzzy logic can be also used with any concept or quality that can be partly true. Any object can be characterized by the degree it possess some quality and the non-quality*; i.e., by the degree it belongs – its grade of membership – to a class and to its opposite or complement.

A fuzzy membership function can take any value in the range [0-1], which allows us to measure urban sustainability and unsustainability in terms of *sustainability / unsustainability degree:*

- the *Sustainability Degree* of a city I at a moment T is its *grade of membership* to S and we designate it as $S_T[I]$

$$S_T[I] = f_s[I] \quad (5)$$

- the *Unsustainability Degree* of a city I at a moment T is its *grade of membership* to ¬S and we designate it as $\neg S_T[I]$

$$\neg S_T[I] = f_{\neg s}[I] \quad (6)$$

Therefore, the Sustainability Degree of a city I at any moment T has a value in the range 0 and 1, and we can assign different meaning to said value:

- $S_T[I] = 1$ the membership to *Sustainability* class is complete, and therefore the grade of membership to *Unsustainability* class is zero;
- $0 < S_T[I] < 1$ the city has a grade of membership to *Sustainability* class, complementary to its grade of membership to *Unsustainability* class;
- $S_T[I] = 0$ the grade of membership to *Sustainability* class is zero, and therefore the membership to *Unsustainability* class is complete.

We see Fuzzy Sets Theory allows us to characterize urban sustainability consistently with above definitions. Let us then review some properties of the fuzzy sets which are useful for understanding herein proposed methodology.

[5] This definition and the majority that follow are from Zadeh (1965).

3.1 PROPERTIES OF FUZZY SETS

Fuzzy sets have four properties interesting for our proposal:

- Complementary set or complement, the complement of a set A is denoted as ¬A and defined as:

$$f_A[x] = 1 - f_{\neg A}[x] \tag{7}$$

- Containment, if A is contained in B its membership function $f_A[x]$ is smaller than B $f_B[x]$ for any x:

$$\forall x \in X: A \subset B \rightarrow f_A[x] \leq f_B[x] \tag{8}$$

This property has great relevance for urban sustainability analysis because it imposes an important condition to the Sustainability Degree of a city; it is equal or lower than the Sustainability Degree of the environment that contains it.

- Union, the union of two fuzzy sets A and B with respective membership functions $f_A[x]$ y $f_B[x]$ is a fuzzy set C, which membership function is $f_C[x]$

$$C = A \cup B \rightarrow \forall x \in X: f_C[x] = max\big[f_A[x] \cap f_B[x]\big] \tag{9}$$

- Intersection, the intersection of two fuzzy sets A and B with respective membership functions $f_A[x]$ y $f_B[x]$ is a fuzzy set C which membership function is $f_C[x]$:

$$C = A \cap B \rightarrow \forall x \in X: f_c[x] = min\big[f_A[x] \cap f_B[x]\big] \tag{10}$$

To summarize, above formulas allow us to relate membership functions to Sustainability and Unsustainability classes as:

$$f_S[I] + f_{\neg S}[I] = 1 \tag{11}$$

Therefore, the *Sustainability Degree* and the *Unsustainability Degree* of a city are linked by the equation:

$$S_T[I] = 1 - \neg S_T[I] \tag{12}$$

Above equation means that any *lack of complete Sustainability necessarily implies some unsustainability degree*, and $S_T[I] = 0,5$ becomes a *limiting* value that separates the cities that are more *sustainable* than *unsustainable* ($S_T[I] > 0,5$) from the cities that are more *unsustainable* than *sustainable* ($S_T[I] < 0,5$).

$$S_T[I] > 0,5 \leftrightarrow S_T[I] > \neg S_T[I] \tag{13}$$

$$S_T[I] < 0,5 \leftrightarrow S_T[I] < \neg S_T[I] \tag{14}$$

After reviewing these basic properties of fuzzy sets, we review below a useful tool for working with fuzzy membership functions: their graphic representation.

3.2 GRAPHIC REPRESENTATION OF MEMBERSHIP FUNCTIONS

Graphic representation of membership functions is always advisable since it provides a lot of information that is not always easily noticeable in the mathematical formulations. Additionally, it allows us to understand some important issues: the first is that if we consider a membership function on a continuous variable i that defines the grade of membership of an element x to a class A, graphical representation allows us to see the existence of two especially relevant values or points:

- A value i_1 so that if $I \leq i_1$ then x membership to class A is zero (and therefore, its membership to class ¬A is complete)

$$\exists i_1: i \leq i_1 \leftrightarrow f_A[x] = 0 \wedge f_{\neg A}[x] = 1 \tag{15}$$

- A value i_2 so that if $I \geq i_2$ then x membership to class A is complete (and therefore, its membership to class ¬A is zero)

$$\exists i_2: i \geq i_2 \leftrightarrow f_A[x] = 1 \wedge f_{\neg A}[x] = 0 \tag{16}$$

Both values are fundamental for the design of an urban sustainability indicator in relation to some variable information i of a city I. *We designate* $\boldsymbol{i_1}$ *as its unsustainability limit or threshold, and* i_2 *as its sustainability limit or goal.*

$$\boldsymbol{f_A[x] = max\left[min\left[\frac{i - i_1}{i_2 - i_1}, 1\right], 0\right]}$$

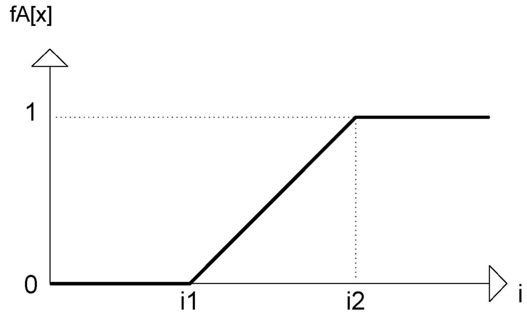


Fig.3 Linear fuzzy membership function, i_1 is the value of i for which x membership to A becomes 0 and i_2 is the value of i for which x membership to A becomes complete

The necessary existence of these limits allows us to define a *relevant variable for urban sustainability* as a variable for which at least one unsustainability limit and one sustainability limit exist [they may be or may not be known]. As consequence, the sustainability limits of a variable are the delimiting values for the range of the variable i that produces fuzzy membership of I to S; i.e., the extreme values of the range which imply either complete membership of the city to S or to ¬S classes.

The second interesting issue of graphical representation is that it allows synthesizing the membership to a set and to its complement in one graphic:

$$\boldsymbol{f_A[x] = max\left[min\left[\frac{i - i_1}{i_2 - i_1}, 1\right], 0\right]}$$

$$\boldsymbol{f_{\neg A}[x] = 1 - f_A[x]}$$

$$\boldsymbol{f_{\neg A}[x] = max\left[min\left[1 - \frac{i - i_1}{i_2 - i_1}, 1\right], 0\right]}$$

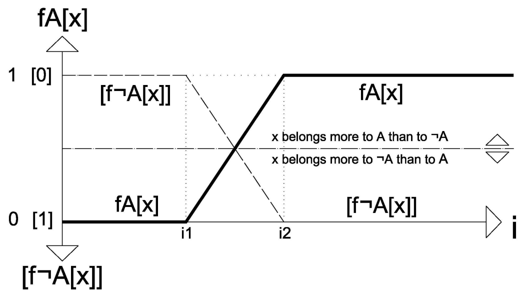


Fig.4 Membership function of an element x to A and ¬*A* sets. There is a horizontal symmetry at f_A[x]= 0.5, which separates the values of i for which x belongs more to A of the values of i for which x belongs more to ¬*A*

And this property implies that membership to S and ¬S can be represented in the same graphic, but even if we represent only one of them (it is usually more interesting representing membership to S) then membership to the complement (i.e., membership to ¬S) is easily obtained.

4 DESIGNING SUSTAINABILITY INDICATORS: SUSTAINABILITY DEGREE OF A CITY IN RELATION TO THE VARIABLES THAT DESCRIBE IT

We have conceptualized the sustainability degree of a city I as its grade of membership to class S, but it is necessary to state that it depends on many different variables and relationships between variables and usually we are not able to calculate it with only one formulation. Thus, we approach the modelization progressively. We analyze the concept *Sustainable* to detect the concepts or qualities S_i that we expect in a sustainable city (i.e., that we expect to be *true* when referred to a *sustainable city)* and we review the information that defines the truth value[6] of these concepts or *propositions* when referred to the city.

For instance; we usually state that a sustainable city must have *high employment levels*; *accessible public transport service*; *adequate provision of green areas*, etc... And indicators measure the degree of truth of those propositions referred to the city (i.e., the degree of truth of the statements 'city I has *high* employment levels'; 'city I has accessible transport',...); which can be modeled as *membership functions* to those different classes implied by said propositions (to the class of the cities with high employment levels, to the class of the cities with accessible public transport service…).

Urban sustainability indicators are equivalent to membership functions of the city to the different classes S_i *contained* in class S for each possible range of different relevant variables i, and its maximum and minimum values have the following meanings:

- $S[I_i] = 0$ means *null membership* to S_i (and complete membership to $\neg S_i$); the city does not have at all a quality expected in a *Sustainable City*;
- $S[I_i] = 1$ means *complete membership* to S_i (and null membership to $\neg S_i$); the quality expected in a *Sustainable City* is completely present in the city.

Therefore, the unsustainability/sustainability *limits* of the relevant variables for each class S_i are the values i_1 and i_2 at which null or complete membership to classes S_i and $\neg S_i$ are reached. Both values are especially relevant for indicators formulation, which we review below.

4.1 SUSTAINABILITY AND UNSUSTAINABILITY LIMITS

A variable i is relevant for the sustainability of a system I if and only if different values of the variable can imply a variation on both city sustainability and unsustainability, being the sustainability and unsustainability limits, those values of the variable for which the city reaches its maximum possible membership to classes S and $\neg S$[7].

These limits may or may not be known, but in general, the formalization of indicators can only be done if we are able to establish (even if approximately) their value.

In their more *simple* form, the limits are two parameters that divide in three different zones the impact on the *Grade of membership* of a city I to any class S_i implied in S, for the range of possible values of i:

- the first is value of i for which I reaches null membership to S_i which we designate as *Unsustainability limit or threshold;*
- the second is value of i for which I reaches complete membership to S_i which we have designated as *Sustainability limit or goal*.

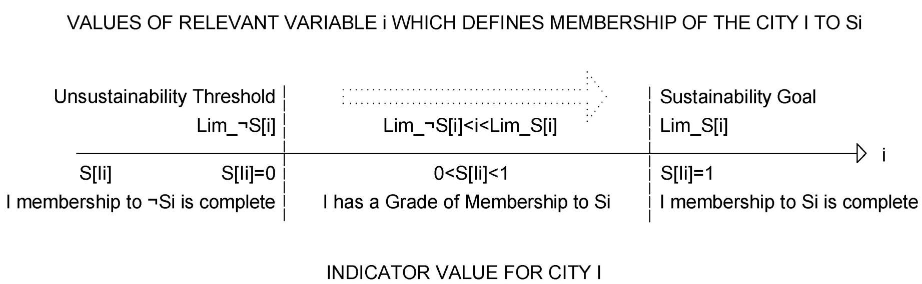


Fig.5 Relation between i values, thresholds and sustainability degree

[6] The concept of Truth Value (Fuzzy Logic) is equivalent to the concept of Grade of Membership (Fuzzy Sets Theory).

[7] The majority of relevant variables do not imply complete membership of the city to classes S and ¬S, but their complete membership to classes Si and ¬Si. Therefore the worst value of the variable does not indicate complete membership to ¬S, but the maximum membership to ¬S such variable can imply. Also, the optimal value of the variable does not imply complete membership to S but the maximum membership to S said variable can imply.

Additionally, there are some important issues that need to be highlighted regarding the limits:

- they can be *exact* values but also *ranges of values* or even *dynamic values*[8]: the *state* of the system may modify the value of the limits and any *change* in the system–environment (including evolutionary processes) may change the limits;
- containment property implies that sustainability degree of any city is always equal or lower than that of its environment; which may impose *additional limits;*
- for some variables urban sustainability may imply *more than two limits;*
- *different contexts* may imply *different limits.*

4.2 FORMULATION OF SUSTAINABILITY INDICATORS FOR DIFFERENT TYPES OF VARIABLES

We have thus arrived to a conceptualization of a sustainability indicator as a membership function of a city I to a subclass S_i (partly) contained in class S regarding the possible values of some relevant variable information 'i'. And 'i' sustainability/unsustainability limits are fundamental for indicator formulation. Though there are many different possible formulations (linear, quadratic, logarithmic ...), in most cases, a linear function can sufficiently accurately model membership[9]. These linear functions can be formalized building on a four limits (two sustainability and two unsustainability limits) formulation:

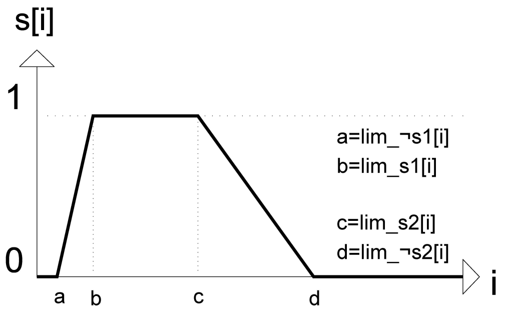
Indicator Formalization

$$\boldsymbol{s[i] = max\left[min\left[\frac{i-a}{b-a};1;\frac{d-i}{d-c}\right],0\right]}$$

Thus:

$$\boldsymbol{S[I_i] = max\left[min\left[\frac{i-\underset{\neg s1}{lim}[I_i]}{\underset{s1}{lim}[I_i]-\underset{\neg s1}{lim}[I_i]};1;\frac{\underset{\neg s2}{lim}[I_i]-i}{\underset{\neg s2}{lim}[I_i]-\underset{s2}{lim}[I_i]}\right];0\right]}$$

Graphic Representation



Source: own elaboration using the following codes:

1) $S[I_i]$ _ Value of the sustainability indicator I_i for a system I
2) i_ value of the relevant variable (it can be an aggregation of variables)
3) $Lim_{\neg s1}[Ii]$_unsustainability threshold 1 for the system I related to variable i.
4) $Lim_{\neg s2}[Ii]$_ unsustainability threshold 2 for the system I related to variable i.
5) $Lim_{s1}[Ii]$_ sustainability limit or goal 1 for the system I related to variable i.
6) $Lim_{s2}[Ii]$_ sustainability limit or goal 2 for the system I related to variable i.

Tab.1 Membership Function and Graphic Representation of a four limits variable i

Starting from above function, many different types of indicators can be built; using two or three limits; substituting some or all linear functions by non- linear functions (Alvira, 2017a, 2017b, 2018). Since our aim in this article is to explain how this approach can be used to easily design sustainability indicators, instead of an extensive review of possible functions, we focus in reviewing formulation of two indicators using herein explained methodology.

4.3 EXAMPLES OF INDICATORS DESIGNED USING THE PROPOSED APPROACH

To better understand the proposed methodology, below two indicators are explained whose formulation implies different level of difficulty:

8 For an explanation related to the limits of global ecosystem 'Earth' refer to Steffen et al. (2015) who suggest that if certain variables of a system get close to their unsustainability thresholds, the sustainable range of values for other relevant variables changes.

9 In my opinion, unless an appreciable accuracy increase is achieved, it is not convenient to use more complicated functions, since it may hinder the comprehension of indicators and as consequence their shared use.

- firstly, we review the formalization of an indicator to assess the *optimality of the Green Areas Provision of a city*. It is an easy formulation to assess an issue about which there is little controversy at present;
- Secondly, we review the formalization of an indicator to assess the degree to which *Population Density* places an urban area between its optimal and worst possible states. It is necessary to use a somewhat more complex formulation (it requires four limits), and it is also necessary to estimate two unsustainability thresholds since we find scarce or no proposals.

Let us review these indicators[10].

Indicator to assess the sustainability of green areas provision [GA]

Sources and related indicators:

- Hernández Aja et al., 1997;
- AEUB, 2010. Indicator 25. Green Areas Provision per inhabitant;
- JSBC, 2011. Indicator 2.1.2. Adequate provision of parks and open spaces;
- MFOM, 2012. Indicators EVB.05.23 & EVB.05.26. Green Areas provision (New Developments & Existing Urban Areas);
- Alvira, 2017a. Indicator Q3.1. Green Areas Provision and Functionality.

Indicator description, sustainability limits and calculation.

It is a relatively easy to formulate indicator, for an issue on which there is enough agreement among experts: *what is the per capita surface of green areas that approaches a city to its optimal state.* There is wide agreement on the importance of urban green areas to define the quality of life of the population and urban sustainability[11], which is sustained on several perspectives:

- their use as a leisure, walking and sports space (AEUB, 2010; MFOM, 2012);
- their nature of 'social relation' space accessible to the entire population, which makes them spaces that promote social cohesion (Hernandez Aja et al., 1997; Higueras, 2009);
- they can be designed as 'green infrastructure', providing increased climate change adaptation (Beauchamp & Adamowski, 2013; Salata & Yiannakou, 2016; TCPA/The Wildlife Trusts, 2012; Zucaro & Morosini, 2018);
- they have psychological benefits by enabling people's contact with nature (Prescott-Allen, 2001).

There is also high agreement that the optimal provision of green areas is between 10 and 15 sq.m per resident/inhabitant, finding more or less compatible proposals from different authors:

- Hernández Aja et al. (1997) proposes different provision ratios for different types of urban fabric and green areas. At the overall city level the author proposes: proximity Parks [several types and surfaces] = 8 sq.m/inhabitant; city Scale Parks [Urban Parks]: 5 sq.m/inhabitant; city total provision: 13 sq.m/inhabitant.
- JSBC (2011) proposes an *acceptable* value of Green Areas provision of 7 sq.m/inhabitant and an optimal value of 13 sq.m/inhabitant;
- WHO (quoted by several authors) suggests between 10 y 15 sq.m/inhabitant;
- AEUB (2010) proposes a 10 sq.m/inhabitant minimum and a desirable goal of 15 sq.m/inhabitant;
- MFOM (2012) proposes between 10 and 12 sq.m/inhabitant of Green Areas for both new urban developments and as overall city wide provision. However, for urban areas within existing cities the authors suggest a 15 sq.m/inhabitant optimum provision.

[10] Noteworthy, the indicators we review below are proposed for neighborhood type areas in developed countries cities. Other contexts could require different designs.

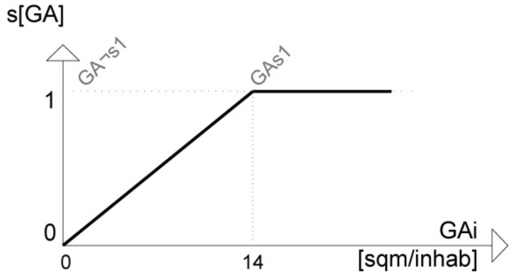
[11] "Green spaces are considered by the World Health Organization [WHO] 'essential' spaces for the benefits they bring in the physical and emotional well-being of people and for helping to mitigate the urban deterioration of the city, making it more livable and healthy' (AEUB, 2010)

We observe high similarity in the proposals, with a 13-15 sq.m/inhabitant range as optimum value (slightly lower values are only proposed in central areas of the city where clogging prevents reaching higher values), being possible to adopt for the indicator the middle value of said range: 14 sq.m/inhabitant.
Therefore, the two sustainability/unsustainability limits for the indicator are:

- sustainability goal GA_{s1}: 14 sq.m/inhabitant;
- unsustainability threshold GA_{is1}: 0 sq.m/inhabitant.

The graph and formula of the sustainability function are:

Graphic Representation	Indicator Formalization



$$s[GA] = \max\left[\min\left[\frac{GA_i - GA_{\neg s1}}{GA_{s1} - GA_{\neg s1}}; 1\right]; 0\right]$$

Being:
GA_ Green Areas provision Indicator;
GA_i_ Green Areas provision in the assessed Area
GA_{s1}_ Sustainability goal in Green Areas
$GA_{\neg s1}$_Unsustainability threshold in Green Areas provision.

Tab. 2 Indicator for measuring the sustainability of Green Areas Provision

Since the unsustainability limit $GA_{\neg s1}$ is 0 sq.m/inhabitant; the sustainability limit GA_{s1} is 14 sq.m/inhabitant, and the relevant variable GA_i (Green Area sq.m per inhabitant) cannot have a lower value than 0, it is possible to simplify above function as:

$$s[GA] = \min\left[\frac{GA_i}{14}; 1\right] \tag{1}$$

This function is similar to many of the usual indicator formulations, which allows us to understand why it is sometimes possible to *intuitively* confront indicators design achieving coherent results[12].

<u>Further comments</u>

It is worth highlighting that as important as assessing the per capita surface of Green Areas are some issues which have not been included in the indicator to avoid complicating the explanation:
The first issue is *Green Areas quality/functionality* (WHO, 2016) which covers aspects such as: the percentage of landscaped area and type of landscaping, equipment, lighting, perceived and real safety, acceptable noise levels (especially in small surface GA). Some proposals to model it are:

- AEUB (2010), which proposes criteria differentiating two scales: neighborhood spaces: it suffices that 50% of the surface is permeable; urban parks: it is necessary to assess their Functionality, which is linked to a series of aspects that require individual modeling, and subsequent joint assessment[13];
- WHO (2016) suggests using the *Normalised Difference Vegetation Index* [NDVI], which it describes as 'an indicator of the degree to which an area is *green*'.

The second issue is *Green Areas accessibility*. In order to assess it several authors have proposed greater distances are acceptable the lower the expected frequency of use, setting thus different optimal distances according to green areas dimension/nature. For example, MFOM (2012) proposes the following maximum

[12] However, later we review another more difficult indicator which cannot be *intuitively* designed, supporting the interest of herein proposed methodology.
[13] AEUB (2010), Indicator 28. Index of functionality of Urban Parks [Surface > 1Ha]. Although the goal of the indicator is assessing biodiversity, evaluated aspects are closely related to the design quality of the green areas. Positive aspects in the valuation of the parks are: Tree coverage in percentage; Shrub Coverage in percentage; Lawn coverage in percentage; Water coverage in percentage; Number of large trees; Number of trees of average size; Number of trees of small size; Diversity of tree and shrub species. Negative aspects in the valuation of the parks are: Artificial Surface in percentage and Distance to natural habitats.

distances from green areas to expected users: green areas up to 500 sq.m maximum distance 200 m; green areas up to 5,000 sq.m maximum distance 750 m; green areas up to 1 Ha maximum distance 2 km; green areas up to 10 Ha maximum distance 4 km. And the third issue is that the overall layout of green areas throughout the city should use their high capability for *climate change adaptation*. Green areas distribution should not only take into account human accessibility and biodiversity connection, but also maximizing heat island mitigation, flooding prevention and optimizing water management (Galderisi, 2014; Zucaro & Morosini, 2018)[14].

<u>Indicator to assess the sustainability of population density</u>

Source and related indicators:

- Jacobs, 1961;
- AEUB, 2010. Indicador 01. Population Density;
- MFOM, 2012. Existing fabrics. Indicator 01. Population Density;
- Alvira, 2017a. Indicador Q1.1. Population Density;
- USGBC, 2018. Compact Development.

<u>Indicator description, sustainability limits and calculation</u>

It is a somewhat more complicated indicator to formulate. Experts agree cities are unsustainable when their population density is very low, but also that they are unsustainable when their population density is very high. Thus, there is an intermediate range of density values which are the optimal/most sustainable states of urban areas (Fariña Tojo & Naredo, 2010; Güneralp et al., 2017; MFOM, 2012; Jacobs, 1961).

The characterization of such states requires using a formulation that incorporates four sustainability limits (two sustainability and two unsustainability limits). However, we find few proposals regarding which population density values most approach cities to their worst possible states, so deeper review is necessary in order to establish these values. For clarity, we first review which limits have been proposed as optimal population density situations. Most consistent proposals have been made by two authors: Jacobs (1961) reviewed the density parameters of several *high vitality and diversity neighborhoods* in US cities, finding they located in an average range of 90 and 185 housing/ha[15], usually considered as *high values*. If we assume an average occupation of 2.5 persons/housing, we obtain an optimum density range between 225 and 463 inhab / Ha[16]. From her study, Jacobs suggested that excessively low or high densities are negative for cities and their inhabitants, i.e., that *there is an optimum range of densities to achieve attractive environments, with vitality and diversity. Agencia de Ecologýa Urbana de Barcelona* (AEUB, 2010), broadened the previous approach, by relating the range of optimal densities to complementary issues:

- *very low densities* imply a dispersed city model that requires consuming a lot of resources[17] and makes contact and shared use of the city difficult (public facilities, public transport,...);

[14] While the resilience/sustainability of the city could be further increased by incorporating urban orchards into Green Areas (Bianconi et al., 2018), this should be assessed using other indicators which assess membership to other classes such as biocapacity use or social relation spaces provision.

[15] Average values of the lower and upper limits for New York, Boston, Philadelphia and San Francisco neighborhoods that Jacobs (1961) considers as having *high vitality and diversity*. Building on her review, Jacobs stated that the prevailing paradigm in the USA that linked high urban quality to urban sprawl was wrong.

[16] Jacobs (1961) suggested a minimum value of 100 housing/acre (approx. 250 housing/Ha) of net density, but she indicated that a density value may had different meanings in different environments. Thus, she suggested that the central areas of the cities that have been conformed over time, have greater age of buildings and a greater variety of typologies and uses, admit higher densities than residential areas built in reduced time intervals, which present great homogeneity. In this last case, high density may imply conflicts and uprooting.

[17] Moore (2011) finds direct relationship between density and urban metabolism; an increase in density of 40 people/sq.km implies a reduction of approximately 0.06 hag in the per capita ecological footprint of the urban area.

- *very high densities* imply excessive congestion, and can lead to indirect consumption increase[18] in the form of greater demand for travel or second residence (MMA, 2007).

AEUB (2010) suggested an optimal density range of 220-350 inhab/Ha. Subsequently, the authors somewhat extended the optimum density range to 200-400 inhab/Ha (MFOM, 2012)[19].

There is some similarity among the three ranges of values, the range 220-350 inhab/Ha (AEUB, 2010) standing as acceptable *sustainability limits* for a varied range of urban environments.

On the contrary, we have not found proposals to establish *unsustainability thresholds*, so a review from several approaches is undertaken below: the first approach is based on the comparison of the two optimal ranges proposed by AEUB (AEUB, 2010; MFOM, 2012). Assuming the range 220-350 inhab/Ha (AEUB, 2010) as *optimal range*, and values 200 and 400 inhab/Ha (MFOM, 2012) as *excellent values*, the later values should imply equal variation in the indicator value. Assuming then the minimum possible value (i.e, zero) as unsustainability threshold $DP_{\neg s1}$, then $DP_{\neg s2}$ can be calculated by means of proportionality rules:

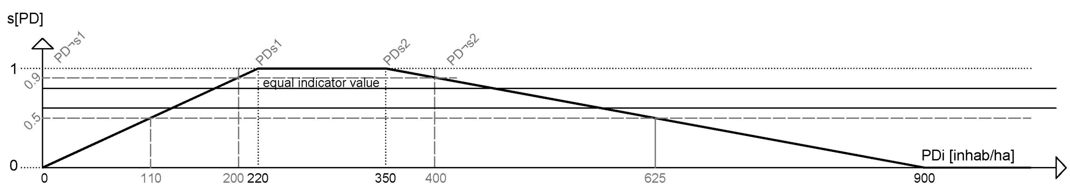


Fig.6 Unsustainability thresholds estimated by proportionality rules

Assuming 0 inhab/Ha as unsustainability threshold $DP_{\neg s1}$ and a linear function then 200 inhab/Ha provide value 0.9 for the indicator. Assigning the same indicator value to 400 inhab/Ha, 900 inhab/Ha value is obtained as unsustainability threshold $DP_{\neg s2}$.

The second approach is building on the concept of *ecological carrying capacity*. A reduced population density implies greater soil consumption to sustain the same population, reducing the area of bio-productive territory available to sustain said population. In Alvira (2017a) the available territory for urbanization in Spain is measured according to Ecological Footprint criteria, obtaining a maximum of 0.0715 hag-eq (447 sq.m) per capita assuming the current population is equally distributed and the available territory is used at 100% for residential use. This figure implies 22.4 inhab/Ha density. Applying maximum unsustainability criteria stated in said text, complete unsustainability is achieved if each inhabitant uses 1.7 times the maximum globally per capita available surface, i.e., when a person needs 0.128 hag-eq (800 sq.m) of urban territory equivalent to 12.5 inhab/Ha density. Since not all urban territory is residential, the previous figure is rounded up to $DP_{\neg s1}=15$ inhab/Ha. From said value $DP_{\neg s2}$ can be calculated by proportionality obtaining $DP_{\neg s2} = 862.5$ inhab/Ha.

The third is reviewing the values proposed in different regulations:

- the maximum value of population density that we have found in Spanish legislation is in Canary Islands (CAC, 2017) where a maximum of 400 inhab/Ha gross density in residential areas is accepted, reaching a maximum of 500 inhab/Ha in urban centers rehabilitation;

[18] The graph that relates energy consumption to housing density is U-shaped. Consumption in environments with low housing density is very high (caused mainly by transportation and single-family housing), and decreases as density increases, then it stabilizes, yet from certain higher density values it increases again as people tend to make more trips for leisure and further away. This has been called 'substitution hypothesis'; when urban areas become excessively dense, their inhabitants experience a 'lack of space' that they seek to replace by undertaking more trips away from 'congestion' or having second homes in the countryside (SEI/TUB, 2010).

[19] In Spain, most dense cities are Barcelona and Bilbao (198 and 196 inhab/Ha) (OSE, 2008). In Madrid most dense neighborhoods have net population and houses densities around 700 inhab/Ha and 350 housing/ha [420 inhab/Ha and 220 housing/Ha gross density]. Therefore, the densities range proposed by AEUB stands as *reasonable*.

- in international legislation, we have found the maximum value of population density in the City of Buenos Aires, with a maximum limit of 1,000 inhab/Ha[20]

The fourth approach is based on compliance with free space standards. Hernández Aja et al. (1997) proposes 10 sq.m road + 10 sq.m green area per inhabitant for central areas. If we establish a minimum road and green zone per inhabitant area of 5 sq.m/inhab as a high dense situation, we achieve 1,000 inhab/Ha as unsustainability threshold. The fifth is from the *streets section*.

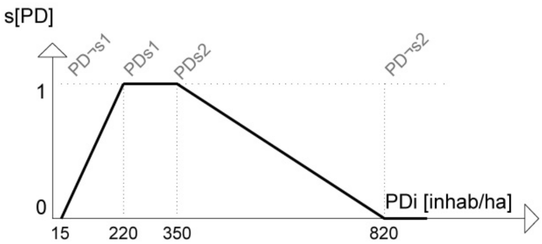
If the maximum ratio building/street section is 3:1 [H:W], then for a 100 x 100 m grid with 20m wide streets we obtain 6,400 sq.m plots [80 x 80 m]. Assuming 60 m height buildings [20 floors] and 18 m built depth, we obtain 25,560 sq.m built per plot. Considering 100 sq.m/housing would result 255 houses * 2.5 hab/viv implying 639 inhab/Ha.

We see different criteria lead us to quite different figures of upper density limit, and the absence of a criterion that makes an assessment/perspective more important than the others makes us propose an *unsustainability threshold of 820 inhab/ha, approximately the average of the values obtained through the different approaches.*

Therefore, we establish the following sustainability / unsustainability limits for the Population Density indicator, PD:

- unsustainability limits. We adopt values proposed by AEUB (2010): PD_{s1} = 220 inhab/Ha and PD_{s2} = 350 inhab/Ha;
- unsustainability thresholds. We use above explained values: $PD_{\neg s1}$ = 15 inhab/Ha and $PD_{\neg s2}$ = 820 inhab/Ha.

The graph and formula of the sustainability function are:

Graphic Representation	Indicator Formalization
	$s[PD] = \max\left[\min\left[\frac{\mathrm{PD_i} - PD_{\neg s1}}{\mathrm{PD}_{s1} - DP_{\neg s1}}; 1; 1 - \frac{PD_i - PD_{s2}}{PD_{\neg s2} - DP_{s2}}\right]; 0\right]$ Alternatively: $s[PD] = max\left[min\left[\frac{PD_i - 15}{220 - 15}; 1; 1 - \frac{PD_i - 350}{820 - 350}\right]; 0\right]$

Tab.3 Indicator for measuring the sustainability of Population Density

Therefore, to calculate the indicator, we first calculate the Population Density of the area using the formula:

$$PD_i = \frac{\mathrm{N}}{\mathrm{S}} \tag{2}$$

Being: PD_i Population Density [in persons/ha]; N_ Number of inhabitants and S_ Total gross surface of the urban area [Ha]

From above Population Density value PD_i we calculate the indicator as:

$$s[PD] = max\left[min\left[\frac{PD_i - 15}{205}; 1; 1 - \frac{PD_i - 350}{470}\right]; 0\right] \tag{3}$$

Futher comments.

The proposed indicator seeks to assess the sustainability of urban population density in neighborhood type areas (i.e., from 16-25 to 50 Ha surface) in a developed-country city model, with a 20m or more street width network. Noteworthy, there are issues that may require reducing above suggested limits in some cases:

[20] Código de Ordenamiento del territorio del Partido de General Pueyrredón, Buenos Aires. Art. 4.1.4.a. Maximum Net Population Density admissible values.

- the relation between maximum population and available residential area, which leads us to place the optimum population density in 2-3 hab/100 built sqm ratios, with a maximum threshold in a density somewhat lower than 4 inhab/100 built sq.m[21];
- the relation between optimal population density and streets width, which means that admissible/optimal densities are lower in urban networks with narrow streets[22];
- the existing relation between residential density and spatial segregation by income (Alvira, 2017a; Leal et al., 2012). Optimal densities explained above usually imply high spatial integration of different income residents, provided other related issues are adequate (green zones provision; street network functionality; urban scenery; housing area ratio per capita ...);
- the relation between optimal density values and the dimension of reviewed area means that suggested values should be lowered when assessing whole cities, neighborhoods of small towns or villages[23].

In addition, optimal population density values should be compatible with the morphological differentiation of cities areas, which requires admitting a sufficiently wide optimal density range excluding unsustainable morphologies.

Thus, herein proposed indicator assigns an acceptable sustainability value to a variety of urban morphologies, but urban morphologies implying lower than 110 inhab/Ha[24] or higher than 625 inhab/Ha population densities achieve lower than 0.5 indicator values. These densities stand as the thresholds from which population density starts to be more unsustainable than sustainable. Also, the increasing need for adaptation to climate change suggests herein proposed unsustainability thresholds could have to further approach the sustainable range (i.e., increasing $PD_{\neg s1}$ and decreasing $PD_{\neg s2}$).

The high energy and land consumption (increase in CO_2 emissions and reduction of agricultural land and biodiversity] coupled to low density values[25] as well as the overcrowding and high energy consumption (heat island effect, congestion, increase in air conditioning use…) coupled to excessively dense urban areas, may be increasingly unsustainable as the clime effectively changes, reducing thus the sustainability range.

Lastly, it is most likely that in many developed countries a large part of their territory whose urbanization is sustainable has already been urbanized[26], so territory for urban use stands as an increasingly scarce resource worldwide. This highlights the need to complete *population density* assessment with measures preventing urban land underutilization; more specifically, regulations that limit the construction of second residences and vacation homes. Besides, urban developments or cities densification should be planned and designed to

[21] Madrid City central area shows negative correlation [-0.57] between housing density and housing built area per capita (own calculation based on Madrid City Council and Cadaster data), which means an increase in the population density usually implies a reduction in per capita housing surface. Thus, when high densities are detected, it is necessary to monitor the per capita housing area. Nevertheless, it is worth highlighting overcrowding in cities is not as much linked to high population density as to homes overcrowding. To detect it Jacobs (1961) proposed assessing the number of people per room. JSBC (2011) assesses the ratio of housing area per inhabitant, suggesting a lousy situation if less than 28 sq.m/inhab and optimal if equal or greater than 40.5 sq.m/inhab [cities] or 47 sq.m/inhab (villages). It is interesting that Gómez-Piovano and Mesa (2017) find that the average per capita housing area in Mendoza Metropolitan Area is approx. 50 sqm/inhab but in lower income areas it reduces to 10 sq.m/inhab.

[22] Gómez-Piovano and Mesa (2017) calculate different recommended maximum densities to achieve good sunlight of the city in the Metropolitan Area of Mendoza (Argentina), which they relate to streets width. The authors suggest a range from 80 inhab/Ha for 10m wide streets to 395 inhab/Ha for streets wider than 19 m.

[23] Higueras (2009) suggests 100 housing/Ha as maximum admissible value to prevent congestion (between 250 and 300 inhab/Ha). OMAU (2012) suggests a minimum/desirable level of 120 inhab/Ha for a group of Mediterranean cities, stating that the optimum density value depends on the context.

[24] An area of semi-detached housing with 45 housing/ha, provides a population density of 112 inhab/ha for an average occupation of 2.5 persons/viv. Calthorpe Associates (2011) calculate water and energy consumption according to type of housing (detached houses big size; detached houses small size; townhouses and collective dwelling), obtaining that the consumption of an isolated detached house is between two and three times higher than that of a collective dwelling. According to own calculations (Alvira, 2017a) only row houses/townhouses and collective dwellings are below current thresholds for sustainable energy and water consumption.

[25] Güneralp et al. (2017), find urban density has similar (sometimes higher) impact for reducing energy consumption in cities than buildings energy efficiency. Energy savings are both linked to lower consumption in collective than isolate housing and to smaller housing surface, requiring lower energy for heating or cooling.

[26] This hypothesis has been tested in Spain, where at least 80% of sustainable urban territory according to Ecological Foot standards is already built up (Alvira, 2017a).

maximize resilience and adaptation to climate change (e.g., densification of current urban areas near the sea and close to sea level should be avoided) (Dodman, 2009).

5 CONCLUSIONS

The present article explains an easy methodology for formulating sustainability indicators within the framework of fuzzy logic/fuzzy sets theory. Building on this framework provides us several advantages compared to the usual *intuitive design* of indicators; both in the indicators formulation / design phase as well as in their subsequent testing[27]. Specifically, herein proposed methodology:

- it allows conceptualizing urban *sustainability assessment indexes* as functions that define the grade of membership of each city or urban area to Sustainability class [S] linking it to its non-membership to Unsustainability class [¬S];
- it allows conceptualizing *urban sustainability indicators* as functions that define the grade of membership of each urban area to each of the S_i subclasses implicit in class S; i.e., subclasses to which the city must have some membership to be able to have some membership to S[28];
- it provides a criterion to select which are the *relevant variables* that should be assessed in each indicator, those that can modify the membership of the city to subclass S_i, which is measured the indicator;
- it provides a criterion to define the *sustainability and unsustainability limits* for the relevant variables, as well as for the mathematical modeling of each indicator.

It is important to insist that the above four issues are criteria for both indicators formulation as well as for their testing and possible refutation or confirmation:

- *sustainability assessment indexes* should meet above condition; if a model does not properly -and simultaneously- characterize membership of the city to S and ¬S classes, then it is not a sustainability index (though it may be assessing another quality or urban phenomenon);
- *sustainability indicators* should satisfy above definition: if an indicator is not an adequate membership function to some class S_i necessary for sustainability, then it is not a sustainability indicator;
- the *relevant variables for each indicator* should satisfy above definition; if the relevant variables (it might be an aggregated variable) do not adequately characterize the city membership to class S_i assessed by the indicator, then they are not the relevant variables (or there are other relevant variables that also need to be valued);
- the *sustainability limits for the relevant variables* must delimit the range of values beyond which variations of the value of the variable do not modify the sustainability of the system and the membership function must adequately model the transition between said values.

Therefore, herein proposed methodology allows us to simplify and clarify -but also to systematize- the design of urban sustainability indicators. It facilitates communication to the rest of the scientific community of the premises on which each indicator is built. And it allows empirical test (both by the person who formulates the proposal and by other scientists).

These are three fundamental issues to optimize research in Sustainability and a requisite to effectively confront the urgent need to reduce the extremely high unsustainability of our cities and societies. Additionally, it is necessary to emphasize that urban sustainability should be assessed in an integrated manner so it can be

[27] For example of indicators testing, see Alvira (2017a & b).

[28] Conceptualizing Sustainability and Unsustainability as complementary classes S and ¬S also makes it easier to detect which are the qualities (subclasses S_i) that maximize the membership of a city to class S (both in terms of the city's probability of enduring and the degree to which its state is optimal) in terms of opposites. If it is possible to determine the qualities that make a city unsustainable (i.e., which imply its membership to ¬S), then it is possible to determine the issues that make it sustainable, which are the opposite. This facilitates detecting some relevant issues for sustainability which are difficult to detect as membership to class S, yet easy to detect in terms of membership to class ¬S. For details of the procedure to design a complete assessment model as well as criteria to check the completeness of the models, refer to Alvira (2014).

used as objective criteria for decision making regarding possible urban transformations. Furthermore, the urgency of reducing our cities unsustainability requires incorporating sustainability as the key decision making criterion when designing their transformations, which constitute their long term evolution. A rational society should be deemed as that which seeks to maximize its sustainability in all its decision making processes[29].

This implies that besides designing sustainability indicators, it is necessary to define their organization in models that should incorporate different levels linked to indicators structure of aggregation, and to define procedures so they can be used in most important decision making processes in our cities, which not only involve new urban projects, but also the modification of current legislation[30].

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[29] Needless to say, in an interconnected world, sustainability of different cities and societies is interconnected. Maximizing one's sustainability often requires maximizing the sustainability of other cities/societies. In order to achieve it global agreements are required, an issue which largely exceeds the present proposal. For an approach on how a global agreement could be designed see Alvira (2017a).

[30] In order to do so, the author proposed in 2014 a general axiomatic framework that provides a guideline for the design of models to quantitatively assess sustainability. In terms of operational models (i.e., models which can be used for decision making), the author has proposed a complete model which enables using sustainability maximization as a decision criterion in most urban transformations (Alvira, 2017a). For an application of this model to draft a Rooftop Code for a neighborhood of Madrid city (Alvira, 2016).

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IMAGE SOURCES

Fig. Cover: Monica Vilhelm & Ricardo Alvira.

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Ricardo Alvira Baeza is an architect and Urban Designer. From 2000 to 2010 he has worked in several major architectural firms, focusing on medium-large projects including: design and construction of a residential neighborhood; skyscrapers and retail centers; a university campus [this last project was designed seeking compliance with BREEAM and LEED ND sustainability criteria]. After 2010, he has focused on research, achieving a DEA in Urban Design and Planning [Polytechnic University of Madrid], with a study comparing the two major sustainability certification systems at the moment: LEED ND and BREEAM for Communities. His PhD Thesis in Architecture and Urban Planning [Polytechnic University of Cartagena], is a complete mathematical model for measuring cities sustainability [Meta_S] including a procedure so it can be used in most urban transformations [both urban projects and legislation drafting, …].

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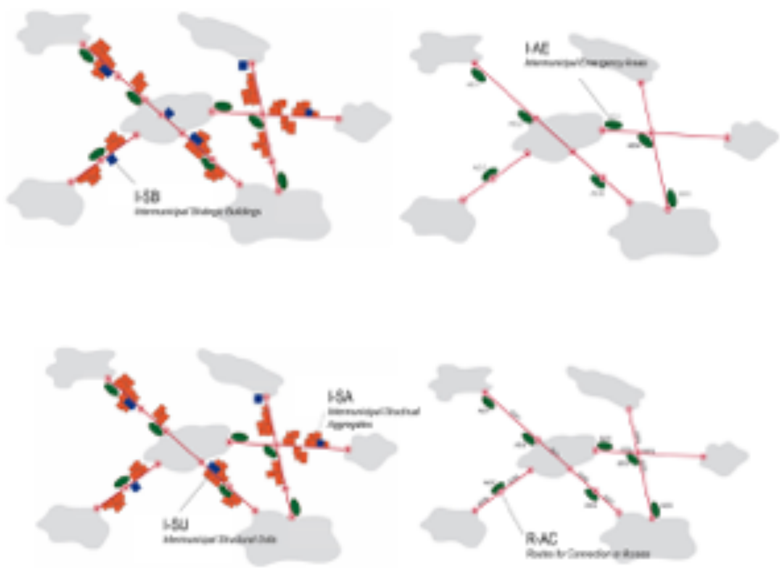

LIMIT CONDITION FOR THE INTERMUNICIPAL EMERGENCY

ABSTRACT

The traditional urban planning issues, related to the design and city shape, today are faced with those derived from safety and risk. The Emergency Plan (EP) is the result of study about risk for each context, and it allows to identify potential emergency scenarios. The paper illustrates model of analysis of Intermunicipal Emergency Plan (I-EP) through Limit Condition for the Intermunicipal Emergency I-LCE), with the purpose of large-scale assessment and mitigation of the seismic risk. This is an approach that extends the methodological principles of Limit Condition for the Emergency (LCE) to the territory, we consider that the EP, in the same way as urban planning, is not a planning activity that can be concentrated only on urban area but must work on the "territory system", especially for the effect control of natural phenomena such as seismic risk. This not only threatens a significant innovation for the LCE but also for its relationship whit the urban planning its design strategies aimed at reducing territorial fragilities. The proposed methodology is applied in the area of Sele, in the district of Salerno (Southern Italy), territory characterized by high levels of seismic and hydrogeological vulnerability. Through this case study we had the opportunity to discuss the potential of I-LCE and its additional recommended updates to increase its effectiveness and efficiency, in addition the necessary innovations of urban and territorial planning systems.

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KEYWORDS:
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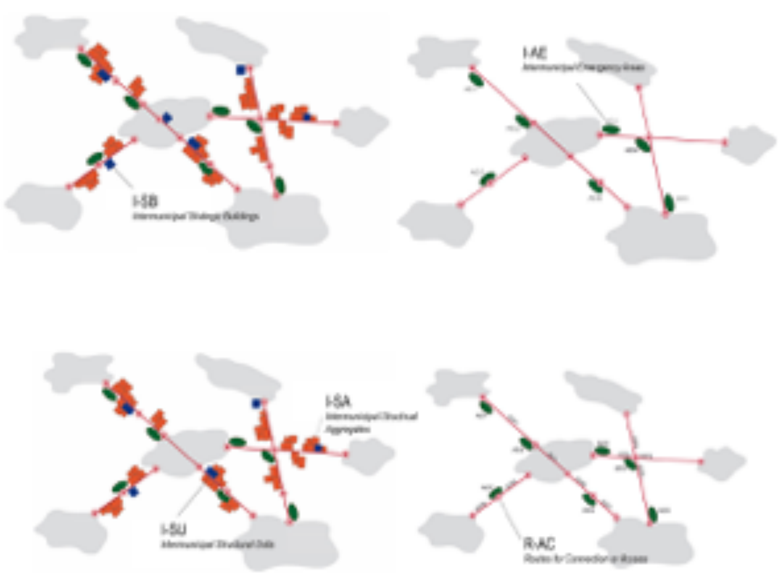

城际突发事件的极限条件

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摘要

涉及到城市的设计和形态的传统城市规划问题，今天面临着由安全和风险衍生出来的问题。应急方案(EP)是对每一种情况下的风险进行研究的结果，能够确定潜在性的突发事件。本文通过城际应急方案(I-LCE)的极限条件，阐明了城际应急方案(I-EP)的分析模型，旨在大规模的评估与降低地震危险。这是将“突然情况的极限条件”(LCE)的方法原则扩展至地域/区域的一种方法。我们认为，EP与城市规划一样，并不只是一项集中于城市地区的规划活动，而是必须作用于“地域/区域系统”上的规划活动，特别是针对地震风险等自然现象方面的效果控制。这不仅威胁到LCE的重大创新，而且还威胁到它与城市规划、旨在减少领土脆弱性的设计战略之间的关系。所提议的方法适用于地震频发和水文地质脆弱的Salerno省(意大利南部)的Sele区域。通过该案例的研究，我们有机会就I-LCE的潜在性及其附加的建议更新及探讨城市和地区规划系统的必要创新进行探讨，以提高其有效性和效率。

关键词:
安全、适应力、城市规划、地域规划、风险管理规划、预防与地域复原项目

1 INTRODUCTION

The main theme of the research is the reduction of seismic risk for resilience territories. These risks include not only natural disasters but also all the likely crises in the city (Molavi, 2018). The International Strategy for Disaster Reduction of the United Nations defines resilience as the capacity of a system, community or society potentially exposed to hazards to adapt to a new scenario by resisting or changing, in order to reach and maintain an acceptable level of functioning and structure (UNISDR, 2015). Resilience is determined by a social system capable of organizing itself to increase its capacity of learning from past disasters for its future protection, as well as to improve risk reduction measures (Cara et al., 2018). Every city can express a certain level of resilience, and the identification of its most influent elements is strategic in order to detect intervention criteria aimed to its improvement (Burton et al., 2016). More recent studies focused on the possibility to carry out seismic vulnerability assessments quickly and with limited costs, in order to extend the application to entire urban systems (Formisano et al., 2011). In this last context the Limit Condition for the Emergency (LCE) is placed. The research presented stems from an agreement of the ICEAA Department of the University of L'Aquila with the Department of Public Works, Government of the Territory and Environmental Policies of the Abruzzo Region. In particular, the agreement concerns studies on LCE and I-LCE, on Seismic Microzonation (MZS), Levels 1 and 3 and on the reduction of seismic vulnerability of strategic buildings. In particular, for the analysis relating to LCE, the research has proposed an innovation considering it necessary to experiment, at a territorial level, a new methodology for the reduction of the seismic risk components and implementation of the effectiveness and efficiency of Intermunicipal Emergency Plan (I-EP). The result of this research, which is described in this article, have then become guidelines of the Abruzzo Region: "Condizione Limite per l'Emergenza, Linee di indirizzo regionale di analisi ed elaborazione della condizione limite per l'emergenza intercomunale" (Regione Abruzzo, 2017). In these guidelines the definition of I-LCE: «Instruments designed to:

- to integrate the project interventions on the territory for the seismic risk mitigation;
- to verify the emergency management systems of the I-EP (buildings, roads, emergency areas, etc.);
- to evaluate and verify strategic choices of EP of the individual municipalities».

It should be pointed out that the analysis of I-LCE does not replace the I-EP, but aims at its own updating, or of its elaboration, with the objective to guarantee the operation of the urban and extra-urban system in the event of emergency. The purpose of the research is to extend the concept of CLE, moving from the local level to the territorial level, to analyze performance levels of territorial system, to understand the potential levels of resilience whereas the response to natural disasters must be provided by a complex system of territories and not isolated urban areas. The research proposes an I-LCE can be considered, as well as an assessment tool, a tool to support the redesign of the spatial form and then of those fragmented structures of settlements typical of the modern era/period, especially from the post-industrial era.

Using I-LCE as a project tool means to identify new rules for the spatial organization /reorganization of the territory fabric and, in case of catastrophic events, to be able to ensure the safe exodus to emergency areas and stacking, to ensure access to first aid equipment and facilities (hospitals, first aid, gathering areas, etc.) and to the strategic buildings included in the EP but also spatial planning tools. The primary objective of the EP is explicitly stated to be the reduction of the expected human losses, rather than economic losses, so that the action is especially addressed to high hazard and high-risk areas (Dolce, 2012). Instead the I-LCE can be considered as a design tool, and as such can intervene on prevention by acquiring the characteristics of a pre-disaster planning that interacts with the traditional urban planning.

The research considers two levels of analysis: local and territorial. At local level, LCE can analyze: geological and morphological analysis of sites; relationships between handworks and urban systems (hierarchical level and percentage covered by the standard); amount of users and their daily or periodic movements; vulnerability (physical) component manufactured about classification and identification of building aggregates; amount of negative interactions between elements (building aggregates) and urban morphology; interactions of the various components and systems with basic and local hazard, hydrogeological and hydraulic hazard, status of underground storage; land use decisions on local strategic location of buildings. At Territorial level, I - LCE can analyze: distribution of the various functions in the municipality systems (performance Level); hierarchy of functional systems (networks and buildings); resource flows (people and goods); vulnerability assessment and explanation of the built system with respect to natural hazards (floods, earthquakes, etc.), land use decisions on location of territorial strategic buildings (D'Ascanio et al., 2016). Through the experimentation with the case study (area of Alto and Medio Sele) the limits of the model and the points to be perfected have been tested. Also the integration of all studies and analyzes related to the seismic risk mitigation (MZS, LCE, I-LCE, I.OPà.CLE) will be able to define a working model in such a way that the retrofit of the territories can be performed based on vulnerability, local risk and Emergency planning needs (Dolce, 2012).

2 LIMIT CONDITION FOR THE EMERGENCY (LCE) AND THE METHOD I.OPÀ.CLE

The analysis of the Limit Condition for the Emergency (LCE) of urban settlement, defined in detail by the law article 18 of the OCDC 171/2014 as «[...] that condition of urban settlement to which, following the occurrence of the seismic event, overcoming, in spite of the occurrence of physical and functional damage such as to lead to the interruption of almost all the existing urban functions, including residency, the urban settlement still retains, as a whole, the operation of most of the strategic functions for emergencies, their accessibility and connection with the territorial context». They are many legislative directives that have introduced LCE, among which we remember:

- the Legislative Decree of 28 April 2009, No. 39 (so called "Abruzzo Decree" - urgent interventions on behalf of the populations affected by earthquakes in the Abruzzo Region and further urgent interventions of Civil Protection), converted, with amendments, by the Law of 24.06.2009, No. 77;
- Ordinance President of the Council of Ministers (OPCM) No. 3907/2010 which, according to the art. 11 of the D.lgs. 39/2009 launched a multi-year seismic risk program for the period 2010-2016;
- OPCM No. 4007/2012 which introduced the analysis of Limit Condition for the Emergency (LCE) for the year 2011 in order to improve the management of emergency activities;
- order of the Head of the Civil Protection Department (OCDPC) No. 52/2013 that defines the financing modalities for the realization and/or completion of the studies of Seismic Microzonation (MZS) and of the Analysis of the Limit Condition for the Emergency (LCE) in municipalities that are part of a union and associations of municipalities, for the year 2012;
- OPDPC No. 171/2014 defines the financing modalities for the realization and/or completion of the studies of MZS and the analysis of LCE in municipalities that are part of a union and/or associations of municipalities, for the year 2013 (art. 21). Moreover, it introduces the faculty to the Regions and Autonomous Provinces to identify one or more union of municipalities on which to start a program aimed at guaranteeing the minimum conditions for management of the emergency system to obtain homogeneous results in MZS studies and analysis of LCE according to specific procedures and financing (art. 22);
- OCDPC No. 293/2015 defines the financing modalities for the realization and/or completion of the studies of MZS and the analysis of LCE in municipalities that are part of a union and/or associations of municipalities, for the year 2014 (art. 21), and reiterates the provisions of art. 22 of the OPDPC 171/2014;
- OCDPC No. 344/2016 defines the financing modalities for the realization and/or completion of studies on MZS and the analysis of LCE in municipalities that are part of a union and/or associations of municipalities, for the year 2015 (art. 21).

The operating methodology has been defined within the regional seismic risk mitigation program (Legislative Decree 28 April 2009, No. 38, Article 11). It is important to underline the importance of supporting LCE analysis to studies on MZS to integrate all those actions aimed at the mitigation of seismic risk, to improve management of emergency activities in the phase that follows immediately the earthquake (Di Lodovico & Di Ludovico, 2015). The graph shown in Fig. 1 describes what happens in an urban settlement following a seismic event before reaching the LCE (shown in the graph with the green point), or up to suffer physical and functional damages such as to cause:

- interruption of the residential function;
- interruption of most ordinary and strategic urban functions.

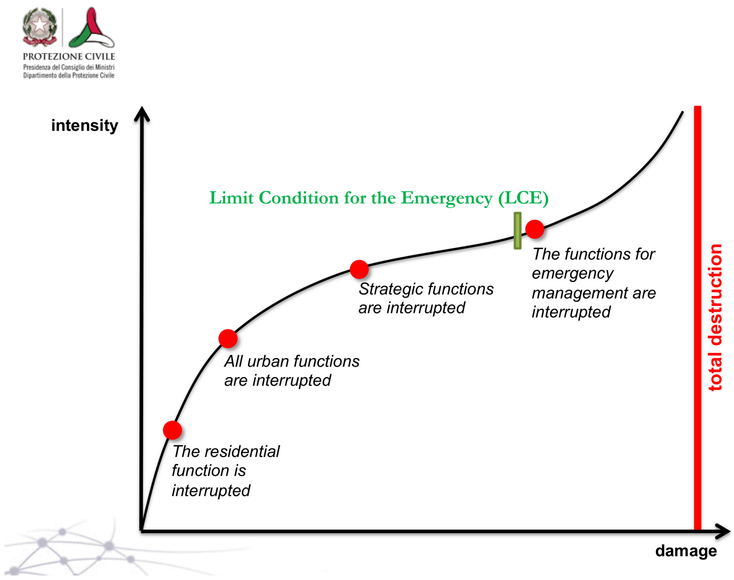

Fig. 1 What happens in an urban settlement following a seismic event before reaching the LCE

The LCE analysis involves:

- the identification of buildings and areas that guarantee strategic functions for emergencies;
- the identification of accessibility and connection infrastructures with territorial context, buildings and areas referred to in a. point and any critical elements;
- the identification of structural aggregates and single structural units that can interfere with the accessibility and connection infrastructures with territorial context (Castenetto, 2013).

The LCE analysis is performed using the forms prepared by the Technical Commission referred to in Article 5 paragraphs 7 and 8 of the OPCM 3907/2010 and issued with a special decree by the Head of the Civil Protection Department (CTMS, 2014a, 2014b). The analysis allows to identify on a basic cartography, all the minimum information necessary to evaluate the urban response to an earthquake. To this end, data archiving standards have been set up, collected in a specific form (5 types of cards) and represented on digital cartography (in shapefile format). The five relevant cards concern: Strategic Buildings, Emergency Areas, accessibility/connection infrastructures, Structural Aggregates, and Structural Units. Once computerized through the SoftCLE (a software drawn up by Civil Protection Department), the cards catalog allows to realize a first level of knowledge (level 1) on urban system quality. The next step is the analysis through GIS tools on the functionality / operation of the Municipal and / or intercommunal EP with respect to the services required to urban system during the emergency phase (CTMS, 2014a, 2017b). In fact, through the LCE analysis we can integrate interventions on territory for seismic risk mitigation. The aims of this analysis are to verify emergency management systems, conceived as a set of physical elements (strategic buildings, emergency areas, structural aggregates and structural units interfering with the connection and accessibility infrastructures), already identified in the EP, and to verify the strategic choices of the EP. It should be noted that analysis of LCE does not replace EP, especially in the identification of sites and strategic management structures of emergencies. It rather aims at its updating / adaptation. Starting from the ELC definition, in the literature, we find other more general analysis approaches based on performance for the probabilistic assessment of damage, seismic evaluation and resilience of urban systems with reference to different levels of performance (Burton et al., 2016; Lagomarsino & Cattari, 2015). There are two models studied and compared to enrich the I-LCE model: I.OPà.CLE (Operational efficiency indices for Emergency Limit Condition – LCE) and the simplified LCE model proposed by the study group of Cara et al. (the Antiga Esquerra de l'Eixample neighborhood of Barcelona), both models for the assessment and mitigation of the seismic risk (Cara et al., 2018).

Since 2013 the Italian Civil Protection Department has developed and further upgraded the method I.OPà.CLE for the assessment of operational efficiency of an EP described through LCE tools (Dolce et al., 2017a, 2017b). This is a method proposal that has remained only in the field of study, and is interesting because it deals, in a complex manner, with the topic of the evaluation of the EP. The method is based on the formulation of synthetic probabilistic indexes that measure the operational capacity in the aftermath of the seismic event, for each physical component, and its sub-elements of the emergency system. The indices are formulated for two seismic events with different return periods (T = 98 years and T = 475 years) as well as in absence of any earthquake occurrence (conventionally associated to return period T = 0). Coherently with LCE analysis, the method is specifically conceived for assessments at municipal scales. Limitedly to the level of accuracy of input data provided by LCE analysis, the final purposes of I.OPà.CLE are to outline the potential criticalities which might inhibit the management of a real seismic emergency, so as to enable the decision maker to undertake specific measures for fixing critical elements and hence upgrading the plan (Dolce et al., 2017a, 2017b). In addition to the operational indices, the method makes it possible to calculate the probability of maintaining the functioning of the physical emergency system described through the analysis of LCE. Flexibility of analysis and modularity of results (Global Indexes - Subsystem - Element) allows information to be provided in more detail, so as to be able to easily identify specific critical issues that require priority actions, thus supporting the decision-making process (Dolce et al., 2017a, 2017b). As with the I.OPà.CLE model, a system is being structured in the research, with probabilistic indices, which allows to evaluate the performances of the I-EP functionally to safeguard life.

The case study of Antiga Esquerra de l'Eixample neighborhood of Barcelona is a simplified model to investigate the influence of the collapse of interfering buildings on the operability of strategic urban roadways, as well as the possible actions that may lead to improve their functionality after the occurrence of an earthquake. The first stage of the proposed methodology consists in the identification of interfering buildings whose damage or collapse, may affect the functionality of vital connections during the post-seism emergency (Cara et al., 2018). The damage grade of the chosen buildings is evaluated after having determined the vulnerability indexes by using the GDNT method, distinguishing masonry buildings and reinforced concrete buildings. This model mainly studies the operativity of the interfering buildings of the LCE an appropriate mechanical model whose definition allows the assessment of the reliability of the urban system crossed by the strategic road. However, it is a model that mainly analyzes the vulnerability of individual buildings without taking into account the needs and hazard present in the area examined. The same research team provides for the improvement of the survey strategies on the existing building heritage and extending it to urban infrastructures, water supply systems, pipelines, communication networks, etc. Ultimately, the improved GIS database created for Antiga Esquerra de l'Eixample can be a starting point for optimized risk mitigation measures and civil protection planning. However, it is a model whose results are extremely important for public safety or civil protection agencies to assess the impact of possible intervention strategies, as well as to optimize the management of seismic emergencies (Cara et al., 2018).

3 FROM LCE TO I-LCE: A NECESSARY CHANGE FOR A RESILIENT TERRITORY

Following an earthquake of a given intensity, urban vulnerability depends both on how individual building components are damaged, and on functional performance that these buildings provide (commercial, services, production, energy, mobility, etc.). Vulnerability of an urban system thus measures the non-linear correlation between intensity of seismic event and extent of damage to the urban system itself, caused by exposure characteristics of its individual elements (Fabietti, 2013). The LCE allows the rapid assessment of urban vulnerability of specific strategic buildings, connecting areas and infrastructures and interfering buildings in urban area. However, analysis is a complex process because it involves different contexts from a spatial, geological-technical and functional point of view. It is therefore a multidisciplinary study that involves different technical and administrative, each with specific roles and competences, in order to optimize the activity and improve final quality of proposals for improvement / integration of EP (Fig. 2).

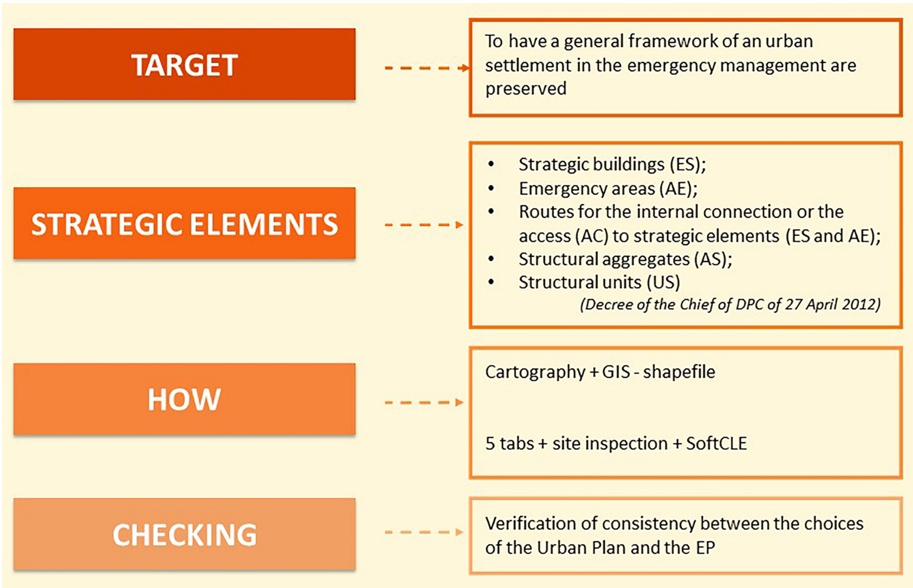

Fig. 2 The Limit Condition for the Emergency

The EP is the operational tool for the management of emergencies and for the mitigation of territorial risks. The main objective of the EP is to define the organizational model of emergency procedures, monitoring activities, risk prevention actions and assistance to the population.

The Plan is structured in three parts:

- collection of all information related to the knowledge of the territory with the identification of risks;
- planning of operations to be carried out during the pre-emergency, emergency and post-emergency phases;
- definition of the intervention model, with identification of responsibilities for the management of emergencies at the various levels.

The EP should be a dynamic and constantly updated document that should be updated and disseminated among the citizens, especially with simulations that allow you to test the contents of the plan, verify the organizational and management capacity envisaged. Because of this static and for other factors the EP and the LCE have limits:

- EP, in Italy, is static plan, sometimes not known by mayors, technicians and citizens; some Regions, such as Abruzzo, have promulgated guidelines for updating the common plans with the aim of making them become dynamic instruments;
- LCE provides analysis model that analyzes only the effects of a seismic event on the city (while the EP takes more risks into account);
- LCE does not provide for a systematic and dynamic knowledge of urban phenomena and structure;
- does not exist a platform that allows the comparison of urban planning processes, geographical information, territorial risks information and the structure of the EP;

- there is no urban analysis of the overall response to a disastrous event of a territory, which cannot be ascertained by the sole verification of the EP through the LCE.

The research also poses that of reading again and integrating experiences of pre-disaster planning (UNISDR, 2012) and mitigation planning (FEMA, 2013) to overcome these critical issues and to propose a new model of I-EP fully integrated with ordinary urban and territorial planning, connection that is possible through the construction of a digital platform for the construction and management of knowledge. The purpose is to obtain a territorial organization of the emergency able to safeguard and secure the building, infrastructural and natural heritage, which provides for the training of citizens to obtain resilient communities and territories.

Based on these concepts, and on the national laws, the I-EP has been prepared and integrated, and it has been elaborated the I-LCE. The I-EP is the reference operational support for the management of emergency situations and for the mitigation of the risk in the territory (National Law No. 100 of 12 July 2012). The I-EP is drawn up by an association of municipalities belonging to the same territorial area. It is the unitary tool of coordinated response of the local civil protection system to any type of crisis or emergency situation, making use of the knowledge and resources available on the territory. They must take into account and integrate the EP, all emergency operational plans of bodies, technical structures, public service operators and be completed with detailed technical procedures necessary for activation. It becomes a tool for the management of broad area issues, those topics, such as emergency management, risk prevention and mitigation, which need both an overview, which goes beyond or are only known the administrative boundaries of the single municipality, both of a certain autonomy, a sort of third party, with respect to local pressures and interests.

The I- LCE was conceived as a bivalent tool that allows both to assess the territorial seismic vulnerability, and to be a support element for the design / update of the I-EP. The I-LCE allows, in fact, to identify the critical issues of the plan and to reorganize the same at a spatial level in order to ensure both the safe exodus to emergency areas, and access to first aid equipment (hospitals, ready assistance, collection areas, etc.) and strategic buildings (Fig. 3). Particularly the synthesis of the information deduced by the I-LCE can be used:

to evaluate the conditions of danger and seismic vulnerability of an intermunicipal territory;

- to evaluate the effectiveness of I-EP;
- to plan further investigations and analyzes for strategic buildings and aggregates and/or structural units interfering with accessibility infrastructures;
- to establish possible methods of intervention in urban areas to guarantee accessibility to strategic buildings and / or accumulation areas and guarantee territorial accessibility;
- to ensure a coherent and comprehensive general emergency system between the municipalities of the Intercommunal Operation Center (IOC) of reference;
- to address spatial planning and land use towards safety-related modes.

A system conceived as such can to supported by a dynamic and continuous knowledge of urban contexts and of the phenomena that generate risks, assessed through a few effective indicators of functionality and operation, managed through a digital platform. This platform must be connected to mobile networks designed to maintain service even after disasters. In Abruzzo, through the extension of this research, we are proceeding to the creation of a regional knowledge platform that will be used for the preparation of the Regional Plan of Civil Protection (Article 11, Law No. 77/2009). Spatial planning is a fundamental tool: only by thinking about the evolution of an area as a whole, without fragmentation, one can well govern its development and its security.

3.1 METHODOLOGY

The methodology behind I-LCE derives from the forms prepared by the Technical Commission (Article 5, paragraphs 7 and 8, O.P.C.M. 3907/2010) for the analysis of LCE (CTMS, 2014a), revised and expanded to be able to identify strengths and weaknesses of the EP. The whole model is described in the regional Guidelines for the analysis and processing of I-LCE drew up by the DICEAA in collaboration with the Abruzzo Region (Regione Abbruzzo, 2017). The I-LCE facilitates integration between the Local EP and I-EP in a logic of multi-scalar risk, is also related to the co-planning that requires an integration of risk planning and disasters with other levels of risk. In general, the I-LCE model provides:

- analysis buildings and areas aimed at strategic management of emergency for a union of municipalities (strategic buildings and emergency areas);
- analysis infrastructures between the municipalities and the territorial context, buildings and areas referred to in point a) and any critical elements;
- analysis structural aggregates and individual structural units located in extra-urban areas that can interfere with infrastructures of territorial connection and emergency areas (art.18, O.P.C.M. 4007/2012);
- analysis strategic choices of I-PE;
- setting up of territorial knowledge frameworks to identify the elements of fragility through a shared platform;
- analysis of the vulnerability of natural, territorial and urban systems through synthetic indicators of performance.

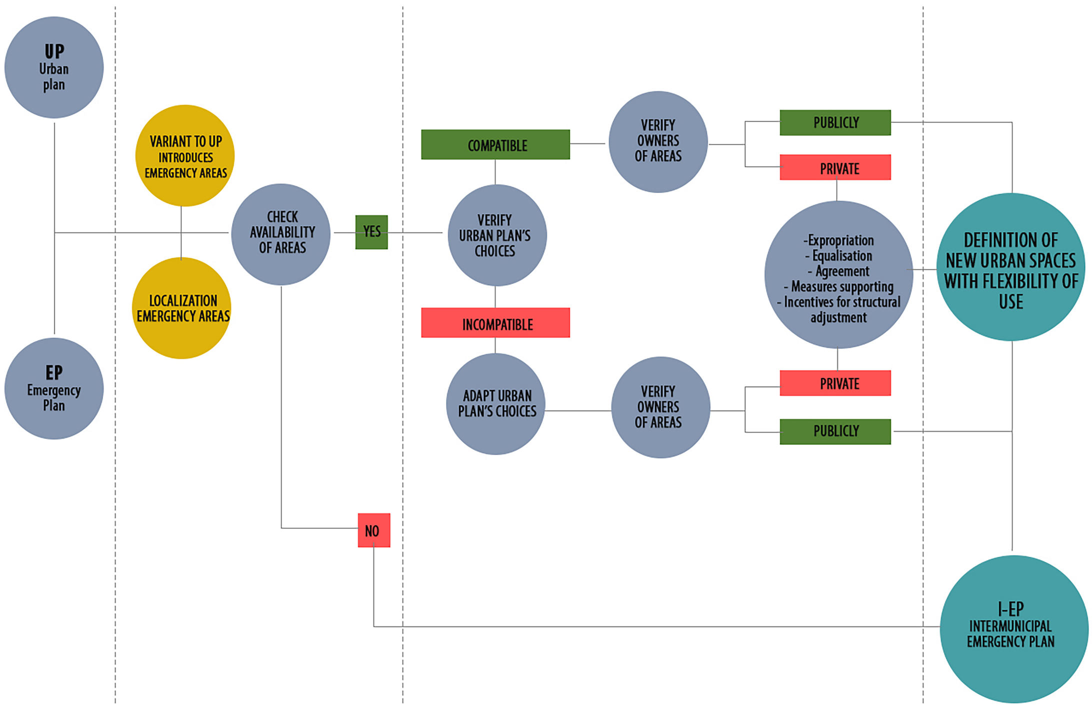

Fig. 3 Relationship between I-LCE, I-EP and urban plan

The final result of analysis makes it possible:

- to express a judgment on the functionality/operation of the I-EP respect to performances required to extra-urban system during the emergency phase, through performance evaluations of the individual elements;
- verify that the choices of the I-EP are compatible with spatial planning and urban planning;
- to identify an accurate image of the territorial risks and therefore of the critical areas through the know of a database to be put into a system with a regional / state platform, such as "Carta dei Luoghi e dei Paessaggi - CLeP" of the Abruzzo Region (Di Lodovico & Di Ludovico, 2014);
- to direct and to improve the strategic choices of the EP and the I-EP deriving from the latter.

- but, in innovative terms compared to the LCE, establish planning guidelines for the modification of spatial planning and land use. In this sense, the research intends the I-LCE also as a design tool and not just an evaluation tool.

To build a decidedly adequate digital platform when it comes to dynamic phenomena, such as risks, which change over time even abruptly, we need to consider many endogenous and exogenous factors. This platform can be addressed to the co-planning, to the verification of the knowledge system, to the dissemination and education of citizens on the Regional Management Risk Plan and the Local Mitigation Planning and finally to the governance of civil protection operations and to the verification of the risk management capacity. An example of a platform, which is being implemented in another line of research, is Hub Risk Data of the Abruzzo Region, elaborated starting from the geographical knowledge bases of the regional Geoportal. By a system whit EP/I-EP, LCE/I-LCE and a Platform of knowledge (of hazards, vulnerabilities and exposures, but even environmental and landscape components) we can:

- build multiple risk scenarios (multi-risk concept), to be used as a basis for territorial prevention and recovery projects in more fragile areas;
- addressing the strategic choices of emergency and ordinary planning;
- evaluate the performance and criticality of the local and regional emergency systems (which must relate to each other);
- work through a co-planning system;
- mitigate and prevent the effects of territorial risks;
- guarantee access to information for all.

These are issues that are only partly dealt with by the emergency planning and the LCE, and which are absolutely necessary to make the critical issues emerging from these instruments effective. Our proposal tries to follow this path towards integration (Di Lodovico & Di Ludovico, 2014).

4 CASE STUDY: THE AREA OF ALTO AND MEDIO SELE

The study area taken into consideration is that of Alto and Medio Sele, in the district of Salerno (Campania, Italy), and we considered in particular the municipalities of Buccino, San Gregorio Magno, Palomonte, Ricigliano and Romagnano al Monte (Fig. 4).

It is a homogeneous territorial area from the geomorphological, cultural and socio-economic point of view, essential prerequisite for implementing integrated planning. The study area is bounded to the north by the Monti Eremita-Marzano, Nature Reserve, and to the south by the mountain range of the Alburni Mountains, washed south by the river Platano – Bianco, tributaries of the river Tanagro, the main left tributary of the river Sele.

Over the centuries, the study area has faced multiple emergency situations:

- it was the epicentre of the earthquake that struck Irpinia in 1980 which caused extensive damage to people and property;
- it was affected by periodic phenomena of hydrogeological instability, including the most recent one dating back to 2011, when the territory to the north was invaded by muddy debris flows, damaging building and agricultural heritage.

Although the municipalities have provided emergency plans, the latter are already inadequate for initial analysis and identified resources. Five cognitive frameworks have been developed for the area: environmental, infrastructural, urban plans, risks.

That allows to identify the intrinsic and extrinsic characteristics of the territory, to analyze its vulnerabilities and exposure as well as to verify the system of management of emergencies in force in the individual municipalities. From this first phase of analysis it has emerged that on the territory of the study area there are many risk factors (through exposure, vulnerability and hazard analysis), a lack of functionality of the current emergency management system.

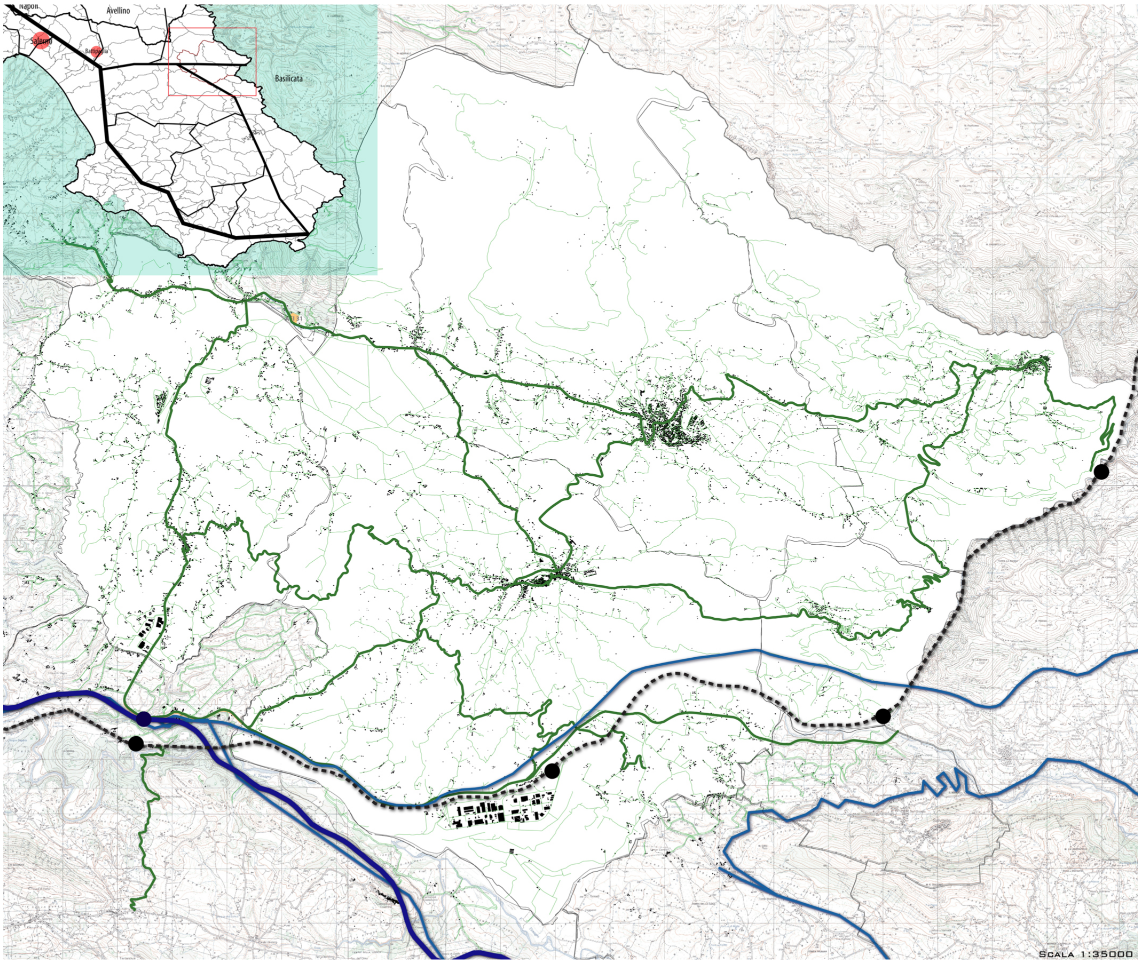

Fig. 4 Case study: the area of Alto and Medio Sele

The construction of the hazard map was very useful, the identification of all areas with different levels of hazard determined by natural and environmental factors. Particularly it was found that in the study area there are a total of 19,184 people, of which 3% are under 5 years of age and 11% are over 75 years old, about 2,795 residents move daily outside the municipalities for work and study. The inflows of people entering are 1,333 units. The territory is characterized by a medium-high seismic risk.

In addition, about 80% fall into areas at risk of landslides, while the hydraulic risk affects only the part south bounded by river effluents. The emergency management system limited to the municipal area (EP analysis) is undersized: all five municipalities have insufficient space and resources.

In particular, all the Emergency Areas identified by the Civil Protection Plans of the individual municipalities, in addition to not covering the needs required for the number of resident populations, fall into areas subject to danger, for which no mitigation action is planned (Tab. 1). It is evident that in the selection of emergency areas the criteria outlined by the Civil Protection guidelines have not been respected (Tab. 2).

Municipality	Max Users [US1]	Min Users [US2]	EP Waiting Areas [sqm]	Max Area [Standard, 2.5 sqm/US1]	Min area [Standard, 2,5 sqm/US2]	Max Deficit [sqm]	Min Deficit [sqm]
Buccino	7,224	5,474	8,691.39	18,060.00	13,685.00	-9,368.61	-4,993.61
San Gregorio Magno	5,892	4,939	10,001.00	14,730.00	12,347.50	-4,729.00	-2,346.50
Palomonte	5,450	4,339	4,273.00	13,625.00	10,847.50	-9,352.00	-6,574.50

Ricigliano	1,479	1,260	2,430.00	3,697.50	3,150.00	-1,267.50	-720.00
Romagnano al Monte	472	377	1,769.00	1,180.00	942.50	589.00	826.50
TOTAL	20,517	16,389	27,164.39	51,292.50	40,972.50	-24,128.11	-13,808.11

Tab. 1 Analysis table of the critical issues of Waiting Areas of Emergency Plan

Municipality	Max Users [US1]	Min Users [US2]	EP Meeting and Shelter Areas [sq.m]	Max Area [Standard, 17.50 sq.m/US1]	Min Area [Standard, 17.50 sq.m/US2]	Max Deficit [sq.m]	Min Deficit [sq.m]
Buccino	7,224	5,474	7,665.00	126,420.00	95,795.00	-118,755.00	-88,130.00
San Gregorio Magno	5,892	4,939	30,791.25	103,110.00	86,432.50	-72,318.75	-55,641.25
Palomonte	5,450	4,339	6,546.00	95,375.00	75,932.50	-88,829.00	-69,386.50
Ricigliano	1,479	1,260	6,135.00	25,882.00	22,050.00	-19,747.50	-15,915.00
Romagnano al Monte	472	377	1,686.00	8,260.00	6,597.50	-6,574.00	-4,911.50
TOTAL	20,517	16,389	52,823.25	359,047.00	286,807.50	-306,224.25	233,984.25

Tab. 2 Analysis table of the critical issues of Meeting and Shelter areas of Emergency Plan

Furthermore, in some urban areas, no emergency areas have been identified at all. There are many factors of exposure, vulnerability and risk and poor functionality of the current emergency management system, the results of the analysis suggest the need, for the municipalities under study, to have an I-EP based on the coordination of actions and procedures, on the sharing of spaces and resources.

Municipality	Max Users [US1]	Min Users [US2]	EP - Waiting Areas [sqm]
Buccino	7,224	5,474	101,366.00
San Gregorio Magno	5,892	4,939	120,020.00
Palomonte	5,450	4,339	83,468.00
Ricigliano	1,479	1,260	32,186.00
Romagnano al Monte	472	377	22,295.00
TOTAL	20,517	16,389	359,335.00

Tab.3 Project recovery areas for I-EP of Intermunicipal Emergency Plan

The aim of the project will be to define a new planning, territorial and emergency methodology that integrates safety with the theme of urban development (Tab. 3). These results were used to prepare I-EP of the area: a plan that allows coordination of actions and procedures to be implemented in an emergency phase that also includes sharing of spaces and resources. First of all, accessibility of the area was studied, identifying the main infrastructures for accessibility to the territory, determining in the GIS environment the travel time from the railway stations and the toll booths.

It is more than two hundred I-LCE tabs to were compiled to analyze:

- I - SB: Inter-municipal Strategic Buildings, essential for the emergency management (such IOC, hospitals, operational centers, etc) on a territorial scale, one of these buildings may become the headquarters of the DICOMAC[1];
- I- AE: Intercommunal Emergency Areas, such a meeting and shelter areas, as well as deposit areas where national Civil Protection can settle (National Mobile Column of Civil Protection);

[1] DICOMAC is a National Coordination Center of Civil Protection Operational Components and Structures activated in the territory affected by the event, if deemed necessary, by the Department of Civil Protection in case of national emergency.

- RAC: Routes for Access or Connection to strategic elements (I-ES, local Strategic buildings, Intercommunal and local Emergency Areas), analyzing primarily the functionality of the route, potential instability, structural aggregates potentially interfering with the route in case of structural collapse.
- I-AS: Intermunicipal structural aggregates, along paths whose collapse can interrupt their functionality or interfere with Emergency Areas (including SE);
- I-SU: Intermunicipal Structural Units.

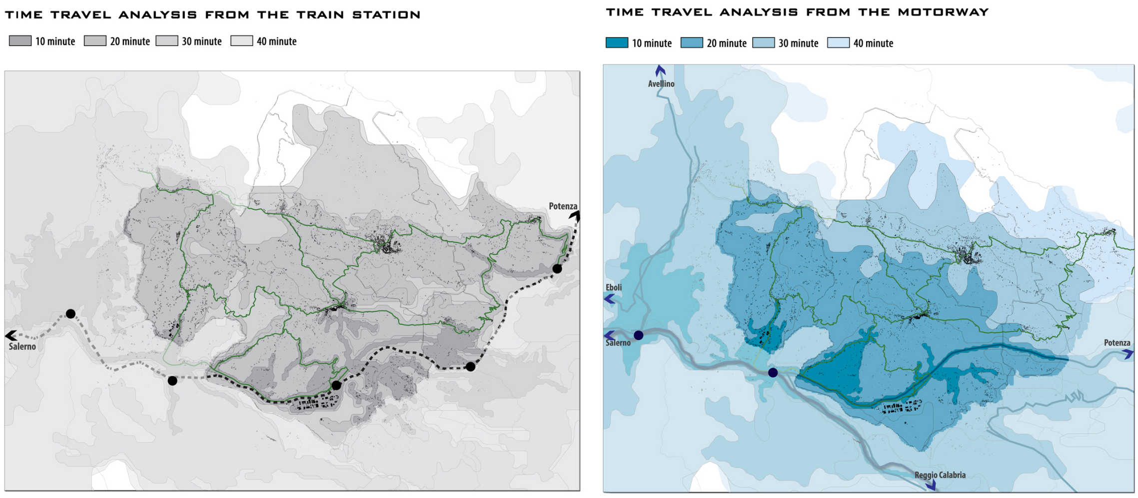

Fig. 5 Analysis of territorial accessibility from strategic transport elements

Information about these elements has been collected in a database and represented on digital cartography (in shapefile format) to understand the critical issues of the emergency system. Moreover, a verification was made about accessibility considering that in 40 minutes it is possible to reach all the areas of interest of the territory, starting from the main accessibility points (Fig. 5). The I-EP proposed for the union of municipalities consists of:

- a collection area for rescuers and inter-municipal resources located near the motorway exit in the territory of Buccino, with a size of 18,160 square meters;
- a storage area for rescuers and resources for each municipality;
- 51 areas of total population hospitalization distributed over the territory and sized according to the number of inhabitants and maximum users present in the area, considering the standard of dimensioning 17.5 sq.m/user.

The buildings that are part of the emergency management system have also been identified, in accordance with the DGR 438/2005 of the Abruzzo Region. Buildings are divided into:

- strategic, whose functionality during an event assumes fundamental importance for the purposes of civil protection;
- relevant, buildings that can become relevant in relation to the consequences of a possible collapse.

Among the strategic buildings, were located: in the municipality of Buccino, IOC, quickly reachable from the motorway exit; in each municipality a MOC (Mixed Operational Center) and a MOC (Municipal Operational Center).

Then it was possible to identify the strategic infrastructures, divided into:

- accessibility infrastructures which interconnect the emergency management system with the external territory sized in such a way as to allow rescue vehicles use;
- connection infrastructures connect strategic buildings and emergency areas.

Once the emergency management system has been defined, the same has been verified in terms of functionality and compliance of the areas and buildings with the criteria defined by the Civil Protection guidelines. For this purpose, the Inter-communal Emergency Plan was superimposed with maps of hazard and municipal urban plans, structuring a verification abacus. For each area and each strategic project building of interest, the location, characteristics, dimensions and level of dangerousness were indicated, and the travel times from each area and strategic building were calculated in the GIS environment. The emergency management system, emergency areas, strategic buildings, strategic infrastructures, were verified through field inspections that allowed the compilation of related experimental analysis forms defined in the I-LCE field. The sheets, duly completed, were computerized, so as to outline a first qualitative level of knowledge of the emergency management system. That permits to evaluate the functionality and operation of the plan regarding services required in the emergency phase, to define characteristics of individual areas, relationships between them and with the territory.

ELEMENTS OF I-EP / STRATEGIC INTERVENTIONS	AEI 1	AEI 2	AEI 3	AEI 4	AEI 5	AEI 6	AEI 7	AEI 8	AEI 9	AEI 9 / AEI 10	AEI 11	AEI 12	AEI 14	AEI 15
LANDSLIDES RISK MITIGATION														
EXAMINATION			DETAILED GEOLOGICAL SURVEY	DETAILED GEOLOGICAL SURVEY	DETAILED GEOLOGICAL SURVEY	DETAILED GEOLOGICAL SURVEY	DETAILED GEOLOGICAL SURVEY	DETAILED GEOLOGICAL SURVEY	DETAILED GEOLOGICAL SURVEY		DETAILED GEOLOGICAL SURVEY			
INTERVENTIONS			- Surfaces water canalization - Drainage	- Surfaces water canalization - Drainage - Suppotr structure and rainforcement stream	- Surfaces water canalization - Drainage	- Surfaces water canalization - Drainage	- Surfaces water canalization - Drainage	- Surfaces water canalization - Drainage - Suppotr structure and rainforcement stream	- Surfaces water canalization - Drainage - Suppotr structure and rainforcement stream		- Surfaces water canalization - Drainage			
HYDRAULICS RISK MITIGATION														
EXAMINATION														
INTERVENTIONS														
FIRES RISK MITIGATION														
EXAMINATION			DETAILED STUDY OF VEGETATION	DETAILED STUDY OF VEGETATION	DETAILED STUDY OF VEGETATION									
INTERVENTIONS			- Green fire boulevard - Prescribed fire - Appropriate forestry	- Green fire boulevard - Appropriate forestry	- Green fire boulevard - Appropriate forestry									
ACCESSIBILITY OF EMERGENCY AREAS														
SPACE	- Updating of the lighting - Maintenance of the area	- Upgrading of area - Creation of new spaces of community	- Recovery of existing building - Upgrading of area - Creation of new spaces of community	- Recovery of existing building - Upgrading of area - Creation of new spaces of community	- Recovery of existing building - Upgrading of area - Creation of new spaces of community - Updating of the lighting	- Updating of the lighting - Maintenance of the area	- Recovery of existing building - Upgrading of area - Creation of new spaces of community - Updating of the lighting	- Recovery of existing building - Upgrading of area - Creation of new spaces of community	- Recovery of existing building - Upgrading of area - Creation of new spaces of community - Updating of the lighting	- Updating of the lighting - Maintenance of the area	- Recovery of existing building - Upgrading of area - Creation of new spaces of community - Updating of the lighting	- Recovery of existing building - Upgrading of area - Creation of new spaces of community - Updating of the lighting	- Recovery of existing building - Upgrading of area - Creation of new spaces of community - Updating of the lighting	- Updating of the lighting - Maintenance of the area
NEW URBAN SPACES		Trade point	Camping area	Multifuntional urban space							Multifuntional urban space	Neighborhood macket	Urban vegetable garden	

Fig. 6 Matrix of interventions for the elements of the I-EP

The building stock was then analyzed, determining any interference with the strategic areas and infrastructures. For each interfering structural aggregate, the degree of vulnerability was defined considering the year of construction, the main structural typology, the maximum number of floors and the state of conservation. To create a system for the design actions on emergency spaces, strategic buildings and connecting elements, it was drawn up a matrix of interventions for the elements of the I-EP (Fig. 6).

The matrix establishes interventions for each emergency area, strategic building and strategic infrastructure to be implemented to make the I-EP operational and functional, to respond to the territorial development objective, to generate processes of re-functionalization that will allow revitalization and recovery of the territory. In fact, "families of interventions" have been identified for: risk mitigation, hydraulics, landslides and fires, expansion and territorial development, through the definition of new urban spaces with flexibility of use that respond to the need to make up for the shortage of territorial services and the lack of areas necessary for the management of emergency phases. For each element of the I-EP in the matrix, interventions aimed at guaranteeing accessibility and making available the necessary spaces have been indicated, including: updating of the lighting, recovery of existing buildings, maintenance and upgrading of the area, creation of new spaces of community.

To ensure coordination between urban planning and EP were identified a multifunctional areas destined in ordinary time to community spaces, and in emergency phase to a I-AE. In the case study, the new multifunctional areas are of the "F" type of the Urban Plan (Fig. 7). In these areas the use in ordinary time must be such as not to reduce or compromise characteristics of the area: they must be designed as territorial equipment, territorial centralities with a socio-economic and cultural value. For these reasons, they represent the places of resilience and experimentation to regenerate and reconvert with new functions and activities. At micro level, open spaces, if properly upgraded or in a suitable state of conservation, provide a range of benefits (Esopi, 2018).

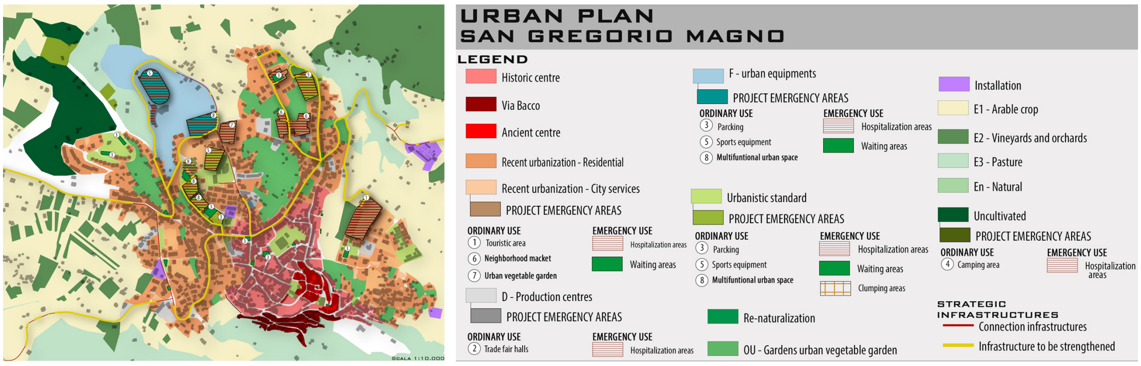

Fig. 7 Example coordination between urban planning and emergency planning

5 CONCLUSION

In the aftermath of a severe earthquake, one early priority in civil protection terms, is to guarantee the management of the emergency phase, which might be seriously inhibited when physical components of the contingency plan (critical buildings, emergency areas and lifelines) are either damaged or unusable (Dolce et al., 2017a, 2017b). The aim of the study is to define a new planning, territorial and emergency methodology, which integrates safety with the theme of urban development. The Plan will re-define or define a model of evolution and development, which is going to shift vulnerability and fragility of these territories to resilience (Rizzi et al., 2017). From this first experimentation we can point out that the analysis model of I-LCE thus identified allowed us:

- to have an overall picture of the emergency management system functioning when it results from urban settlements of associated municipalities and synergies between the choices and resources of individual municipalities;
- to integrate interventions on the territory for the mitigation of seismic risk;
- to verify the emergency management system, together with strategic buildings, emergency areas, connection and accessibility infrastructures identified by the I-EP;
- to verify choices for I-PE and EP of the individual municipalities;
- to verify the consistency between the choices of the I-EP and the real needs to respond to the emergency phase;
- to verify the consistency and compatibility between the choices of the I-EP and the strategic ones of the urban and spatial planning;
- to identify the most fragile areas on which to intervene;
- to use the "intervention matrix" prepared in the study for the I-EP elements to mitigate local and territorial risks and support changes in planning, retrofit and improvement of urban planning and spatial planning;
- to guarantee access to data for citizens, technicians and institutions through a shared database platform.

The next step concerns implementation and setting up of the system digital network platform, starting from the regional database, introduced previous paragraphs. This regional platform, it is currently under construction: only the cognitive part has been completed which will shortly be made accessible to everyone on the opengeodata (Regione Abruzzo, 2018). The data contained in the platform will be accessible for administrations, institutions and professionals and it will have a double goal: to create a dynamic knowledge of the territory and help and support decision makers in generate efficient policies and plans which support a sustainable development and increase resilience of the territories (Di Ludovico et al., 2017). A project of a digital platform will be developed (Damalas et al., 2018), addressed to the governance of civil protection operations and to the evaluation of the risk management capacity (EC, 2013), to the sharing of information (the cognitive framework), the Prevention Projects or the modalities of emergency intervention, and the communication and participation of citizens (Crawford et al., 2018; OECD, 2003; Poljanšek et al., 2017).
The I-LCE wants to be an integral part of this platform at the base of a planning model that is able to put into a system the urban planning issues, from the big scale to the local one, and the risk mitigation themes. It is a model that allows to define intervention strategies that, through the use of the most modern techniques and technologies, permit to identify and plan territorial interventions (regeneration, safety, etc.) according to shared priorities, certain times and costs (Di Lodovico & Di Ludovico, 2017). Therefore, a planning model based on the principles of caution, responsibility and prevention, in which the strategies for mitigating risks from earthquakes and floods must be understood as the responsibility of everyone. However, an effort to push forward decision making and to enhance cooperation with different members of community is necessary to restore affected territory and recreate the opportunity for future evolution of built-up area and evacuation sites (Mashiko et al., 2017). The encouraging results obtained from the first applications of I-LCE suggest continuing the experimentation on further settlements with different characteristics (size, complexity, problems), in order to test the sensitivity of the evaluation model on which we are still working, and which must be still perfected through the introduction of synthetic indexes. In addition to testing the model, we want to define more precise intervention matrices, with many types of risk mitigation measures. Furthermore, the use of platform allows us to create, what David Weinberger calls "The Smart Room": a system of knowledge that relates to the Internet of things, with an increasingly connected world. It is necessary to create a shared knowledge room that is filtered on several levels to improve decision-making, to allow the dissemination of knowledge to citizens and above all to be used to cooperate and share information and projects on several levels and to several stakeholders. This system wants to integrate models of territorial prevention with models of development of spatial and land-use plans to create a network of resilient territories.

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IMAGE SOURCES

Fig. 1: Civil Protection Department; Fig. 2: Author; Fig. 3: Roberto Fiaschi, Marco Natali, Francesca Tommasoni, Francesco Alberti, Figg. 4, 5, 6, 7: Nadia Robertazzi

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CYCLABILITY IN LAHORE, PAKISTAN

LOOKING INTO POTENTIAL FOR GREENER URBAN TRAVELING VALUE

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ABSTRACT

Measuring perceived or objective cyclability or bikeability has drawn less attention compared to walkability, particularly in developing countries like those in South Asia and the Middle East. This paper presents the results of a survey about cyclability in Lahore, Pakistan, focusing on human perceptions rather than the built environment. The overall sample included a total of 379 respondents from three socio-economic classes: those from lower socio-economic backgrounds accessing traditional/older bazaars, respondents from the middle socio-economic class accessing uptown bazaars, and respondents of higher socio-economic status accessing pedestrian shopping malls. The exploratory data collection was conducted in spring 2018 in Lahore by means of a short standard questionnaire with 19 questions, resulting in 17 categorical/dummy variables, two open-ended variables, and two continuous variables targeting socio-economics, bike trip characteristics, biking barriers, and preferred travel specifications. The results showed that the middle socio-economic group was more inclined, flexible, and willing to bike compared to the lower and higher socio-economic-groups. The lower socio-economic group used the bicycle more frequently than the middle socio-economic group. Around half of the middle socio-economic group commutes via bike compared to the lower socio-economic group. There was little to no representation of 55-64 and 65+ age groups in the data. The descriptive findings of this survey indicate some preliminary signs of differences of decisions and perceptions about biking compared to high-income and European countries. These differences need to be tested in future statistical analyses.

KEYWORDS:
Urban Transportation Planning; Sustainable Mobility; Active Transport; Cyclability; Pakistan

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巴基斯坦拉合尔的循环稳定性 探索绿色城市旅游的潜力

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摘要

与步行条件相比，衡量可感知的或客观的可循环性或自行车可骑性引起的关注较少，特别是在南亚和中东等发展中国家。本文介绍了在巴基斯坦拉合尔进行的一项关于可循环性的调查结果，强调的是人类感知，而不是建筑环境。普查包括来自三个社会经济阶层的379名受访者：来自社会经济背景底层的传统/较老的集市、来自社会经济中级阶层的受访者住宅区市场，以及社会经济地位上流的步行购物中心。2018年春季，在拉合尔通过一份包含19个问题的简短标准问卷进行探索性数据采集，得出17个分类/虚拟变量、两个开放变量和两个针对社会经济、骑车旅游、自行车障碍和首选旅行规范的连续变量。结果表明，与低、高社会经济群体相比，中层社会经济群体更倾向、更灵活、更愿意骑车。底层社会经济群体比中层社会经济群体更频繁地使用自行车。与底层社会经济群体相比，大约一半的中层社会经济群体骑自行车上下班。在数据中，55-64岁和65岁以上年龄组几乎没有骑车习惯。这项调查的描述性调查结果表明，与高收入国家和欧洲国家相比，关于骑自行车的决定和感知有一些初步的差异。这些差异需要在未来的统计分析中加以检验。

关键词：
城市交通规划，可持续流动，活跃交通方式，循环性，巴基斯坦

1 INTRODUCTION

This paper provides primary data derived from a mobility survey conducted in Lahore, Pakistan in 2018 and discusses the potentials and barriers of policy-making to promote biking in the Pakistani context. The findings might also be applicable for similar neighboring geographical and cultural contexts like the Indian subcontinent and the Middle East and North Africa (MENA) region. The necessity of conducing such cycling surveys is driven by the lack of reliable disaggregate data in Pakistan and its neighboring regions.

Urban cycling can curb the ill effects of motorized transport in urban areas with respect to congestion, parking spaces, amenity, air pollution and fatal accidents (Hickman & Banister, 2014). Therefore, there is a need to increase via urban planning the number of urban bicycle-users commuting short distances. Choice of transport mode has direct relation with household income as the literature findings suggest that high income group is more flexible in choosing the transport mode for commuting while the low income group has limited options (Replogle, 1992). Previous research has shown that the bicycle, along with cars and public transport modes, plays a significant role in mobility and livelihood for people especially the poor (Anand et al., 2006; Pinto & Sufineyestani, 2018). Pakistani cities are growing at a rapid pace. Lahore itself, the second biggest city in Pakistan, already has a population of 11.13 million (Government of Pakistan, 2017). While the population of Pakistan is 207.8 million with growth rate of 2.4% (Government of Pakistan, 2017), the share of population living in urban settings has increased from 32.5% to 36.4%. This growth puts pressure on infrastructure services, especially roads. Thus, it is important to conduct research on options that can reduce congestion on roads i.e. making Lahore (now considered a megacity) more cyclable to alleviate issues of pollution, congestion, parking, and high travel costs. There is no compiled data available in Pakistan on cycling trips, income level, age, and other factors that hinder bicycling as a mode of transport. Japan International Cooperation Agency (2011) stated that the bicycle, rickshaw, and horse carriage could play an important role in making urban transport a more convenient and affordable option in Pakistan. However, facilities and infrastructure for cyclists (being a sustainable and more affordable travel mode) are either nonexistent or inadequate. As a result, those who choose to use the bicycle regardless of this dearth of infrastructure end up being the victims of 50% of all road accidents (ibid). While the proportion of non-motorized daily trips including bicycles had remained relatively high in the past, it is now declining at a significant rate. In Lahore, this decreasing trend of bicycle trips can be attributed to the shift toward motorized vehicles and increased public transport usage in the absence of adequate cycling infrastructure. JICA study in 2011 stated that the estimated proportion of a person's daily trips using motorcycle/ bicycle was 18.8%, which suggests even a lower proportion of the trips being made explicitly by bicycles (Tab. 1).

Mode		Trips (,000)	Proportion	Proportion Excluding Walk
Public Transport		3,409	19.3%	35.4%
Private Vehicle	Cars	2,894	16.4%	30.1%
	Motorcycle/ Bicycles	3,314	18.8%	34.5%
Mechanized Total (Excluding Walk)		9,617	54.5%	100.0%
Walk		8,050	45.5%	-
Total		17,667	100.0%	

Tab. 1 Proportion of daily person's Trips in Lahore (JICA, 2011)

The 2011 JICA survey showed a significant decrease in use of bicycle. The major reason behind the decreasing trend of bicycling in Lahore is because of poor physical road infrastructure. The last few decades have also seen the development of several new housing communities that did not incorporate bicycles paths into their design. This mode is completely ignored in traffic junction design, forcing cyclists to dangerously mix in with motorized traffic and leading to low bicycle-usage. Thus, this research was conducted to collect primary data for the further analysis of the potential and constraints of cycling and to promote the integration of safe non-motorized transport modes into Pakistani urban planning.

This research is designed to address gaps in knowledge about the potential of cycling in Pakistani cities. The survey designed to answer the research gaps by investigating the effects of income, education, gender, travel distance, and bicycle ownership on cycling as a mode of transport. The survey results provide an overview of the potential of cycling in urban Pakistan. The questions sought to identify constraints like extreme weather, culture, gender, infrastructure for cycling, and dependence on family members for transport. Lastly, the survey also revealed users' mode choice depending on decisive factors like time, distance, and nature of trip. This contribution is limited to the descriptive statistics found during the data collection. In order to have enough space and capacity to present the details of the findings, this paper does not include any statistical hypothesis or modeling. The future works will use refer to this manuscript for the purpose of presenting modeling results. The survey and its findings provide numeric data for subsequent co-relational studies using dependent, independent, and extraneous variables. Statistical techniques like correlation and regression can be applied to this dataset. This study will also act as a reference unit for other urban areas in Pakistan with similar characteristics. The methodology and questions were designed to parallel the designs used in existing literature and to collect data in un-biased manner that represented all income groups.

2 CYCLABILITY

Cyclability usually refers to the ability to use the bicycle as a transport mode using spatial structures and streets, e.g. cyclability of a street (e.g. Guthrie et al., 2001) or a city (Muñoz et al., 2016). This study discusses urban cyclability but examines people's other travel choices and their individual and household conditions in addition to physical/spatial characteristics. The main reason is to improve the limited understanding of planners and decision-makers in Pakistan or similar contexts about people's perceptions of biking as a transport mode. Before it is possible to improve cyclability using objective interventions like developing biking infrastructure, it is necessary to have an evidence-based image of the factors that are associated with biking in the first place.

The existing literature about cyclability shows that this term encompasses and is defined by a wide range of phenomena: modal split in order to choose policies, observed and estimated bicycle demand, bicycle levels of service, number of accidents, and physical and environmental benefits from biking (Berloco & Colonna, 2012). Jones and Novo de Azevedo (2013) observed that a "favourable climate, flat topography, fairly compact urban form and highly connected (gridded) street network appear to provide the fundamentals of a 'cyclable' city" but other cultural or human-related issues can support or weaken cyclability of a city or area. Parkin (2009) observes not only physical characteristics like road width, traffic flow and speed, average number of heavy vehicles and buses, gradient, bumpiness, lateral conflict, and aesthetics, but also human-related factors like overall feelings of safety, effort, and pleasure. Cyclability studies have a status like the general studies on the advantages and sustainability of biking. researchers take selected (not all) aspects and limit their studies only to some perpectives and viewpoints. For instance, Pirlone and Candia (2015) take socio-economic (social and economic sustainability) and environmental terms (environmental sustainability) for analyzing the sustainability of cycling. Examples of international efforts to improve cyclability can be seen in several high-income countries that invest in their biking infrastructures as a pull factor to reduce personal car use. In Spain, (Muñoz et al., 2016) collected data about cycling-related indicators of residents in the mid-sized city of Vitoria-Gasteiz by conducted an ad-hoc telephone mobility survey of 736 employees and students in 2012 and suggested some recommendations to transition the city to a more bike-friendly one. Their suggestions including "marketing campaigns to encourage non-commuting cycling trips, bicycle measures to target social groups as opposed to individuals, bicycle-specific programs such as "Bike-to-work Days", and cycling courses."

Data collected from interviews with 343 people in a district of Milan, Italy shows that improving the city's bike lane network could lead in a 34.4% increase in cycling in the district (Rebecchi et al., 2016). In Denmark, Nielsen et al. (2013) examined cyclability using information collected from the annual Danish National Travel survey. They used the data of 2009/2010 and 2010/2011 for a total of 39222 respondents – 9128 of whom cycled an average of 7.7 kms on the survey day – and concluded that there is a high probability of cycling for short distances. Another large Danish bikeability study was conducted from 2006 to 2014 on 59000 respondents living or working in cities with more than 9000 inhabitants. It observed several biking variables like trip stages, number of trips, journeys and the travel were associated with the socio-economic and demographic characteristics (Christiansen, 2012; Christiansen & Haunstrup, 2012; Nielsen & Skov-Petersen, 2018). Studies about cycling and cyclability have rarely been conducted in neighboring countries/regions with approximate similarities to the geographical and cultural situation of Pakistani cities. In India, bicycle ownership and trip data is available in census and many researchers have used this secondary data.

These studies have been conducted on the relationships between cycling and various environmental aspects, socio-economic status, and physical factors. Srivastavaa et al. (2017) established a relation between bicycle use and its environmental effects and concluded that using bikes could save significant amount of greenhouse gases. This research also concluded that low-income households use bicycles while middle- and upper-income households used motorized vehicles. Another study conducted by Majumdar and Mitra (2015) examined behavior of cycle users with respect to travel time and physical factors. Primary data was collected with a questionnaire survey in this study. In the Middle East and North Africa (MENA) region, research on cyclability mostly deals with topics of sustainable transport, urban road infrastructure, and efficient mobility. There is not enough work available on the opportunities and constraints of cycling and socio-economic factors.

Only a few studies have been done in some countries in the region: an empirical and analytical study to promote cycling among different age groups in Turkey (Tandogan & Ergun, 2013), and an urban cyclability assessment model in Doha, Qatar (Ferwati et al., 2017). Other works done on the neighboring region of the MENA include cycling as a part of mobility patterns as a whole and does not present the status of cycling and cyclability separately (Masoumi, 2013; Soltanzadeh & Masoumi, 2014). A review of the past studies on the similar topic reveals that the topic has mainly been explored through quantitative methods. Although there are indeed studies that investigate the various factors related to people's behaviors and perceptions toward cyclability through qualitative methods, they are fewer in number. There are also some studies who employed mixed-method techniques for data collection. Some of the studies specifically targeted cyclists, while others targeted all travelers using any travel mode or the area's residents. Of all the data collection methods employed in the studies, interviews via traveler-/commuter-intercept surveys were the most common method. Other methods consisted of web- or phone-based surveys, field observations, in-depth face-to-face resident interviews, expert interviews, and focus group discussions. Low response rates were often the main limitation for collecting data through web- and phone-based interviews: response rates generally ranged 20-60%. Response rates for traveler-intercept surveys were higher, with only one study reporting a rate of 19%.

Many of these studies used a variety of locations to perform the data collection. Some of them focused on particular districts in a city or the town/city as a whole, while others conducted surveys at key locations of trip routes e.g. commercial areas, cordon points, and (occasionally) residential areas. Response ratio (the sample coverage of overall city population in terms of percentage) ranged as low as 0.03% to a high of around 0.3%. Tab. 2 summarizes the results of some of the past studies on the same topic.

3 METHODOLOGY

This study explores cyclability on the Indian subcontinent using Lahore, Pakistan as a representative example. The term cyclability in this study refers to spatial issues like different socio-economic status of different urban districts as well as the individual and household characteristics and urban travel behaviors.

Study	Sample Size	Response Rate	Case-study areas	Response Ratio	Data collection method
Arora, 2013	574 bicycle users (109-124 at each location) and 82 cycle rickshaw pullers	Not available	All locations where National Highways intersect Delhi city border (05 in number)	0.01 (cyclists) and 0.02 (cycle rickshaw)	Video recordings of two-way traffic flows at various hours of the day and Personal interviews
Chatterjee et al., 2013	Qualitative sampling: 144 (12 in each Cycling City and Town)	Not available	12 Cycling City and Town in England	0.20	In-depth face-to-face interviews
Christiansen & Skougaard, 2015	2-Stage Stratified sampling (208 Strata): 16,465 persons	58.4%: 1,938 web and 7,666 telephone interviews	Danish residents belonging from 13 geographical groups	Not available	Web (self-administered) and telephone interviews in a year
Clifton et al., 2012	Random sampling: 1884 customers (Long surveys: 697 and short surveys: 1187)	19% (long survey) and 52 % (short survey	78 retail establishments in the Portland Metropolitan Area	Not available	Customers intercept survey (via handheld computer tablets) and Field observations of built environment in 2011
Gössling, 2013	Qualitative sampling	Not available	Copenhagen	Not available	Expert interviews
Jones & Novo de Azevedo, 2013	20 (2010) and 12 (2011) representatives, 12 participants of mass bicycle ride and 15 cycle commuters	Not available	Pelotas, Brazil	Not available	Focus group discussion, Field observations and random Interviews in 2010 & 2011
Majumdar & Mitra, 2015	50 potential respondents for expert interviews and Simple random sampling for travel survey: 575 responses	24.0% (12) for e-mailed survey	17 locations of substantial trip generation in Kharagpur, India	0.20	Expert interviews (AHP Questionnaire) sent out through emails and Travel intercept survey
Muñoz et al., 2016	736 employees and students	Not available	Vitoria-Gasteiz, Spain	0.30	Telephone survey in 2012
Nielsen & Skov-Petersen, 2018	9604 residents: The sample of Danish National Travel Survey	58.4%: 1,938 web and 7,666 telephone interviews	Danish residents belonging from 13 geographical groups	Not available	Secondary data of Danish National Travel Survey
Rebecchi et al., 2016	Random sampling of residents: 343 citizens	Not available	District 7, Milan	0.20	Web survey and Direct interviews

Tab. 2 Methodological considerations of similar past studies

This study was designed with the objective of creating a small but reliable dataset to link biking behavior with individual and household characteristics, travel behavior, and spatial factors. In Indian subcontinent especially in Pakistan, there is no reliable data available on bicycling. Therefore, descriptive statistics is yet a good contribution in this manuscript. The detailed statistical hypothesis or modelling will be presented in future work due to space limitation while referring to this manuscript.

3.1 CASE-STUDY AREAS

For the cyclability survey, Lahore is selected as it is the country's second biggest city and its population has increased at a high rate in recent years. Lahore's urban boundaries increased from 220 km in 1995 to 336 sq. km in 2005 and 665 sq. km in 2015 (Ibrahim & Riaz, 2018). The city's population grew by 3% from 5.20 million in 1998 to 11.13 million in 2017. This rapid growth of population translates into increased trip demand and has led to a shortage of available and effective transport. Fig. 1 shows Lahore's growth over the last two decades. In those two decades, the city grew southward in accordance with its master plan. This growth divided the city into areas populated by various socio-economic groups. The newly build residential sector housed middle- to high-income groups while the older developed areas housed mostly middle- and low-income groups. In the old parts of city, travel distances for activities like work, education, shopping, and leisure are generally shorter than in other parts of the city because land is used in a more mixed fashion. While on the other hand, segregation of land uses in the newly build residential areas increased the average length of trips and urban planning became car-based. Moreover, the policy of the last government regime was to promote signal-free corridors to facilitate the car users. The data shows Pakistan has experienced a massive increase (268%) in vehicle registration in the ten years between 2005 and 2015 (Gallup Pakistan, 2016). Bicycles are not included as there is no registration required for them. While it is thought that rapid transit systems in developed countries assist cities in their wealth creation by reducing car dependence, they are an expensive mode of travel in emerging countries (Newman & Kenworthy, 1999).

Two of the selected case sites in Lahore – Baghbanpura and Pakistani Bazar – are older sections of the city and have a mixed land-use urban texture. The internal road networks are largely composed of narrow and congested streets. Due to congestion, motor vehicle speed is reduced and it is safe to cycle in these areas. Baghbanpura and Pakistani Bazar are home to mostly low- to middle-income residents. Car ownership rates are lower in these areas than other parts of the city, but motorized vehicles like motorbikes and cars are still relatively common. Other selected sites – Liberty, Emporium Mall, and Packages Mall – can be considered high-income areas. Public transport routes are sufficiently developed that they can be effectively used by residents to access these shopping areas. Furthermore, all planning is oriented toward car-owners, such as large parking places and cheap parking prices. In these areas, bicycle-use is quite rare (mainly by servants in homes) as even students must commute with motorized vehicles because of long travel distances. Bicycle-use was completely ignored in road design and no parking is available for cyclists in these areas. The lack of infrastructure for cycling and the high average vehicle speed creates a dangerous environment for bike-users. The location of surveyed areas pointed out in Fig. 2.

3.2 DATA AND SAMPLE

The sample included 379 respondents spanning three socio-economic classes that correlated with their access to facilities to meet their needs. Respondents with lower incomes largely had access to traditional areas and older bazaars, while middle-income respondents accessed uptown bazaars and high-income respondents accessed pedestrian shopping malls. These bazaars and case-study markets are illustrated in Fig. 2.

The survey instrument was based on 21 questions focusing on spatial, individual and household characteristics, bike trip specifications, general mode choice, and causalities of bike-use. Tab. 3 summarizes the questionnaire including the variables and their types. Since most of the desired information was qualitative in nature, they were transformed into categorical and dummy variables suitable for discrete choice modeling. The questionnaire was kept as brief as possible so that the interviews could be completed quickly. The questionnaires were filled out during face-to-face interviews with residents living in various parts of the city.

The sample size provides only an exploratory look into residents' socio-economics, travel behavior, and cycling preferences; thus, no representativeness ratio or index is calculated for the survey. Tab. 4 summarizes the total number of respondents and valid responses for each question. In that table, "N/A" refers to either "No Response" or was applied when the question was not applicable to the respondent. This study's findings are presented in the form of frequencies and percentages for categorical and binary data as well as descriptive statistics for the two continuous variables. The two continuous variables were tested for normality via two methods: Kolmogorov-Smirnov and Shapiro-Wilk, where P-values of less than 0.05 indicate non-normality.

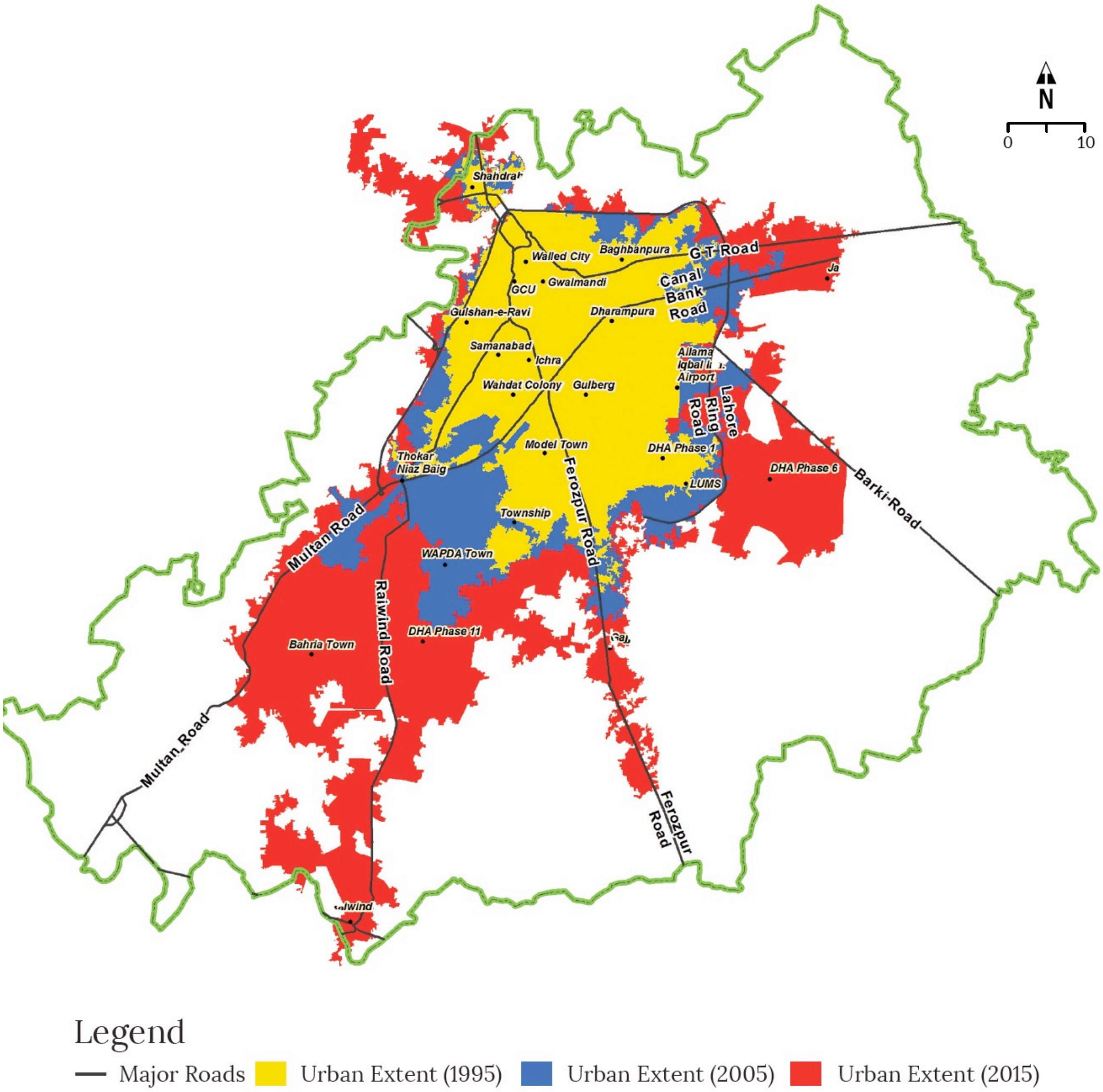


Fig. 1 Urban extent of Lahore (1995 to 2015).
Source: Ibrahim and Riaz, 2018

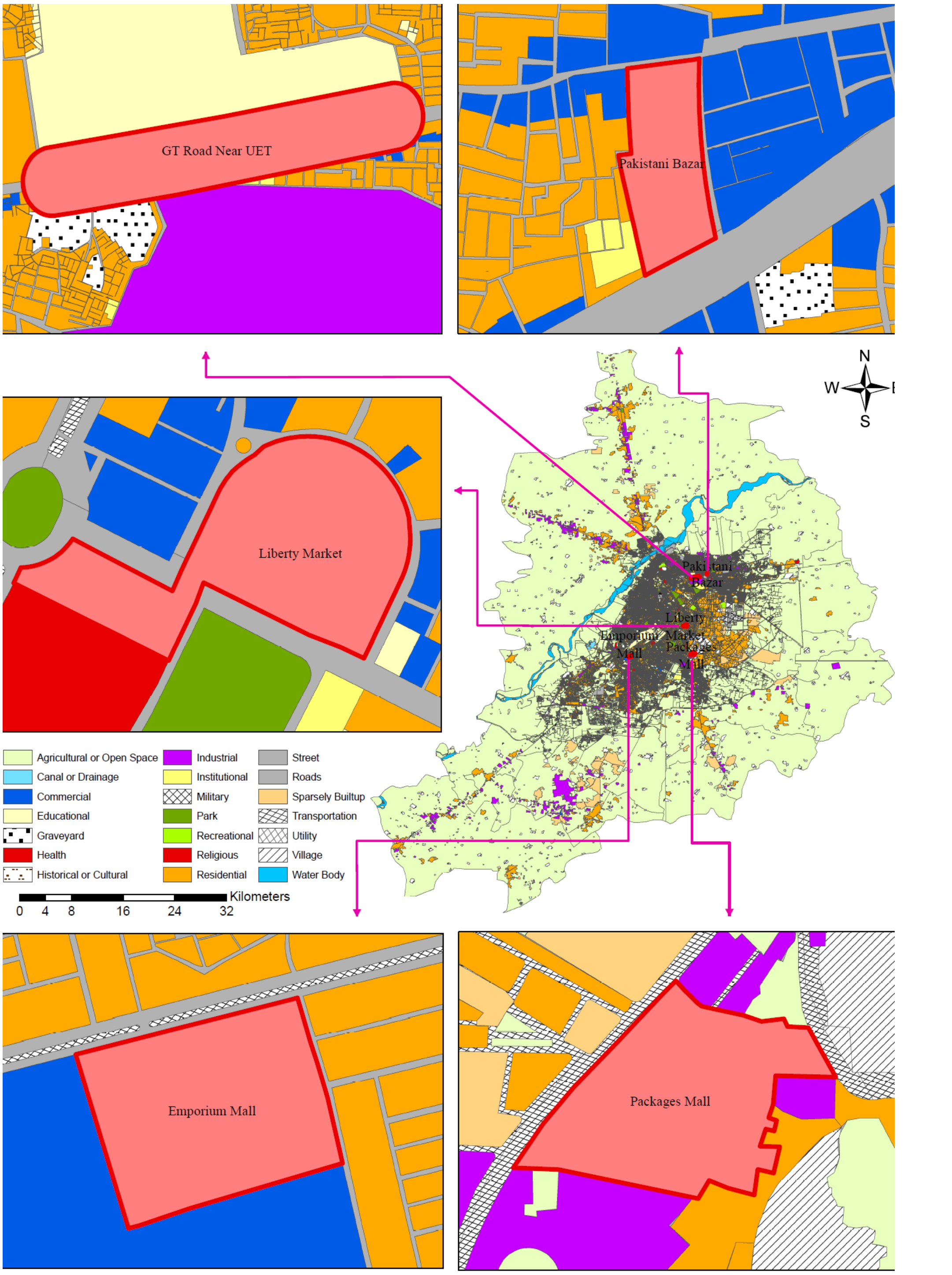


Fig. 2 Location of case study areas in Lahore City. Source (Authors, 2018)

Variable	Variable Type	Categories
Location	Categorical	Lower-Socio-Economics, Medium-Socio-Economics, and Higher Socio-Economics
Gender	Categorical	Male, Female, and Transgender
Age	Categorical	15-24; 25-54; 55-64; and >65
Income	Categorical	0-15,000; 15,000-50,000; 50,000 - 100,000; and >100,000

Education	Categorical	Under Matric, Matriculation, Under-Graduate, Graduate, and Post-Graduation
Know how to ride bicycle	Binary	Yes or No
If no why not?	Open-ended	-
Use for commuting	Binary	Yes or No
Cycling frequency	Categorical	Daily, Weekly, Monthly, Occasionally, and Need-Based
No. Of cycle user in house	Continuous	-
No. Of cycle owned in house	Continuous	-
Hindrance in bicycle use	Categorical	Health and Fitness, Weather and Environmental Condition, Culture, Gender, Family Dependency For Travelling, and Non-Availability Of Facilities I.E. Bicycle Lane
Purpose of majority trips	Categorical	Recreation, Educational, Work, Health, Fitness, and Wellbeing
Preferred mode of choice	Categorical	Walk, Cycle, Motorbike, Car, Public And Mass Transit, and Paratransit
Use cycle in addition or split of other mode	Binary	Yes or No
If not use cycle then reason	Open-ended	-
Preferred mode of choice irrespective of time	Categorical	Walk, Cycle, Motorbike, Car, Public And Mass Transit, and Paratransit
Preferred distance to travel using cycle	Categorical	0.25 Km, up to 5 Km, 5-10 Km, 10-15 Km, and More Than 15 Km
Preferred time to travel using cycle	Categorical	Under 15 Min, 15-30 Min, up to An Hour, and More Than 1 Hour
Preferred trip to travel using cycle	Categorical	Recreational, Educational, Shopping, Work, and Health-Fitness-Wellbeing
Aspect driving using cycle	Categorical	Affordability, Reliability, and Accessibility

Tab. 3 The survey instrument for quantification cyclability in Lahore, Pakistan

Category		Location	Gender	Age	Income	Education	Know how to ride bicycle
N	Valid	379	379	377	374	376	376
	N/A	0	0	2	5	3	3
Category		Use for commuting	Cycling Frequency	Hindrance in Bicycle use	Purpose of Majority Trips	Preferred mode of choice	Use Cycle in addition or split of other mode
N	Valid	341	176	364	372	374	353
	N/A	38	203	15	7	5	26
Category		Preferred mode of choice irrespective of time		Preferred Distance to travel using cycle	Preferred Time to travel using cycle	Preferred Trip to travel using cycle	Aspect driving using cycle

N	Valid	365	361	353	354	369
	N/A	14	18	26	25	10

Tab. 4 The sample size for each question

4 FINDINGS

Tab. 5 summarizes the non-continuous (categorical) findings of the overall sample by their frequencies and percentage shares. A large majority of the sample belonged to the lower socio-economic group (about 69%), while only 5% of the sample belonged to the middle socio-economic group. Due to cultural difficulties in interviewing, 71% of the respondents were male. Most respondents were in the age group of 25-54 years (66%). More than half of the respondents had an average monthly income of 15000 Pakistani Rupees (105€) to 50000 (351€)[1]. Between 24% and 28% of the sample had high school matriculation (graduation), or university degrees including under-graduate and graduate

The most popular modes of transportation in the sample were motorbike and car, each making up 33% of the responses, followed by bike at 11%. Nearly all of the respondents know how to ride a bike (97%), but less than one-third of respondents actually use it to commute. About 16% of the sample cycles daily and 14% cycles occasionally. The largest obstacles to biking are cultural issues (26%) and gender (24%) followed by other barriers related to the environment and infrastructure. Affordability, reliability, and accessibility are almost equally important for the respondent for the purpose of biking.

Another part of the findings is related to respondents' preferences regarding biking. Slightly more two-thirds of the all respondents reported that they prefer biking only short distances, i.e. up to 5 km. More than half (64%) prefer to bike less than 15 minutes, and 22% prefer biking up to 30 minutes. The travel purposes preferred for biking are recreation (21%), work (26%), and health, fitness, wellbeing (22%). The results are also graphically presented in Fig. 3.

Category		**n**	**%**	**Category**		**n**	**%**	**Category**		**n**	**%**
Location	Lower socio-economics	260	68.6	Know how to ride bicycle	yes	368	97.1	Education	under matric (less than a high school degree)	48	12.7
	Medium socio-economics	20	5.3		no	8	2.1		Matriculation (graduation)	92	24.3
	Higher socio-economics	99	26.1		N. A.	3	0.8		Under-graduate	105	27.7
Gender	Male	268	70.7	use for commuting	yes	116	30.6		Graduate	106	28.0
	Female	109	28.8		no	225	59.4		Post-graduation	25	6.6
	Transgender	2	0.5		N. A.	38	10.0		N. A.	3	0.8
Age	15-24	125	33.0	Cycling Frequency	Daily	62	16.4	Preferred Distance to travel using cycle	>1	19	5.0
	25-54	250	66		Weekly	27	7.1		0.25 Km	127	33.5
	>65	2	0.5		Monthly	11	2.9		up to 5 Km	131	34.6
	N. A.	2	0.5		Occasionally	52	13.7		5-10 Km	55	14.5

[1] Pakistani Rupees were converted to Euro based on the rate of 0.007€ for each Rupee (as of July 6, 2018).

Income	0-15000	82	21.6		Need Based	24	6.3		10-15 Km	29	7.7
	15000-50000	198	52.2		N. A.	203	53.6		N. A.	18	4.7
	50,000 - 100,000	78	20.6	Hindrances	Health and Fitness	48	12.7	Preferred Time to travel using cycle	under 15 min	242	63.9
	>100,000	16	4.2		Weather and Environmental Condition	55	14.5		15-30 Min	83	21.9
	N. A.	5	1.3		Culture	98	25.9		Up to an hour	28	7.4
Preferred mode of choice irrespective of time	Walk	41	10.8		Gender	91	24.0		N. A.	26	6.9
	Cycle	42	11.1		Non-availability of facilities	72	19.0	Preferred Trip to travel using cycle	Recreation	78	20.6
	Motorbike	124	32.7		N. A.	15	4.0		Education	71	18.7
	Car	123	32.5	Aspect driving using cycle	Affordability	123	32.5		Shopping	24	6.3
	Public / Mass Transit	31	8.2		Reliability	131	34.6		Work	99	26.1
	Paratransit	4	1.1		Accessibility	114	30.1		Health, Fitness, Wellbeing	82	21.6
	N. A.	14	3.7		N. A.	10	2.6		N. A.	25	6.6

Tab. 5 Categorical findings of the overall sample

It is also noteworthy to know how the results breakdown for different socio-economic statuses in the city. The overall share of male respondents was 71%. The dominant age group of 25-54 years ranged from 66% to 68% of respondents in the three socio-economic areas. A large portion of the sample in the lower- and middle-economic groups makes less than 15000 Rupees (105€) or 15000-50000 Rupees (105€ - 351€) per month, while less than half of respondents in the higher socio-economic group have a monthly income of 50000-100000 Rupees (351€ - 701€). There are more people with undergraduate (36%), graduate (36%), and postgraduate (10%) degrees in the case districts designated as higher socio-economic areas.

There is no large difference in biking skill levels in the three areas, but over half of respondents from middle socio-economic areas use bike to commute. The pattern of cycling frequency in middle socio-economic areas is slightly different from the other two areas. On average, people from these areas cycle occasionally (53%) based on needs (29%). The most-cited cycling barriers in the three socio-economic areas are culture (32%), gender (45%), and gender (26%) respectively. At 55.3%, 68.4%, and 64.8%, fitness, health, and wellbeing are the main reasons for biking in the three urban types. The preferred transport mode in the first group of areas is motorbike (45%), while in the second and the third groups of areas motorbike/car (25% and 25%) and car (60%) are the most popular choices. In the three socio-economic areas, 64%, 74%, and 75% use bike combined with other modes. The most preferred modes irrespective of time are motorbike and car in the first and second type of areas (combined: 69% and 60%), while car and walking are the most popular ones in the third type (combined: 69%). It is interesting that in higher socio-economic areas, 18% of people prefer to walk, compared to 9% and 5% in the other two urban types. Similarly, the tendency to bike in this area is 5% more than the other two. People in the middle socio-economic case sites have a stronger tendency to bike longer distances and for work (73%). Their most-cited biking-related issue is affordability (80%). Respondents from lower socio-economic areas prefer biking shorter distances. Accessibility is an issue for all three classes: one-fourth to one-third of the respondents from each type of area cited this problem. Fig. 4 presents the breakdown of the categorical findings for the three socio-economic areas.

There are two continuous variables: number of bicycle users per household and number of bicycles per household. Tab. 6 shows the descriptive statistics of these two variables for the whole sample. The number of bike users per household ranges from 0 to 5 with an average of 1.51, while bike ownership ranges from 0 to 4 with an average of 1.16. The distribution of these two variables was estimated by Kolmogorov-Smirnov and Shapiro-Wilk normality tests. The results show that the distributions are non-normal ($P<0.001$ as seen in Tab. 7). Although the number of bikes per household is lower in low socio-economic areas, the number of bike users is clearly higher in this urban type compared to the other two areas (Fig. 5).

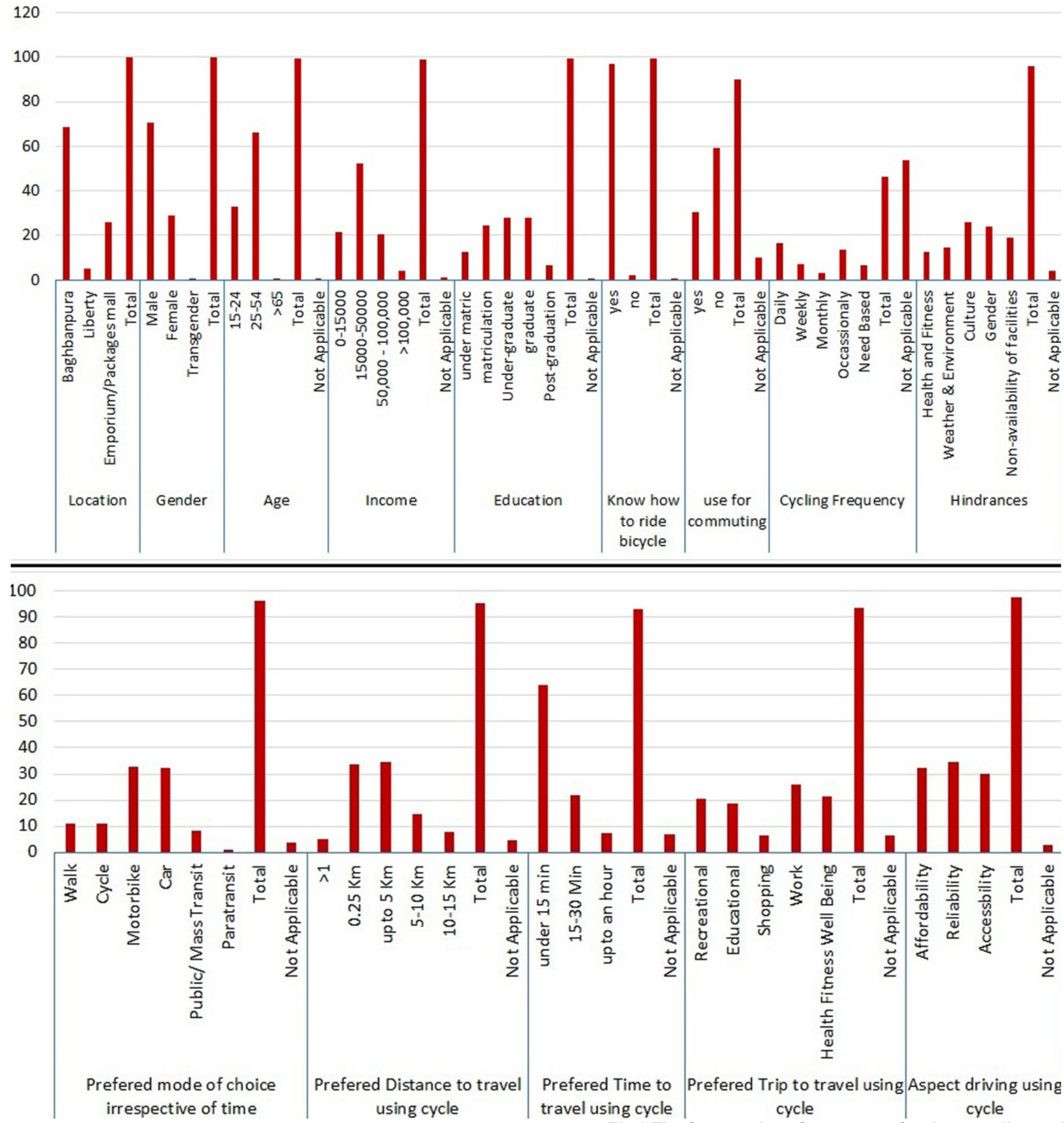
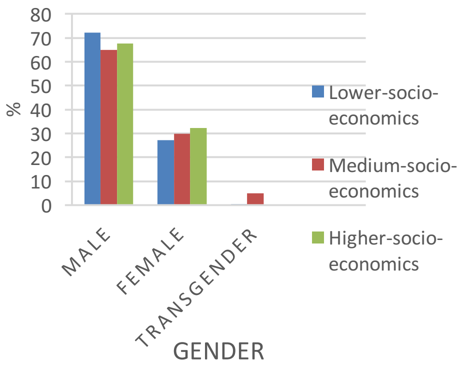
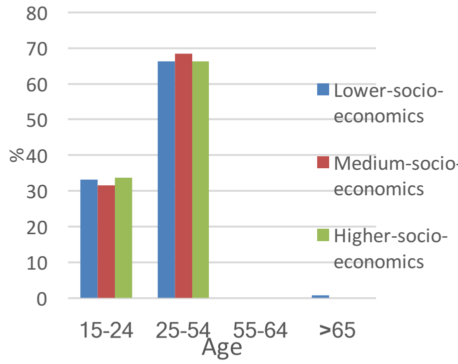
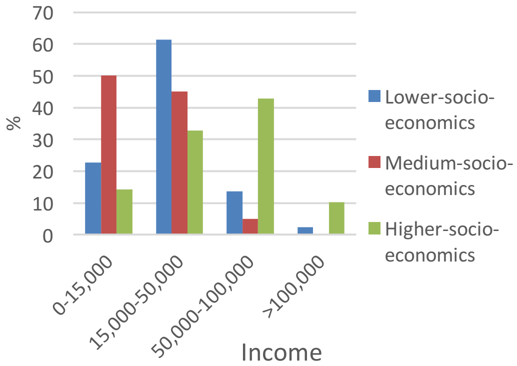
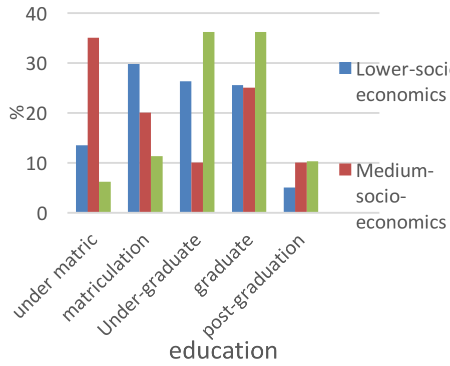


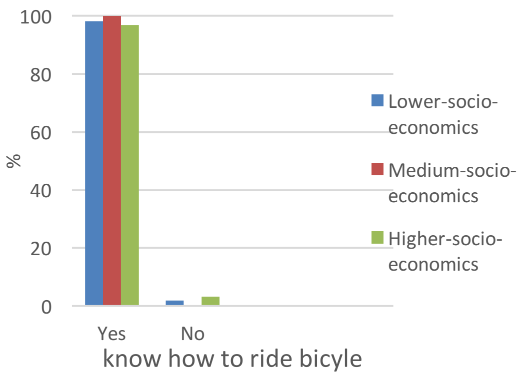
Fig.3 The frequencies of responses for the overall sample

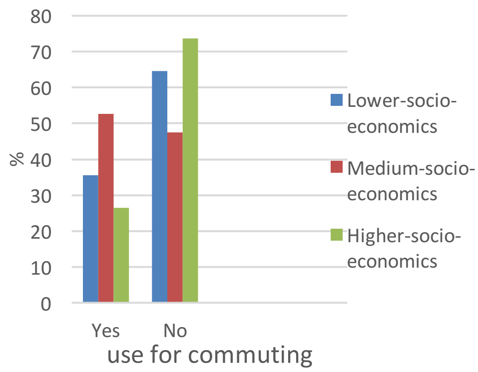

80
70
60
50
40
30
20
10
0
%
MALE
FEMALE
TRANSGENDER
GENDER
Lower-socio-economics
Medium-socio-economics
Higher-socio-economics

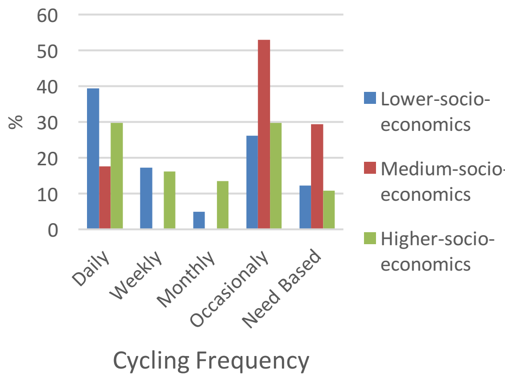

80
70
60
50
%40
30
20
10
0
15-24
25-54
55-64
>65
Age
Lower-socio-economics
Medium-socio-economics
Higher-socio-economics

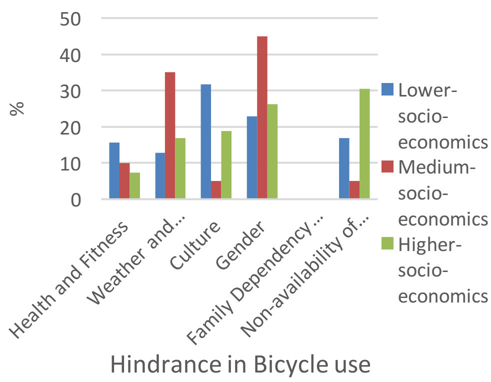

70
60
50
40
30
20
10
0
%
0-15,000
15,000-50,000
50,000-100,000
>100,000
Income
Lower-socio-economics
Medium-socio-economics
Higher-socio-economics


40
30
%20
10
0
under matric
matriculation
Under-graduate
graduate
post-graduation
education
Lower-socio-economics
Medium-socio-economics


100
80
60
40
20
0
%
Yes
No
know how to ride bicyle
Lower-socio-economics
Medium-socio-economics
Higher-socio-economics


80
70
60
50
% 40
30
20
10
0
Yes
No
use for commuting
Lower-socio-economics
Medium-socio-economics
Higher-socio-economics


60
50
40
30
20
10
0
%
Daily
Weekly
Monthly
Occasionaly
Need Based
Cycling Frequency
Lower-socio-economics
Medium-socio-economics
Higher-socio-economics


50
40
30
20
10
0
%
Health and Fitness
Weather and...
Culture
Gender
Family Dependency...
Non-availability of...
Hindrance in Bicycle use
Lower-socio-economics
Medium-socio-economics
Higher-socio-economics

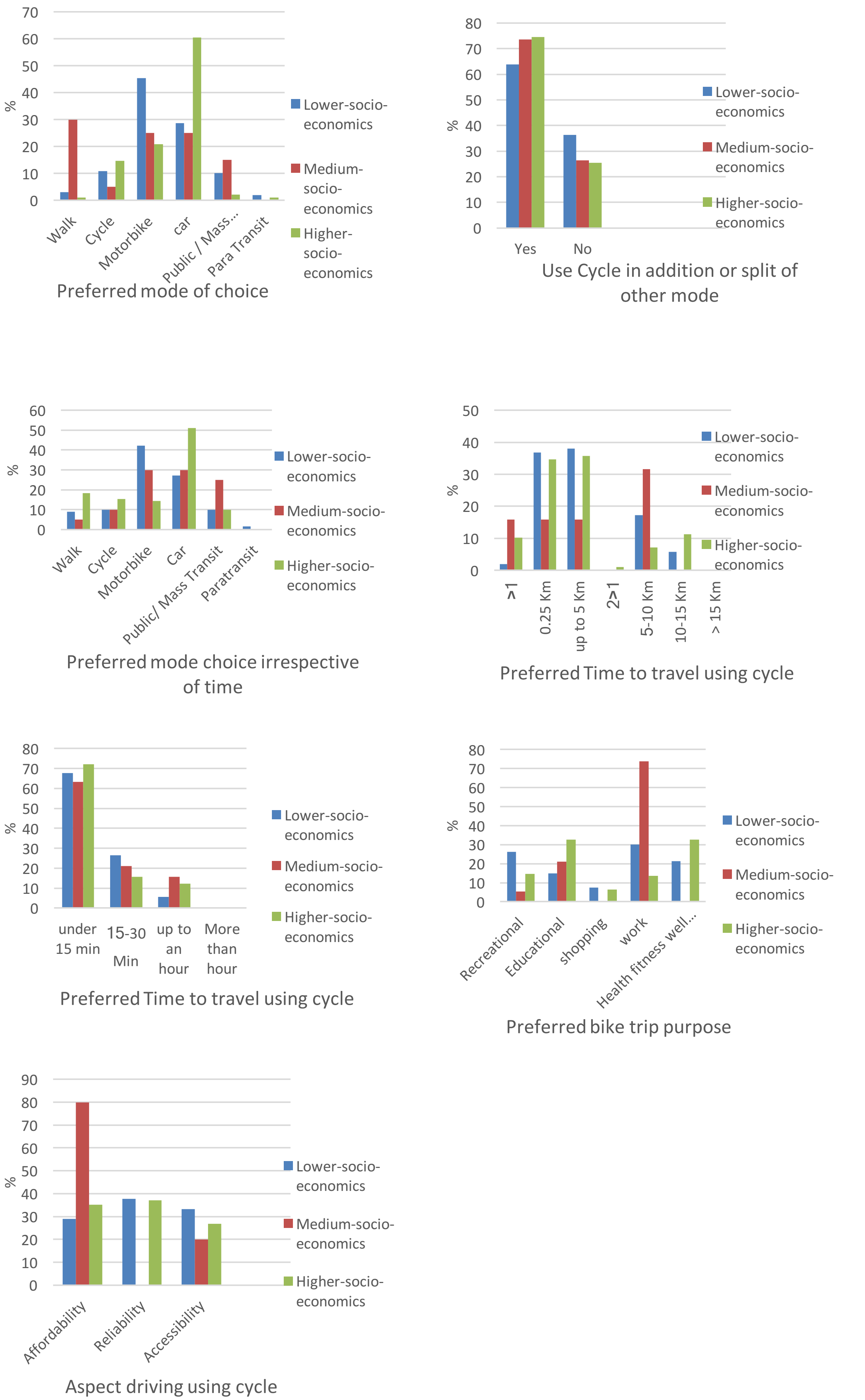


Fig. 4 Breakdown of the categorical findings for the three socio-economic areas

Variable	N	Minimum	Maximum	Mean	Std. Deviation	Variance
No of Cycle user in House5	181	0	5	1,51	1,214	1,474
No of Cycle owned in house	168	0	4	1,16	0,814	0,663

Tab. 6 Descriptive statistics of continuous variables

Variable	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	P-value	Statistic	Df	P-value
No of Cycle users in House	0,241	163	<0.001	0,889	163	<0.001
No of Cycle owned in house	0,319	163	<0.001	0,806	163	<0.001

Tab. 7 Normality test results for number of cycle users and owners per household

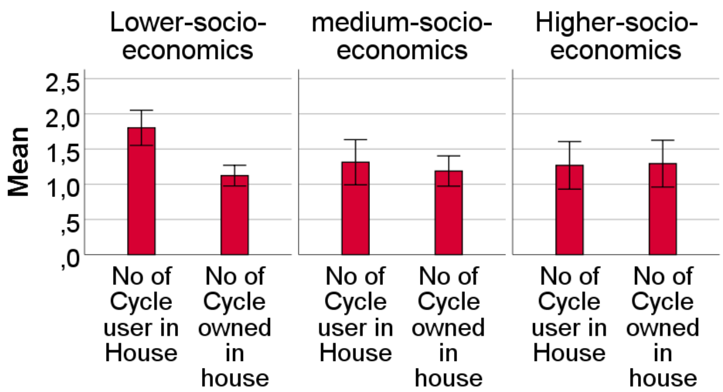


Fig. 5 Mean household bike ownership and use for three different socio-economic statuses of different districts

5 DISCUSSION

From the results above, this section discusses the standing of this research in comparison with global cycling practices. It is one of the first studies in Pakistan to explicitly include transgender residents in the survey sample, but the small number of transgender respondents makes it impossible to derive specific conclusions or recommendations based on their responses. The results showed that the middle socio-economic group was more inclined, flexible, and willing to cycle compared to lower and higher socio-economic-groups. Respondents from the lower socio-economic group frequently used bicycles compared to the middle socio-economic group. This might indicate a need-based cycling pattern and an obvious effect of socio-economic conditions of people on cycling. Bicycling is not that popular in Pakistan as in some of the other cities of Asian countries such as Singapore, Tokyo etc. who have recently developed their interest for cycling through the introduction of bike-friendly policies (Smethurst, 2015; Zhang et al., 2015).

According to the 1998 census (Government of Pakistan, 1998), around half the population of Pakistan is comprised of females and the other half is males. The results showed that culture and gender were the main hindrances that people of Lahore faced to bicycle, may be because it is perceived that the bicycle's emergence is a product of Western culture (Smethurst, 2015), which is generally not freely welcomed in parts of Lahore, even though Lahore is the second biggest and modernized city of Pakistan. It is interesting to note that respondents from lower socio-economic case sites cited culture-based hindrances more frequently, while respondents from middle socio-economic areas cited gender- and weather-based hindrances more frequently. Also, in low-cycling countries, cycling is not evenly distributed across all ages and genders (Aldred et al., 2016); the same pattern is observed in Lahore too. In Pakistan, there exists a significant geographical effect on the choice of mode of mobility as the residents of richer areas rely on automobiles (e.g. cars) and not on bicycles (or walking), slightly more than those of poor areas (Adeel, 2018). The results showed that higher socio-economic groups indicated that the lack of infrastructure is one of the causes to discourage cycling. Weather-related hindrances are another difficulty that the same respondents pointed out. The study also showed that highly educated respondents did not prefer cycling any more than less-educated respondents. This study gives evidence that a uniform cycling policy for all genders, age groups, and cultures through the provision of necessary infrastructure might not rectify barriers to cycling in Lahore.

A study from Belgium (Vandenbulcke et al., 2011) shows that commuting by bike in one neighborhood promotes commuting by bike in nearby neighborhoods. The results in this study showed that around half of the middle socio-economic group commutes by bike. This indicates an opportunity that introducing culture of commuting through bicycle in some of the neighborhoods of Lahore may impact other neighborhoods and can promote a cycling culture. This study showed that middle-socio-economic group was more active in commuting via biking compared to other two socio-economic groups. Therefore, if cycling is promoted in middle-income socio-economic groups, it may impact the same way (as discussed above) to encourage cycling in other two socio-economic groups as well.

Regardless of trip type, none of the groups significantly showed their preference towards cycling as a travel mode, indicating that cycling is not encouraged enough so far by both users and policy-makers. The reflections can be observed through non-availability of cycling infrastructure, lack of policy, plans, and practices (e.g. bicycle-sharing, bicycle and riding facilities through other mass-transit travel modes), non-integration with other travel modes (e.g. bus-transit). Other hindrances such as hot weather and socio-cultural barriers also need to be addressed to promote cycling. Countries that are most similar in circumstances to Pakistan (e.g. China) have already adopted bike-friendly policies and long-term urban transportation plans that integrate cycling as a travel mode (Zhang et al., 2015). Even in countries like America and Canada that are heavily dependent on motorized vehicles, infrastructure is designed to accommodate bikes and planners are now pushing for more bicycle-use and less car-use (El-Assi et al., 2017; Wray, 2015). This is done by implementing bike-friendly policies and redesigning infrastructure even through the existing land-use is not very conducive to cycling (El-Assi et al., 2017). Studies show that one important factor that dooms bicycling policies is a lack of willingness to cycle (Strömberg & Karlsson, 2016) whereas in this study results showed that considerable percentage of respondents were willing to use bicycle in addition to or in-split with other modes of travel. However, a responsive cycling policy to take care of their willingness (and needs) is missing which needs to be addressed through bicycle-friendly policies.

Time, distance, and purpose of trips are the important factors that influence mode choice and much published literature is available on this topic. The results of this study showed that, even if there is no time constraint, people of lower socio-economic group were less likely to prefer bicycle to commute to their work as showed by other studies too (Ji et al., 2017). It is found that they, along with higher socio-economic group would like to travel via motorbike and car. However, respondents from middle socio-economic areas opted for public transport in addition to motorbike and car. This shows that there are some other factors involved in mode choice e.g. distance and time constraints. Furthermore, respondents from lower and higher socio-economic groups preferred to travel by bicycle up to 5 km while middle socio-economic respondents showed more willingness to travel by bike up to 10 km. This is a very important figure to consider when planning urban transport systems for all modes of travel. In addition, the results also showed that, for shorter trips (especially under 15 minutes), respondents from all three socio-economic groups preferred to use the bicycle. Another influencing factor could be type of trip. This study showed that a significant percentage of respondents from middle socio-economic groups preferred to travel via bicycle to their work place because of the nature of trip e.g. studies show that work-stress (i.e. to reach to work place on time, type of work where repeated trips are to be made etc.) is one of the leading factors to choose travel mode to commute to work (Blanc & Figliozzi, 2016). The same group was also found to be more concerned about affordability.

The overall results show that there is a lot of potential to promote cycling practices in Pakistan among all socio-economic groups. There is need to introduce plans and policies to promote cycling in combination with other modes of transport like bike-sharing practices as in Denmark (Kaplan et al., 2015). Also, rather than solely relying on socio-economic parameters of cycling, other aspects necessary to be considered are improvement in the overall wellbeing, environment, health and urban-transportation related issues (Xiao-jiang, 2011). Some developing countries have already taken such initiatives by including cycling as a sustainable mode of travel into their policies, and recommendations to follow suit have been given in some of the literature available on Pakistan (Naeem et al., 2016). However, there is a need to take additional and more concrete steps in Pakistan, starting with the acknowledgment of biking as a viable and important mode of travel.

There is a general lack of academic studies and published research on bicycling in Pakistan, which makes it difficult to understand the perceptions and preferences of bike-users. This study has taken a leading step to address that issue by producing meaningful data on cyclability in Lahore. The study found that cycling and its benefits have previously been neglected by urban and transportation planners and policy-makers at local, regional, and national levels. It is clear from the results that people know how to ride the bike, there are active bike users, and people are willing to use the bicycle but are simply not encouraged to do so. There is a lack of planned strategies. There are social norms, weather conditions, gender- and culture-related hindrances with rectifiable effects that are not being challenged or addressed. There are many cost-effective solutions available that have been adopted by other low-income countries to integrate bicycle with other cost-effective and efficient mass transit modes (rail and bus) that can contribute to sustainable development of the country. However, such solutions have not been yet get due attention of the policy makers in Pakistan. The solution to this problem needs further in-depth understanding of the issues, a strong political will, initial capital, long-term planning, sustainable urban strategies, and inclusion of all stakeholders and modes of travel.

In terms of collected data, there was lower representation of respondents in the middle socio-economic group compared to the other two groups. Also, there was very little or no representation of the 55-64 and 65+ age groups in the data. Lahore itself is a metropolitan area with mixed land-use and mixed socio-economic distribution, so a larger sample with more defined socio-economic conditions/groups in relation with various land-uses can add further knowledge to the research question addressed in this study.

6 CONCLUSION

To conclude, this study has explored many aspects of bicycling in Pakistan (Lahore as a case study) with respect to three socio-economic groups. The overall reflection is that the bicycle is a desirable yet neglected mode of travel. It is a popular mode of travel (or/and have user) in all the three socio-economic groups that are analysed in this study which is very encouraging for the urban transport policy-makers. However, policy-makers have not embraced the bicycle as a critical opportunity to make environmentally sustainable and economically prudent policy solutions. There is a need to make bicycling more a viable and efficient mode of transport for all age groups, socio-economic classes, educational groups, cultures, and genders. The need for increased provision of bicycling infrastructure is highlighted, which would help to overcome some of the hindrances identified in this study. It will also encourage people to cycle longer distances, for longer time spans, and for multipurpose trips. The willingness of the users to bike to work can be thus further stretched to the other trip purposes too by implementing policies that encourage bicycling. In short, Pakistan can address future concerns in energy, economics, health and other sectors by including the bicycle as a mode of travel alongside other modes. There is a need to study Pakistani bicycling preferences in conjunction with different land uses e.g. commercial, residential, educational etc. in greater depth. This research can be further extended to collect large-scale data from other cities in Pakistan i.e. lower and higher income cities. This study presented the perspective of the cycle users, a similar study can be conducted by including the perspective of policy-makers to understand the opportunities, challenges, and potential of promoting bicycling in Pakistan.

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IMAGE SOURCES

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Editors

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WATER FOOTPRINT INDICATORS FOR URBAN PLANNING

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ABSTRACT

Compared with the great number of studies carried out on virtual water, the Urban Water Footprint - UWF, has been object of less attention from researchers, probably because only in the last decade city water shortage has presented itself as global problem.
The study analyses the issue of the water value as a non-renewable resource, subjected to pressures that influence its quality and quantity. The "value" of water therefore indicates the measure of a resource used as an indispensable element of urban complexity, subtracted from its ecosystem and transformed from a natural resource to an anthropic resource.
Two indicators of the Water Footprint Network-WFN are proposed to analyze the water footprints of urban areas. The blue water indicator, generally used by the WFN to assess the stress of water bodies, where in this study is calculated as urban water consumption. The green water indicator used by the WFN to assess the rainfall uses of an regional area is analyzed here as an ecosystem element of the urban territory.

KEYWORDS:
Urban Water Footprint; Planetary Boundaries; Urban Water Planning

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水足迹，城市规划指标

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摘要

与对虚拟水资源进行的大量研究相比，城市水足迹(UWF)一直是研究人员关注较少的主题，这可能是因为在过去的十年中，城市水资源短缺已经成为全球性的问题。
本研究分析了作为一种不可再生资源，水资源价值所面临的影响其质量和数量的压力问题。因此，水的“价值”指的是一种资源的衡量，被用作城市复杂性的一个不可或缺的因素，从其生态系统中消减，并从一种自然资源转换为一种人为资源。
提出了水足迹网站(WFN)的两个指标用以分析城市地区的水足迹。蓝色水指标，通常被WFN用来评估水域的应力，在本研究中是作为城市用水量计算。绿色水指标被WFN用来评估本文分析的某一区域的降水利用，将其作为城市地域的生态系统要素。

关键词:
城市水足迹，地球界限，城市水规划

1 INTRODUCTION

The international community considers the urban systems as the physical form where it will be possible to reach the objective to share the benefits resulting from the actual level of development of the technological systems and from the use of the natural resources. The document New Urban Agenda - NUA, approved after the United Nations conference "Housing and Sustainable Urban Development" in October 20/10/2016, underlines that cities could be the source of resolution rather than the cause of the challenges that our world is facing (Habitat III, 2016). The NUA aims to be a tool for decision making and the stakeholders for urban planning and design, based on the needs of a civil society; it has to be able to imagine and realize the great structural transformations determined by footprint of human systems in each city. The NUA outlined new skills for urban planning, to support the role and enhanced capacity of national and local governments in data collection, mapping, analysis and dissemination and in promoting evidence-based governance. The objective is to promote a shared knowledge about the "geographic" data also through censuses, household surveys, population registers, and to develop economical - environmental indicators to urban plans. This study aims to evaluate how water shortage can constitute a drivers in the targets of urban re-planning. The World Economic Forum (2017) shows that in consideration of the fact that more than 3,5 billion of people lives currently in urban areas, water shortage will constitute in a brief period, one of the greatest risks that the national and local governments must face. This study aims to evaluate how water shortage can constitute a drivers in the targets of urban re-planning. The World Economic Forum (2017) shows that, due to the fact that more than 3,5 billion people currently live in urban areas, water shortage will soon constitute one of the greatest challenges that national and local governments must face. Water shortage is the subject of several studies carried out by Water Footprint Network, which has implemented a method to measurement anthropic uses of the water, substantially based on three indicators: *green water* determined by the rainfall; *blue water* which is water's employment from rivers and groundwater bodies, *grey water* is calculated as the volume of water that is required to dilute pollutants to such an extent that the quality of the water remains above agreed water quality standards. The WF indicators are largely used by the scientific community in particular in the studies directed to measure the *virtual water* that "travels" with products. The virtual water conceived by Allan in 1998, it refers to the volume of water consumed or polluted for producing the product, measured over its full production chain (Allan, 1998). When nation exports/imports such a product, it exports/imports water in virtual form. The virtual water isn't submitted to the regulation that concern the right to "to use the water" (unlike the Emissions Trading - Prohibition Act that regulating the emission in the atmosphere in according to Protocol of Kyoto). This permits to the economic operators "to transfer" the flows of water throughout the continents without any logic, except economic. These flows of products released in the great urban areas to satisfy billion people, are out of control of the local governments and can result in a biological impoverishment of their areas, and in shortage of their aquifer. This is one of main worries of the international organizations, first the Fao (FAO, 2011). According to Hoekstra and Mekonnen (2012) the main focus of the water planning is to satisfy the increasing water need, both local and regional level without over questioning whether consumptions was actually necessary. There isn't a complete vision of the national, of the domestic and of the industrial consumptions. The authors show that the WF of the average water consumer is of 1.385 m3 /y, the average consumer in the United States has a WF of 2.842 m3 /y, while China and India have a WF of 1.071 and 1.089 m3 / y respectively. Compared with the great number of studies carried out on virtual water, the Urban Water Footprint - UWF, has been object of less attention from researchers, probably because only in the last decade city water shortage has presented itself as global problem. It clearly a very different phenomenon, because water shortage in urban areas, doesn't mean a total lack of water as occur in the regions afflicted by intensive irrigation. What worries researchers of the UWF, is the relationship between the great quantity of water used in the cities and the effects that this can have on the hydrological local environment in terms of quality/quantity of water and extreme weather. This study investigates the possibility of using the water footprint indicators in order to have common values on the uses of water in urban areas, where "value" means a measurement of water used and subtracted from the natural environment for anthropic uses. First of all, a general framework will be made of the studies that have dealt with "value" to water flows in the urban and non-urban context. In paragraphs 3 and 4, footprint indicators have been proposed to assess the variability of water consumption within urban territories. Then, the Blue Water Footprint and the Green Water Footprint were calculated only for the water flows consumed in the Italian cities, like drinking water and domestic water. In paragraph 5, it was argued on the links between UWF values and urban planning instruments and how the UWF indicators can address urban transformations towards sustainable approaches.

2 THE URBAN ENVIRONMENT AS FLOW OF RESOURCES IN/OUT

The footprint that the human systems leaves on natural ecosystems is conditioned by the process of mutual adaptation between vegetable and animals species. These biochemical dynamics modify the ecosystems, and at the same time have create a state of dynamic equilibrium in which every element belongs to a whole. This scientific knowledge has developed over the last decades starting from Lovelock's Gaia Theory (Lovelock & Margulis, 1974) and has accompanied the scientific optimism which have led to the growing use of natural resources. The studies of the ecological footprint (Wackernagel & Rees, 1998; Wackernagel et al., 1999), have supported the necessity to introduce suitable indicators to measure the anthropic pressure on natural systems. These Indicators must be defined not on the basis of environmental characteristics affected by human systems, but calculated on the basis of the consumptions of natural resources used in anthropic processes. According to researchers the purpose of these indicators, is contributed to determinate the coefficient of biocapacity with which the natural systems succeed in restarting the states of equilibrium compromised by human footprint. In fact the biological times of resilience required by natural ecosystems, are not compatible with the aggressive nature of the anthropic footprint, (Tiezzi et al., 1992). The resources consumed by the cities has been object of studies on the urban metabolism, in which the urban environment is described as a hybrid system, where the cycles ecosystemics "intertwine" with the technological system create by the man (Baccini et al., 2012; Gisotti, 2006; Kennedy et al., 2007). In particular the in / out water flows that cross the city, develop dynamics that upset the pre-existing ecological characteristics, determining in the majority of cases, new cycles of ecosystem (Varriale, 2017). As shows the Fig.1, in the anthropic cycle of water there are many alterations in the environmental process and the consequent risks for the urban environment, among which:

- extraction from underground water with the risk of stress of reservoirs, and the aquifers lowering;
- collecting rainwater in mixed systems grids for disposal, with risks of urban flooding;
- unauthorized water withdrawals by private, and the risk of illegal disposal of industrial waste in the sewer system;
- risk of increased leaks from the distribution networks due to the obsolete state of the net.

In the cycle anthropic water is occurs the breakup of natural cycles of elements of ecosystem, where particularly in urban environments, vast volumes of water are lost. Many researchers are questioned on those broken cycles and on the way to recompose it beginning with a detailed analysis in the city. The metabolic flow of the water crosses the city for "to feed it" in all the natural and anthropic elements and when it flows out of the city it is then returned to its natural environment in different qualitative and quantitative states. In the first studies of the Water Footprint, it was made clear that to measure the total volumes of these flows, there was the difficulty to measure a dynamic flow prone to continuous variations. The section of a riverbed in fact could give different readings of its flow according to the season. Furthermore in the Footprint approach the water measure doesn't show exactly the existing volume but the "employed volume", in other words that part of the flow used for anthropic purposes. That volume in the anthropic usage is a different from that the natural level. In Seyam et al. (2003), the value water flow is defined as the missing link between the measurement of the water and the hydrology.

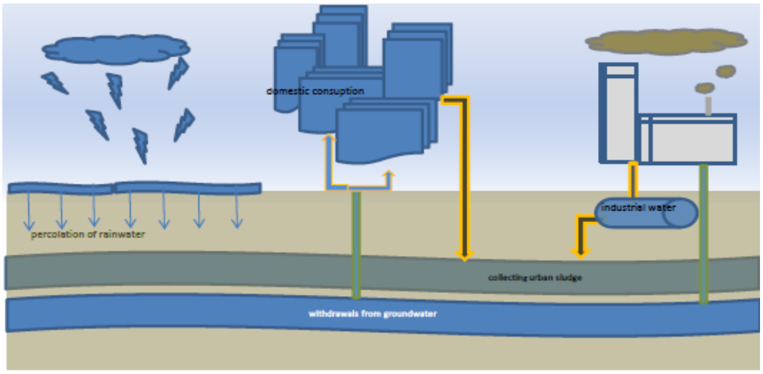

Fig. 1 Cycle of anthropic water

The hypothesis of the researchers is that the value of a molecule of water depends on the path that it follows inside the hydrologic cycle and from the values produced along this path. As a result, the resiliency of the water resource is based on quantity of rainfall of area refill. As a consequence, the emptying of the river basins for hydrologic services of urban distribution, without consider the rainfall, it cause a loss of the value of flow of the water. In the studies conducted by Costanza et al. (2014), the attribution of the value of an ecosystem resource is necessary when it needs to make some objective choices on the consequential benefits from its use. Generally the evaluation of the costs and benefits of environmental resource is poorly quantified because it is necessary to evaluate a wide range of benefits that include ecological sustainability, efficiency, social equity. But it is only the latter, according to researcher, that promote the definition of the value of the resource, through a governance that aims to share the resource for the public good. The demand to share globally the value of the water, is sustained also by Vörösmarty et al. (2015), who indicate the necessity of taking actions to deal with the dangers of the water shortage and pollution with laws which promote universally the sustainable use of water. Terms of sustainable consumption (Chapagain et al., 2012). In the study conducted in the Basin of the Zambesi, the researchers calculated the whole value of water use, included the "geographical transfer" of the water in the global commerce. Clearly, hydrological value of the water varies: the WF of regions or hydrographic basins has a different meaning from that in urban areas. In fact the scale to which the urban water footprint refers to, is that of the hydrographic basin that develops itself in the limits or inside the semi-urban borders. The studies that underline the problem of the scale o appraise the water footprint are different. Ma et al. (2015), for instance, in the analysis of WF in Bejing, shows that water consumptions of the mega-cities is ten times more elevated in comparison with the volume of available resources in the semi-urban area, which is inevitably translated in a meaningful external water reliance. Rushforth and Ruddell (2015), in the city of Phoenix in Arizona, estimate as WF is wider than regional track, going towards other nations, with consequence to have to face the right to the water, with different groups of political interest. Other studies focus new indicators for measuring WF in urban area. Fialkiewicz et al. (2014) suggests to analyze all structures that produce water consumptions in urban area using an approach bottom up that to gives evidence of the behavior of the human systems in the water use. The study of Wolfgang et al. (2016), proposes a methodology to estimate water use an urban scale, quantifying the consumptions of the drinkable water for different urban districts. The indicators are developed for the blue, green and grey footprint, in terms both the volumes of domestic - sewer nets line, and of rainfall flux. According to Agudelo-Vera et al. (2011), only starting detailed analysis of the consumptions is possible to develop a planning for domestic use of water. Monstadt (2009) furnishes an interesting contribution on new perspectives of WF analyses in urban planning. The author underlines the crucial importance of urban infrastructures grid for ecological sustainability of the cities. The technological nets manage the resources flows and model in essential way the environmental practices in the cities. The author thinks that the complex interdependences among cities and urban infrastructures widen our understanding of the ways in which we can develop, to govern and to renew the cities in sustainable way. In this approach, technological networks are not the keys of the "smart cities", instead represent an instrument towards urban sustainability. According to Papa et al. (2013), the technologies are one of the fundamental drivers for the construction of a sustainable city based on: technologies, people and governance. The footprint analysis have rarely been reproduced in urban planning analysis, while analysis of the urban people behaviors has been object of a broad seam of studies. The study Gargiulo and Russo (2017) investigate on the energetic consumption and the issues of CO2. The study shows that many studies have been developed on the relationship between the physical characteristics of the urban form and the energy consumption, while the focus of the search rarely compares the issues of CO2 with other urban characteristic as the functional, geographical and socioeconomic aspects. The city in many studies continues to be a bidimensional physical form, the search hardly faces the urban territories as process of the social behaviors. In the next paragraphs we bring some evaluation of water footprint conducted with new indicators implemented for measure the urban water consumptions beginning from some behaviors of the users.

3 THE CONSUMPTIONS OF DRINKABLE WATER

The first challenge that planning of water consumptions must face is due to the uncertainties of the data on the people behaviors. The behavior of the consumers in Italy it has been analyzed with data from Istituto Italiano di Statistica that referred only to domestic and industrial water use. From the Istat data of period 2000 -2011, on 116 cities of Italy we observed a period of substantial reduction of the domestic consumptions procapita, with an average reduction of -6.9%, with two level extremes: -30.54 % and +8.19 %. The distribution of the rate reduction of the consumptions between 2001/2011, shows that the reductions higher than 20% are very frequent. In the Fig. 2 the trend of the reduction in water consumption 2004/2011, is compared to the average values. In the same period the average increase of people is +4.5%. This trend has been compared with the demographic evolution each municipality. So we have that the rate of reduction of water use is enough distributed both in the Provinces with an increase of the population and in those with a decrease. In some cases (Tab.1), where the population is decreased in meaningful way, there are meaningful increases of the water consumptions.

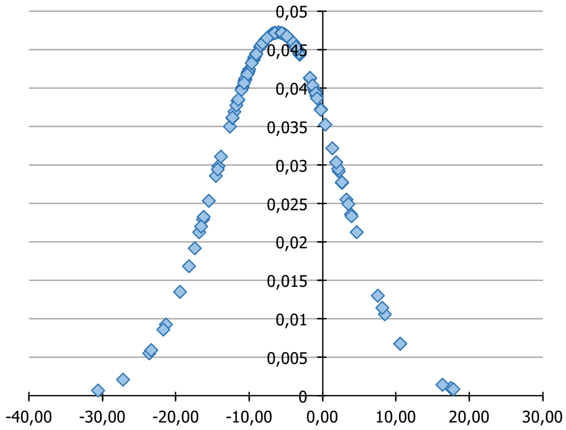

Fig.2 Trend of reduction value of the water consumptions 2004/2011 estimated with mean values

The demographic data doesn't seem meaningful for definition of tendencies of water consumptions, as is already shown in a study on the negative correlation between the energetic consumptions and density of population (Gargiulo & Russo, 2017). The estimates on water requirements are based on water supplies that quantify the population according to some categories, such as:

- uses from private residences, about the consumptions of the private sphere of the families, of which: personal cleaning, feeding, washing laundry, cleaning of the house, care of the private gardens and spaces condo etc.;
- uses from public buildings or collective institutes what: hospitals / clinics private, schools / university, markets, penitentiary, public and private offices, religious institutes, etc.;
- uses from public services what: management of the urban green, of the urban spaces, washing of the roads, fireproof service, etc;
- commercial and tourist uses: hotels, restaurants, business generally, etc.

Cities	Consumption reduction rate	Demographic balance
Trieste	0.99	-10,061
Treviso	5.89	3,382
Cremona	2.65	-1,298
Isernia	5.4	873
Caserta	0.71	552
Benevento	4.51	-337
Nuoro	11.87	-204
Sassari	5.31	3,053
Oristano	1.73	488
Catanzaro	2.99	-5,887
Crotone	2.46	-1,129
Reggio Calabria	6.14	464
Catania	1.66	-19,208
Caltanissetta	11.39	300
Messina	11.56	-8,764

Tab.1 Variations population and water consumptions 2001/2011

Obviously many of these consumptions depend on processes that could be overestimated or underestimated, and vary in the time according to the choices of the socio-economic players. The water endowment should be based on the behaviors of the consumers rather than on the numerousness of the various samples. Actually some regions are already developed Regional Waters Plans where underlined to deepen the data on the socioeconomic characteristics that form the demand of water in a specific area. For instance, the seasonality is considered as a fundamental parameter for the evaluation of the water supply, because there could be different habits referred to water use between seasons. In a study conducted on the Water Footprint of Sant Antonio Abate (south Italy) in 2017, the variations in the seasonality of the water consumptions are exclusively been imputed to the behaviors of the economic players that are represented by the industries of the canning sector of the tomato, that is active only in the summer months in that areas (Varriale, 2017). The seasonality and the demographic dynamics are fundamental parameters to value water endowment pro capita by planner, but according to an analysis more deepened, seem to be less determinants as thought. Among the water consumptions of the Italian families, there is for instance, the distrust of the consumers on the quality of the waters of the public nets. In the survey have not been advanced questions on the possible risks on the water quality due to the bottling in plastics or to the industrial risks of the bottling process, but it is evident that the 75.3% of the interviewed ones have motivations that overcome every risks because in the period 1995/2016 the consumptions of bottle of water are increased of around 9%. Obviously, the water consumed has a different value "social" from the natural right to the water, and in Italy the total of the footprint of the water in bottle included the exports, corresponds to 11.570.000 L / year (Tab.2). We have quantify the consumption of drinkable water-taking into account the data that we have examined, the water that the Italian consume in domestic use and for personal uses is given by the following (express values m^3/y):

$$W_{ci} = W_p + W_b = 5.411.580 + 11.570 = 5.423.150 \times 1000 = 5.42 \times 10^9\ m^3/y \qquad (1)$$

Where:

Wci Drinkable water Consumption is given from:

Wp = volumes accounted by the Utility (Istat, 2012) and Wb = consumptions bottled water.

Consumption type	2016
Consumers bottled water	54,721,800
Consumption in l/year/p.c.	206
Water bottles in mgl *	12,700
Export l in mg	1,130
Consumption Italy l/mg	11,570

Tab. 2 Statistics of plastic bottles on Censis data (Censis, 2018) (*) Thousands of liters

The families that declare not to trust to drink the water of the faucet still represent a considerable percentage despite the progressive improvement of the last fifteen years: from 40,1% in 2002 to 29.1% in the 2017. The families that declare not to trust drinking the tap water represent a considerable percentage, (despite the improvement of water supply of last fifteen years): from 40,1% in 2002 to 29,1% in the 2017. There are 7,4 million families that consume water bottle, with a marked territorial variability. The fact that people doesn't have a clear awareness of its own water footprint is confirmed by a survey in USA in 2017, with a sample of 1020 people. The results of the survey shown that majority of the questioned, indicated the water saving as a solution to the excessive consumption (for instance choosing showers briefer, alternate water when it washes us the teeth, etc.), rather than suggest improvements of the efficiency (i.e. technologies soft to guide dosing or recovery plants). Water is perceived therefore as a good that belongs to private sphere of individual, submitted to personal choices in which founds the inalienable right to the water.

4 BLUE WATER FOOTPRINT

The consumptions of drinkable water calculated in the previous paragraph, constitutes only a part of the volume of the blue Waters in urban environment. Indeed, the supplied volumes to consumers are always below the water's volumes introduced in the water nets that in the Italian municipalities they are average of around 145 m^3 /y for inhabitant, in comparison to the provided volume of 89.3 m^3/year. Therefore part of volume introduced in the water work then is loss, during the activities of disbursement and distribution. The leakage of drinkable water caused for, piping losses, mistakes of measurement, and not-authorized consumptions, they are equal to 38,3%, for a volume of 3,4 billion/m3, Istat (2017). The leakage volume has a strong impact on the volumes of water withdraw from the water basins in the cities (Fig. 3). The leakage have an obvious territorial variability that depends on the efficiency of the local water supply network. The accounts of urban water supply is conceived as an incomplete accounting in how much what enters the flow in terms of volumes, it doesn't correspond to what it goes out. The actual leakage are defined as a volumes that remain after all the components of consumption (measured and not measured) have been taken away by the volume of drinkable water that enters into the net. The volume not measured, it corresponds to consumptions not invoiced and authorized (i.e., consumption for urban parks) and the apparent losses (water's theft, measurement failures) represent the water consumed but not paid by the clients. The water management service often complain that is accounted in the consumptions represents only a part of the water flow managed in urban area, and that the principle "who pollutes pay", confirmed by the Dir UE 60/2000, is not honoured. Therefore, calculations on the losses in the water budgets are indirect evaluations with limits of uncertainty, rather than direct measurements (European Union, 2015). The global water volumes entered in the supply system to provide all urban distribution water grid are crucial to understand the type of pressure on peri urban area. For this reason we have analyzed the water volumes introduced in the distribution water grid of 20 Italian regions.

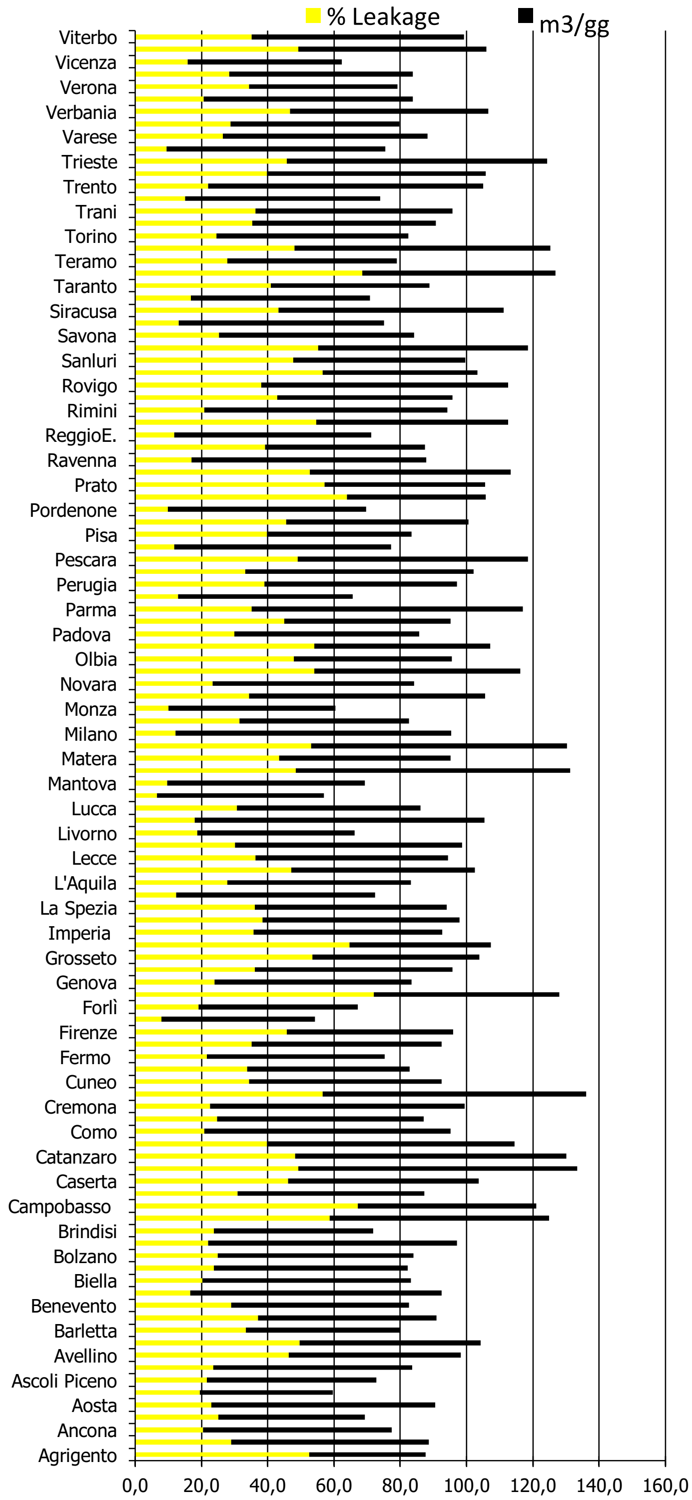

Fig. 3 Volumes disbursed and volumes lost in the water networks of the Italian provinces, Istat 2017

We have divided the period 1999-2012 (Istat data) in three principal spans 1999-2005; 2005-2008, 2008-2012 to consider the regional variations in the entered volume of water by utilities. The objective isto verify growth or reduction trend of the water volumes for region. As shown in Fig. 4, it is possible to observe that the volumes entered in water net vary in the incoherent way in all the regions, for all three periods. For instance in Marche the introduced volumes are in growth in the third period from 1999 to 2012, while in Campania the volumes introduced into the net decrease in the second period for then to increase in the third one 2008/2012.

In Calabria instead in the third period there is a reduction of the volumes introduced in comparison to the previous periods. These variations can be explained in terms of processes out of control such as:

- the consume not measurable because made for public activities of the municipalities (cleaning roads, construction sites, etc.);
- unauthorized consumption that occur in urban suburbs in illegal supply for domestic, industrial or agricultural;
- visible losses of the water distribution, that employ time in the phases of identification and reparation.

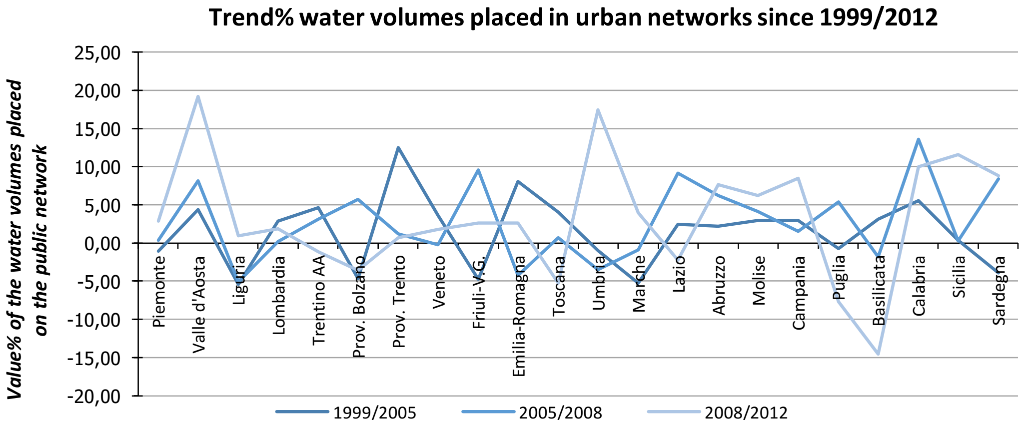

Fig.4 Volumes entered in the network for each Region expressed as difference % in between periods

These "chaotic" trends of the volumes introduced into the water nets during the period 1999/2012 show how much is difficult to effect precise forecasts of the urban water consumptions, and how much these uncertainties could increase in reason for the obsolescence of the urban water infrastructures, with an WF that could begin to take shape as a "water sprawl" on the territory. The analysis of the water footprint in urban areas should in fact take into account the fact that the sources of water do not always insist within the peri-urban boundary, so often it's necessary draw water from other neighboring basins. Therefore the urban water footprint spills over other urban areas, and the catchment networks sometimes stretch for thousands of km in and out of the river district with a sprawl difficult to contain. Furthermore, the volume supplied to urban distribution network, could also be lower than the actually volume provided by catchment area with losses also on that network. But unfortunately there are no certain data about this, despite these activities in Italy are managed exclusively by the regional authorities. In order to have an accurate impression of water consumption in urban areas, it would be necessary to include volumes of water imported and exported into the regional networks whit the relative losses of these. It would be necessary develop accounting for volumes transferred between subsystems also defining acceptance limits for loss level of each system (European Union, 2015). A factor to be considered in the analysis of the urban water monitoring concerns the sources from which the volumes of water are withdrawn. The principal sources of extraction in Italy are: sources, underground aquifers, basin artificial, lake and superficial waters. The wells pumping averagely represents the withdrawn more used in the Italian regions (Tab. 3). The wells containing waters of high quality and have times of resilience undefined because they are determined by the depth of groundwater, by the characteristics of the ground and by the precipitations. Therefore, this represent a critical step from the point of view of the ecosystem. Collecting water from wells is practice the most widespread in Italy, and as points out the Tab.3. In the majority of the regions both of high consumption and low - satisfies more than the 50% of its requirement, with the Basilicata exclusion that mainly collect from superficial waters. Water's collecting directly from sources are distributed in this way: from wells 48.6% (with an evident water stress from underground waters), 36% from source, 5% from superficial waters, 10.5%, from artificial basins or lakes and 0.2% from brackish waters. Regarding the import / export of water, it should be noted that Basilicata and the Marche collection around 90% more of what they consumed, and that export almost 50% of the volumes of water in other regions. So, from analysis of the local hydrographic districts, it is possible to highlight the value of the transported volumes through the regional areas and obtain an account of ecosystem water flow.

Italian Region	Water Source	Water well	Surface waters	Lakes	Brackish waters	Total
V. d'Aosta	47,063	5,640				52,703
	89.3	*10.7*				
Liguria	29,760	132,764	34,155	47,386		244,065
	12.19	*54.4*	*13.99*	*19.42*		
Lombardia	264,711	1,200,996	1,577	46,186		1,513,470
	17.49	*79.35*	*0.1*	*3.05*		
Piemonte	293,108	337,726	20,741	2,746		654,321
	44,8	*51,61*	*3,17*	*0.42*		
Veneto	230,330	418,943	63,142	2,385		714,800
	32.22	*58.61*	*8.83*	*0.33*		
Friuli V.G.	59,613	163,863	9,614	1.010		234,100
	25.46	*70*	*4.11*	*0.43*		
Emilia	41,461	310,655	108,318	46,117		506,551
	8.18	*61.33*	*21,38*	*9,1*		
Marche	110,698	36,930	6,208	21,745		175,581
	63.05	*21.03*	*3.54*	*12.38*		
Umbria	43,738	71,212				114,950
	38.05	*61.95*				
Toscana	89,509	236,792	130,225	4,219	1,094	461,839
	19.38	*51.27*	*28.2*	*0.91*	*0.24*	
Lazio	858,371	300,014	3.592	24,126		1,186,103
	72.37	*25.29*	*0.3*	*2.03*		
Abruzzo	232,150	59,716	11.288			303,154
	76.58	*19.7*	*3,031.54*			
Molise	114,489	42,671	13,854			171,014
	66.95	*24.95*	*8.1*			
Campania	470,269	457,594	58	25,002		952,923
	49.35	*48.02*	*0.01*	*2.62*		
Basilicata	40,145			286,632		326,777
	12.29			*87.71*		
Puglia	560	88.481		89,827		178,868
	0.31	*49.47*		*50.22*		
Calabria	194,311	170,930	46,723		10,027	421,991
	46.05	*0.41*	*11.07*		*2.38*	
Sicilia	169,735	419,456	4,631	113,350	6.853	714,025
	23.77	*58.75*	*0.65*	*15.87*		
Sardegna	39,655	40,818	3,521	246,026		330,020
	12.02	*12.37*	*1.07*	*74.55*		
Totale	3,330,374	4,495,948	460,782	956,962	17,977	9,257,255

Tab.3 Received volumes (thousand m^3/y) by type withdrawl, our elaboration, ISTAT, 2012

5 GREEN FOOTPRINT

The green water is calculated with the volume of the meteoric waters used in the activities of irrigation, particularly is calculated as virtual water contained in the zootechnical and agricultural products and traded at global level. This flow of water in the WF account is defined renewable, given that, under natural conditions of the meteorological events, the rain flow is distributed in the ground for percolation and subsequently in the atmosphere by evapotranspiration, in according to a natural cycle of the water. Instead in this study, the calculation of the Urban Green Footprint - UGW has been considered that the waterproofed of the urban territories is the cause of the "consumption" of the meteoric waters, that are subtracted to the natural cycle of the water. Indeed it deals with waters that falling on the waterproofed grounds of the urban territories, that are conveyed toward the nets of collection of water, and sometime they are mixed with wastewater.

Therefore, the anthropic activity of waterproofing of the urban ground is considered as the cause of the loss of water volumes of rainfall. Obviously, widest is the asphalted surface, greatest is the water that is subtracted by the natural environment. According to these considerations we have calculated therefore the Urban Green Water following (expressed in m^3/y):

$$UGW = A_p - A_v * I_{rf} = 8{,}424{,}924 \times 1{,}000 = 8.42 \times 10^9 \qquad (2)$$

Where: UGW = urban green water; Ap = Area Province (County), Av = green area; Irf = Index of rainfall. The green area has been calculated as the value % of green areas on the total provincial area, ISTAT 2016.
The calculation of the index of rainfallsis based on the so called pluviometric height, where a millimeter of accumulation is equal to 1 liter water fallen on a surface of 1 square meter. For every province there has been so identified the relative UGW, given from the areas constructed and the green areas, for the rainfall index of the province.

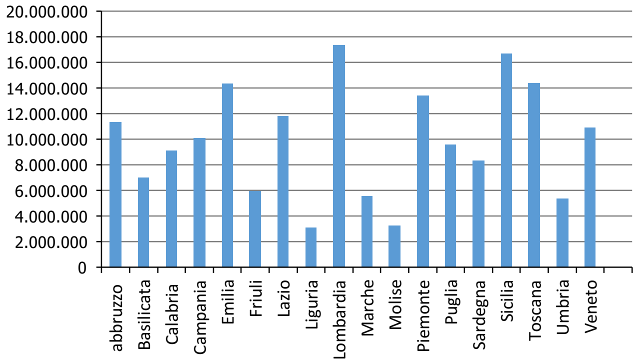

Fig.5 Green footprint for Italian Regions, our elaboration, Istat 2015

The collected data for regions are reported in the Fig. 5, where the Lombardia, Emilia Romagna, Sicilia and Toscana are the most UGW.

6 WATER INTELLIGENCE: THE BORDERS OF THE URBAN WATER FOOTPRINT

The indicator UBW and UGW proposed in this study are mainly based on some observations:

- not all the anthropic applications of the water are kept under control by the national water accounting, particularly the water used economic operators;
- the calculation of the withdrawals from underground reserves and from superficial water bodies doesn't keep in mind of all the collecting obtained for the agricultural compartment, industrial, tourism and of the leisure time service;
- dirty water's volumes entered in the companies' accounts don't always correspond to the volumes of dirty waters really delivered to the water bodies after treatment, where there are rain water and unauthorized withdrawals.

The two Indicators calculated, blue UBW and green UGW - indicate two impressive ecosystem problems (stress of the basins caused by collecting of superficial / underground waters; the waterproofing process of the ground) that the cities cannot transform in the brief period if not with combined actions of water intelligence. A governance of all players and stakeholders must be able to put together technological, economic, social and eco-compatible factors of water management, for an urban planning that sees in the sustainability the critical element of the urban quality and a decisive factor of the competitiveness and of the ability to attract resources, know how and investors (Papa et al., 2016). We must to take into account the fact that funding of many projects of sustainability water will be out of financial range of the public administrations. Nowadays, a lot of political decisions are turned to improve the drinkable water nets through technologies adept at self-regulation referenced to losses and relative pressures of the flows, to the purpose to reduce water wastage that the service of distribution records in Italy (De Paola et al., 2017). But also the implementation of these soft technologies records the financial difficulties of the administrators. According to Aldaya et al. (2012), all this makes to think that for the future the governance of the water will not be an exclusive domain of a regional government or however public. According to the author, even if the water remains a public resource, this suggest that the role of the companies and the investors can become fundamental in the management of the water resources and that the urban planning must be compared with a plurality of players and tools of governance more effective. Furthermore, the ambitious projects of Smart City financed and realized only by big private investors as the project Masdar in Abu Dhabi, have been the failures from the point of view of competitiveness of the urban areas. In fact, the project of urban sustainability must be accompanied by the incremental growth of the social capital, that is based on great scale of cooperation and interaction among the stakeholders of the cities, (Papa et al., 2013). The water intelligence cannot be understood only as new technologies to restore the waters of urban anthropic cycle. The great transformations of the urban areas can be realized rather with a new to governance putting together the pieces of a highly complex social action, as the ability to coordinate actions, projects and to integrate technologies that are still separately developed the ones by the others, but that they have clear synergies in their operation and they must be shared by their users (Gargiulo & Russo, 2017). Finally, the calculation of the urban water mark here proposed, can be identified as an early-warning systems (Steffen et al., 2011). In fact, according to the authors, the nature of Earth-system dynamics - the nonlinearities, tipping elements, thresholds / abrupt changes strongly, suggests that humanity needs to system to warn us when we are approaching such potentially catastrophic points. An early-warning system is a prerequisite for being able to recognize and steer away from such thresholds. Every edge is situated inside a zone of uncertainty that scientific researches can reduce, to reset or to put in further alarm. So, all depends from the ability to assimilate new scientific information about the terrestrial system, on the ecosystems, on the urban systems. It's necessary calibrate again the objectives of sustainability toward new and necessary dynamic equilibriums. The same occurred with the borders of the climate, first included within the limit of 450 ppms of CO2, then redefined under the threshold level of 350 . Everything suggests that the anthropic footprint on the planet must be managed in concert with a research capable of analyzing and quantifying the phenomena of our dynamic systems, indicating the limits, the threshold values beyond which our footprint cannot be pushed. And it is on these borders that water intelligence will have to work.

7 CONCLUSION

The purpose of the study was to investigate a little in-depth study of WF's research on urban consumption. We have seen how the consumption data often entrusted to the water service operators, do not give evidence of all the phenomena that compete to the urban water footprint. The blue and green footprint in Italians' cities was calculated, with indicators that could be replicated in other national or local contexts for comparison. The indicators proposed and elaborated according to the Water Footprint methodologies, present two substantial innovations in the studies on anthropic pressures, among which:

- in first place the characterization of the anthropic use of the natural resource starting from the behavior of the networks of social actors – ANT;
- secondly the urban dimension of the green footprint. The GWF in the WF account is defined as the renewable resource that is subtracted from its ideal cycle to enter the virtual cycle of trade in agricultural and zootechnical goods. In our opinion this approach is not sufficient for the characterization of urban territories, because the waterproof surfaces of the city, represent a real consumption of green water that are subtracted from urban soil.

With the use footprint Indicators it's necessary a reflection about how to set a limit to the collecting of water from the hydrographic basins, that implicates the necessity to save the water, keeping in mind of a multiplicity of factors, among which:

- the water in the urban areas is a limited resource, that in the urban territory is imported often for purposes that are not only linked to the drinkable water;
- the urban soil requires "waterways" that can contain the effects of climate change in terms of scarcity and extreme events. Water is therefore called upon to play its role in contributing to the sustainability of the urban territory;
- water quality plays a fundamental role in the quality of life of all animal and plant species that live in the urban area. Therefore, the dilution criterion used to make acceptable the chemical footprint, will lead us in the short term to an appalling emergency caused by enormous volumes of water polluted not usable;
- the water sprawl with which urban areas try to grab the available water resources, could generate huge problems of governance in the future, in which the claim to the right to water could go beyond technical-economic aspects, causing great conflict in the territories. Water sprawl should therefore become the object of study and further study of water footprints in urban areas.

Urban planners need to be equipped to handle these macro processes. The calculation of the footprints of each process and of limit of resources' uses, can support dialogue with stakeholders to manage the major structural transformations of everyday life, which inevitably the management of the anthropic cycle of water will entail in the future. Traditionally the urban planning of the water resources was effected on valuations of variation of the population and the relative demographic dispersion on the urban territory and peri-urban. This study suggests that it is not the number or the density of population that it determines a water footprint. Not only: the urban planning of the cycle of the water has had as objective that to define the volumes to withdraw, little have been investigated the real consumptions and on the relative stress of the hydrographic basins. The characterization of the urban water footprint asks for an analysis of the behaviors the trends to the consumption of the population, as example the distrust of the European consumers towards the waters of net and also the increasing consumption of waters in plastic bottles. As the development of the aquatic parks, a phenomenon in growth both in Europe that in Italy, that strongly engrave on the water stress. It would be necessary to analyze what the consumers want, and to wonder why the ANT nets privilege for the fun the equipped places rather than natural places. The social sciences should investigate more in depth on what we could define a desire of affiliation to an "anthropic landscape", and therefore in some way a "virtual and technological landscape". A territory that is perceived as safe, compared to emerging vulnerability of the urban territories, afflicted by climatic events, drought, atmospheric pollution. It results therefore evident as the urban transformations must pick up these trends of the human behaviors and in the same time they must transforming the cities beginning from the subjects that choose them. The studies of WF can help to stimulate the planners to rely themselves to new paradigms of planning about the available resources in urban area, keeping in mind of the "concept of limit". The indicators developed by the Ecological Footprint from 1999 have had a decisive role in the seeding into the environmental sustainability vision the concept of limit, that necessarily implicates the creation of new tools to plan the anthropic spaces and the activities beginning from what it is indeed available, and that can technologically be improved for a sustainability of the footprint. The urban transformations should for instance integrate the problems of the water losses of the urban nets with the reuse of volumes of used waters, for new projects for the urban sustainability of the next decades. Furthermore, methodologies developed for the Carbon Footprint – CF, the energetic efficiency, and for the Water Footprint - WF, the hydro efficiency, have a scientific value of which is important to take into account into the setting of a new paradigm for the urban constructions, because they represent a tools that are developed of the description of the complex systems. The Indicators already consolidated of CF and WF, represent a method to describe behaviors in which social actors, biochemists agents and physical (partly still to us strangers) process, contemporarily compete with unpredictable courses. What we can do in multivariate contexts as those of the urban territories, is to contribute to the identification of the attributes to describe a process, and it is really this the objective of the CF and WF studies: to describe the phenomena that happen, to quantify them, to select them and categorize to the purpose to improve our knowledge about the holistic systems that surrounds us. The studies of Footprint can contribute to the construction of the objectives of transformation toward the smart cities, because they represent de facto the databases on the dynamics of the processes, on the manner how consumers use the energy rather than the water, but also about their perception of the *value* of the resource they employ. Because if on one side we can agree with the fact that the value of a resource depends on the use that we do of it (Costanza et al., 2014), on the other hand it is also true that the use that we make of a resource, determines also of its value, inexorably.

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REVIEWS PAGES

THE RESILIENCE CITY/THE FRAGILE CITY. METHODS, TOOLS AND BEST PRACTICES 3(2018)

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.

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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，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，能够对与城市和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。

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02_BOOKS
书评推荐与期刊该期主题相关的最新出版著作。

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03_LAWS
法律部分提供主题相关标准方面的大量综述。

author: Maria Rosa Tremiterra
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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
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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。

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01

THE RESILIENCE CITY/THE FRAGILE CITY.
METHODS, TOOLS AND BEST PRACTICES 3(2018)

REVIEW PAGES: WEB RESOURCES

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In this number

GREEN AREAS GET SWALLOWED BY DESERTS: THE DESERTIFICATION PHENOMENON

Desertification is defined as "land degradation in arid, semi-arid and dry sub-humid areas, resulting from various factors, including climatic variations and human activities" (Rio, 1992). This is the innovative definition of the phenomenon (which is increasingly growing in the north Mediterranean countries) given by the United Nations Conference on Environment and Development (Rio, 1992). Its innovative nature is linked to several reasons, including that of considering desertification as the consequence of the overlapping of both anthropic and natural factors. In fact, until the last decade, this phenomenon was linked to periods of severe drought and only in the eighties it became a global problem (Iannetta, 2007).
Furthermore, desertification is one of the effects of climate change since it has increased in recent years, especially in areas affected by simultaneous precipitation and temperature variations (ISPRA, 2017). Climate change affects desertification in two different ways: on the one hand, it influences the expansion of natural deserts, on the other the increase in extreme weather events (such as floods and periods of severe drought) favours soil erosion.
To date, desertification is a widespread phenomenon, considering that the more desertified lands are vast, the faster they grow because space is removed from the natural resources that in the climate system have the function of reducing the presence of carbon dioxide in the atmosphere (which is the cause of rising temperatures), such as soil, that represents the second carbon tank after the oceans (Zucaro & Morosini, 2018).
This section presents three websites that provide data and documents to investigate the extent, causes and impacts of desertification: WAD (World Atlas of Desertification), soil maps and United Nations Environment. The World Atlas of Desertification aims to provide maps on the phenomenon of desertification and the map layers compiled using the convergence of evidence concept can be interrogated in an interactive way by the users. The soil map is a website managed by a working group belonging to the Council for Research in Agriculture and the Analysis of Agricultural Economics (CREA), which aims to provide digital databases and cartography of soils through the use of Geographic Information Systems (GIS). The third website is the United Nations Environment Programme, which is the main global environmental authority that sets the global environmental agenda and promotes sustainable development.

European Commission

World Atlas Desertification
https://wad.jrc.ec.europa.eu/

The World Atlas of Desertification is an atlas composed of maps constructed from the digital cartography base of the world and Lovell Johns' maps. This atlas is an assessment of land degradation at a global level; it is the result of scholarly collaborations among various experts from institutions and universities around the world, who were able to address the phenomenon of desertification thanks to their extensive experience and knowledge. The website is easy to consult, since the home page has six sections which can be accessed by clicking directly on the reference image:

- introduction;
- global patterns of human domination;
- feeding a growing global population;
- limits to sustainability;
- convergence of evidence;
- solutions.

At the bottom right side of the home page there are three more links that give access to information about the atlas and authors and allow the users to download the full version of the Atlas. Each of the sections listed above is in turn organized into subsections that group the different maps and documents, which can be viewed digitally. The "Global patterns of human domination" section provides snapshots that illustrate the dynamic human footprint on Earth and its potential impact on the soil resource.

The snapshots are organised into two groups: human presence and globalisation. The "Feeding a growing global population" section, instead, organises the maps into three subsections, where the global expanse of agriculture and the crucial aspects of the dynamics food productions in relation to land degradation are illustrated. The "Limits to sustainability" section is divided into six subsections which contain the maps monitoring the status of soils to understand the various processes of change that can lead to land degradation, in order to define the environmental thresholds within which human actions must be maintained to avoid future catastrophes.

In the "Convergence of evidence" section there are many documents (always articulated in subsections) which illustrate the complex human-environment interactions in order to evaluate the causes and consequences of degradation, because only a good understanding of the causes and the effects of the phenomenon can provide a guidance to control or reverse desertification. Maintaining and/or improving the productive capacity of land requires a step towards land degradation neutrality.

For this purpose, in the last section, called "Solutions", there are documents which envisage actions to preserve or improve the ability of natural resources to support ecosystem functions and services. In fact, sustainable management of soil and water play a fundamental role. In each subsection there are links which give access to all the maps and the possibility to download for free the maps and the various documents of the Atlas. At the top right side of the home page there are four links which give access to the Privacy statement and to the section "Search", which is the most interesting since users are directly connected to the website of the European Commission by clicking on it.

Soil Map
http://www.soilmaps.it/en/

The soil map is a website of the Centro Nazionale Cartografia Pedologica (CNCP), which is the Italian National Center for Soil Mapping. It is well articulated and rich in data on the soils of Italy, and can be a valid support for the assessment of the risk of desertification at national level since data recovery often represents the longest part of a work aimed at measuring a phenomenon; for this reason, the assessment cannot exclude the use of existing databases. This site is organised into six sections that are easily accessible from the first page of the site:

- home, with a drop-down menu on the left side that allows access to different areas. Through this menu it is possible to find the objective of the work of the research group, the location of the research center and information about the staff. In addition, from the same drop-down menu users can access two more pages, one that displays the various technological platforms, and the other – the "Publications" section – that collects volumes and maps easy to consult and download. To the right side of this section there is a box that allows the user to make a cartography search by entering the reference city;
- soil maps; in this section, after a brief presentation (as for the previous section) users can connect through a drop-down menu - on the left side - to pages that deal with specific topics, such as the Italian Pedological Regions and Land systems. Moreover, from the same menu, other three pages are accessible: the page that provides a list of the referents for each specific theme and for each Italian region, the "Publications" page (where all the documents are available for free download) and the page directly connected to the WebGis;
- database, in which the menu on the left side displays links to different pages where users can download data and publications, always in open version;
- pedoclimate, a section which structure is similar to the previous one;
- projects, a section that presents all the projects activated by the research center, divided by macro-topics, which can be accessed from a menu on the top left side of the section itself. Among the projects in progress, there is the project "Predisposition of a National Atlas of the areas subject to desertification" which proposes to identify, on a national scale, the areas currently desertified and those that, for the climatic and anthropic processes in progress, are more at risk of desertification. The result will be a first approximation of a database of desertified areas and at risk of desertification of Italy: the areas will be classified by type of desertification process and by the presence of mitigating or aggravating conditions of the process, with a 1:100,000 scale of the reference topographic cartography;
- deposits, the last section on the top left side, which contains two links: Presentation and Publications. On the page accessed by clicking on the Presentation, after a brief description of the section, there is a link that can be used to report a deposit, including the contacts of each referent.

Moreover, on the first page of the site, in the upper right corner, there are four more sections:

- downloads, where you can download data and documents in pdf format as well as software, made available under open licenses;
- links, a section which contains the sites focused on land use and on the phenomenon of desertification of Italian regions. In addition to the regional sites, there are links to Italian associations of soil science, research institutes and links to databases on these issues;
- contacts, where users can find the references of the managers of the various CNCP projects;
- site map, a useful modeling of the articulation and the contents of the site.

United Nation Environment Programme
https://www.unenvironment.org/

The United Nations Environment Programme is a United Nations website that aims to raise awareness among all EU countries in caring for the environment, through information campaigns aimed at improving people's quality of life without compromising that of future generations.

The site is organized in different sections, available by clicking on the links at the top of the home page: Regions, About us, Work with us, Languages, Resources and Events. The "Resources" section gives access to a page where all the publications, reports and newsletters related to the topics of interest are listed on the right side with the relative links. At the top left of the page, instead, there is a box for Advanced search, where the user can search by keywords, category and resource type or by topics. It is also possible to narrow down the search field by selecting several options at the same time or adding other types of information such as the region, the country and the tags. The scrolling list on the right side is easy to consult: by clicking on the title, users are connected directly to the linked page, where they can consult and download the material of interest for free. Desertification is one of the topics covered: users have just to enter the keyword "desertification" in the box on the left to access the different articles and reports focused on this type of phenomenon, which has aroused much interest especially in the last year, considering that the first report is dated February 2017 and the last one exactly one year later. By clicking on a report users access a page where they can download the material. In addition to the link of the report download, there are links through which it is possible to access other studies of possible interest for the user who is consulting that particular report. Lastly, to the left side of each page there are links to social networks: Facebook, LinkedIn, Twitter and AddThis - email a friend.

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IMAGE SOURCES

The images are from: https://www.cosepercrescere.it/la-desertificazione/; https://wad.jrc.ec.europa.eu/; http://www.soilmaps.it/en/; https://www.unenvironment.org

02

THE RESILIENCE/THE FRAGILE CITY.
METHODS, TOOLS AND BEST PRACTICES 3(2018)

REVIEW PAGES: BOOKS

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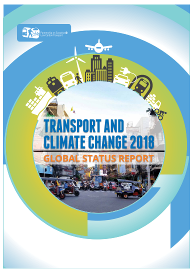
In this number

TOWARDS SUSTAINABLE AND RESILIENT SOCIETIES

Addressing climate change is one of the major global challenges of our time. We live in a world of increasingly unpredictable and complex risks. Trends such as demographic change, rural–urban transitions, technology change and climate change are reshaping our region (Ramachandra et al., 2014). We need to be much better prepared to deal with the interlinked impacts of long-term trends, and deal with the inevitable changes the future will bring. It is increasingly urgent to understand how best we can realize the transformations that will ensure that we achieve the Sustainable Development Goals. The 2030 Agenda for Sustainable Development states global leaders' determination to "take the bold and transformative steps needed to shift the world on to a sustainable and resilient path". Transformation requires breaking through the 'path dependency' that defines the way things are done. In particular, the transport sector is a major contributor to greenhouse gas emissions; responsible for 23% of global energy-related carbon dioxide emissions. The rate of emissions from transport is increasing faster than from any other sector. Transport activity, in turn, drives transport emissions, which grew by 31% from 2000 to 2016. The growth of absolute transport emissions between 2000 and 2016 was highest in Asia (92%), Africa (84%) and Latin America (49%), driven by growth in prosperity and in passenger and freight transport activity in these regions. The technology is playing an increasing role in low carbon transport plans and target from countries, states and provinces, cities, and companies (Angelidou, 2017). In last decade, the political and corporate leadership on transport and climate change is growing in scope and intensity, within and outside of global agreements (De Gregorio et al., 2015). The actions required to strengthen resilience can be understood in terms of inter-related and complementary resilience capacities: Anticipatory capacity, the ability of human systems to anticipate and reduce the impact of shocks through preparedness and planning; Absorptive capacity, the ability of human systems to absorb and cope with the impacts of shocks and stresses; Adaptive capacity, the ability of human systems to change in response to multiple, long-term and future risks, and to learn and adjust after a shock materializes; Transformative capacity, the ability to take deliberate steps to change systems that create risks, vulnerability and/ or inequality.

According to these themes, this section proposes three works that help to better understand the topics of this number: Open Data Infrastructure for City Resilience. A Roadmap, Showcase and Guide; Transformation towards sustainable and resilient societies in Asia and the Pacific; and Transport and Climate Change Global Status Report 2018.



Title: **Transport and Climate Change Global Status Report 2018**
Author/editor: Partnership on Sustainable, Low Carbon Transport (SLoCaT)
Publisher: German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and the William and Flora Hewlett Foundation
Publication year: 2018
ISBN code: -

This first edition of the Transport and Climate Change Global Status Report is intended to help ensure that low-carbon transport is a fundamental strategy in climate action at global, regional, national, and sub-national levels. Considering the implementation of the Paris Agreement on climate change, transport must inevitably play its part if global targets are to be met. The report describes recent trends in transport demand emissions, illustrates recent policy targets and measures across a number of transport sub-sectors, and sets a baseline from which to demonstrate the potential of transport to make a proportional contribution to the 1.5-degree Celsius scenario. This report is intended primarily as a resource for policy-makers to raise ambition on climate mitigation and adaptation in sustainable transport plans and programs by countries, cities, states and provinces, and private sector companies; thus, the report provides a central repository on transport and climate change data which can help to support policy-makers in setting transport planning targets. In addition, the report offers trends analyses supported by peer examples to help increase coherence among low carbon transport policies for actors at different levels of government.
In the first part, the report consists of a global overview comparing current trends in transport and climate change across three dimensions: passenger and freight transport, international aviation and shipping, and global regions with respect to transport demand, transport emissions, and low-carbon transport policy measures. In the second part, it describes recent trends in transport demand and transport emissions and illustrates potential Paris Agreement-compliant mitigation pathways. This part is divided into three parts: Part A discusses the various drivers of transport demand, considering recent trends in passenger and freight transport demand, and reports on global development of transportation infrastructure; Part B reviews transport emissions growth by mode and region, and explores transport energy intensity, carbon intensity of fuel, and other impacts; and Part C discusses transport emissions projections and mitigation potential. In the third part, it describes frameworks for transport and climate change planning through the United Nations Framework Convention on Climate Change mitigation and adaptation planning processes, along with low carbon transport policy targets and measures across eight major policy areas, which are illustrated by recent examples from a range of global regions including extensive case studies from the Global South. In the four part, it summarizes global investment in the transport sector and examines the current level of investment from four sources: the public sector, the private sector, official development assistance (ODA), and climate finance. The funding gap between the current level of investment and projected future needs in the transport sector is highlighted as well. This report is not intended to make policy recommendations, nor does it advocate the use of any particular low carbon transport measure, mode, or technology. Data are drawn from the most recent publicly-available source to populate a set of key indicators, which are to be refined and expanded in the future. As available data are not consistently robust for each of the eight policy areas, the report maintains indicators to highlight existing gaps with the goal to support future data collection efforts. Mode shift and emission reduction impacts for implemented measures in each of the eight policy areas are quantified where possible, data sets are currently limited for most of this policy areas.

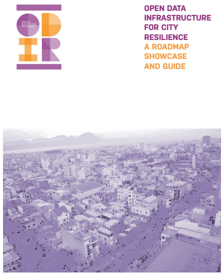
Title: **Transformation towards sustainable and resilient societies in Asia and the Pacific**
Author/editor: The Economic and Social Commission for Asia and the Pacific (ESCAP)
Publisher: United Nations and Asian Development Bank
Publication year: 2018
ISBN code: 978-92-9261-115-6

This report takes stock of the changing nature of risk in Asia and the Pacific, and the stresses, shocks and opportunities that are affecting a diverse region's prospects for achieving the SDGs. It quantifies the effects of selected natural hazards, commodity shocks and pollution shocks on the region's fundamental human systems. It highlights practical efforts being made by citizens, civil society, government and the private sector to build resilience capacities. This study identifies three barriers to transformation that make change difficult. The first is inadequate human and institutional capacity; the second is institutional rigidity, which diminishes institutions' capacity to evolve; and the third is inadequate social momentum for change. Socio-cultural factors, gender and other dimensions of inequality, and imbalances in access to decision-making also affect prospects for transformation.

The report contributes to regional and global dialogue on the theme of the 2018 high-level Political Forum on Sustainable Development, "*Transformation towards sustainable and resilient societies*", from an Asia-Pacific perspective. It explores how resilience thinking can strengthen public policy to enable the transformation towards sustainable societies envisaged by the 2030 Agenda for Sustainable Development.

- Chapter 1, sets out the relevance of the theme for achieving the 2030 Agenda in the Asia-Pacific region, and the steps needed to build the four key resilience capacities: absorptive, adaptive, anticipatory and transformative. It presents a three steps approach for incorporating resilience into policymaking that: (1) identifies risks; (2) explores the potential impacts on human systems and vulnerable groups; and (3) identifies policies and institutional responses that build these resilience capacities.
- Chapter 2, explores the first two steps, reviewing the main underlying sources of risks in the region. It assesses the impacts of various types of recurrent shocks on human systems in the region, with a focus on the most vulnerable people in society;
- A Special Feature of the report takes stock of the situation in the region with respect to the SDGs that explicitly refer to resilience;
- Chapter 3, supports the final step: the identification of policy and institutional responses. It shows how each of the four different types of resilience capacity can be built, presenting a range of examples of policies and programmes, from across the region, that have proven effective. It draws conclusions on the key characteristics that individuals, organizations and societies need to become resilient;
- Chapter 4, concludes the report by considering opportunities to support transformation for resilience, particularly through regional cooperation.

It shows how capacity-building and institutional interventions – from the household level through the community level to the national level – can increase resilience. It underlines that the likelihood of achieving some of the most urgent transformations advocated by the 2030 Agenda can be increased by better understanding the context of risk and focusing on resilience-building. It has stressed opportunities to support transformations that can support more resilient development, including through a focus on learning, deeper stakeholder engagement, innovative partnerships and financing for resilience.



Title: **Open Data Infrastructure for City Resilience. A Roadmap, Showcase and Guide**
Author/editor: Resilience Brokers, GeoSUMR, OpenNorth and Esri
Publisher: UNISDR Making Cities Resilient Campaign
Publication year: 2018
ISBN code: -

This publication contributes to the Making Cities Resilient campaign, launched by the United Nations Office for Disaster Risk Reduction (UNISDR) 2015-2030 at the local level and partners since 2010. It has been developed as a resource for cities that include urban planning, risk reduction, resilience building and civil contingency. It has been designed to help cities to integrate open data policies and infrastructure into their wider city data strategies and the development of their resilience action plans. The Roadmap, Showcase and Guide have a particular focus on open data, risk analysis and response that resilience action planning requires. This publication also highlights how investments in open data-based approaches combined with the use of geospatial data and geographic information systems (GIS) software can generate strong resilience benefits for city authorities. Also, the publication is a part of a suite of new tools that are oriented toward the 10 aspects essentials for making cities resilient, a ten-point checklist developed for the making cities resilient campaign by leading urban resilience experts.

The structure of the publication is composed of three section Roadmap, Showcase and Guide. The section A, two key assessment tools for understanding the level of data maturity of a city are presented, alongside a set of tried and tested approaches. In the section B, it includes use cases from a range of developed and developing country cities. In the last section C, it covers cross-cutting issues such as how to develop crowdsourced mapping, data standards, open innovation and risk communication.

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03

THE RESILIENCE CITY/THE FRAGILE CITY.
METHODS, TOOLS AND BEST PRACTICES 3 (2018)

REVIEW PAGES: LAWS

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In this number

TOWARDS INTEGRATION BETWEEN DISASTER RISK REDUCTION AND CLIMATE CHANGE ADAPTATION IN THE EUROPEAN UNION

Climate change, urbanization, population growth, and environmental degradation strongly affect the urban capacity to effectively respond to severe natural events. At the international level, the Sendai Framework for disaster risk reduction 2015-2030, adopted by United Nations (UNISDR, 2015), try to provide a first common policy reference and a basis for the development of a resilient sustainable development agenda for better managing the consequences of these issues. Furthermore, one of the issues addressed by the Sendai Framework refers to the link between Disaster Risk Reduction and Climate Change Adaptation. In the past Climate Change Adaptation and Disaster Risk Reduction were considered different and separate concepts. In particular, while Climate Change Adaptation meant to increase the social and infrastructural capacity of the territories to respond to the future climate changes, Disaster Risk Reduction was addressed to act on the three components of the risk concept – hazard, exposure and vulnerability – and reduce them, and especially the vulnerability, for adverse events. However, several researchers (i.e. Balaban & Şenol Balaban, 2015; Norton et al., 2015) and policy documents highlight that Climate Change Adaptation and Disaster Risk Reduction are strictly linked. As highlighted by the Hygo Framework in 2007, indeed, risk reduction is a means to adapt to climate change impacts since climate variability represents a source of risk. In this perspective, Climate Change Adaptation can be considered a component of the broad Disaster Risk Reduction agenda (ProAct Network, 2008). It is possible to identify various relationships between Climate Change Adaptation and Disaster Risk Reduction (ProAct Network, 2008). For examples, both aim to build resilience in the face of hazards and have to be integrated into relief, recovery and development plans and policies and thus require multi-stakeholder participation. Furthermore, from an operative viewpoint, in order to achieve the common goal of Climate Change Adaptation and Disaster Risk Reduction, they recognize:

- the need to define and implement measures at the local level;
- a starting point in the knowledge of existing conditions of risk and climate variability;
- the benefits of environmental management measures for future risk reduction;
- the importance of the risk analysis for defining effective actions.

Nevertheless, Disaster Risk Reduction and Climate Change Adaptation have also differences. For example, while Disaster Risk Reduction has a well-defined theoretical profile, Climate Change Adaptation is mainly based on practical local applications. Besides the Sendai Framework, other international documents pay attention to

the Disaster Risk Reduction and Climate Change Adaptation' integration, including the UNFCC Paris Agreement and the UN Sustainable Development Goals, both adopted in 2016.
In this context, considering the increase of disasters in its territories, the European Union has started to take into account this need to adapt to climate change in order to reduce the disaster risks. In particular, since 2001 the European Union has adopted a set of documents that put in relationships these two aspects. They are the EU Climate Adaptation Strategy (2013), the EU Civil Protection Mechanism (2001), the EU Action Plan on the Sendai Framework for Disaster Risk Reduction (2016), the EU Floods Directive (2007) and the EU Green Infrastructure Strategy (2013). In order to understand in which way the European Union is addressing the integration between Climate Change Adaptation and Disaster Risk Reduction with a specific reference to the urban planning implications, in this issue two European legislative framework are described. The first one is the Commission Staff Working Document "Action Plan on the Sendai Framework for Disaster Risk Reduction 2015-2030. A disaster risk-informed approach for all EU policies". Since the European Union played a key role during the negotiations for the definition of the Sendai framework, the Action Plan includes a set of operative addresses for the implementation of the Sendai priorities. Secondly, the European Commission's Communication "Strengthening EU Disaster Management: rescEU Solidarity with Responsibility" is illustrated. This document integrates the EU Civil Protection Mechanism established in 2001 for supporting Member States during disaster events.

ACTION PLAN ON THE SENDAI FRAMEWORK FOR DISASTER RISK REDUCTION 2015-2030

The Sendai Framework is a voluntary instrument that was adopted by the United Nations in 2015 and aims at preventing new and reducing existing disaster risks by using an integrated approach. In particular, the adoption of its "priorities" can have effects in the reduction of vulnerability and increase of resilience of a territory. This instrument is the result of a policy concertation at the international level during which the European Union played a leading role.
In order to pursue the international targets and develop a "disaster risk-informed approach" to take forward the EU disaster risk management agenda and to reinforce efforts to increase resilience to shocks and stresses in Member States, in 2016 the European Union adopted the Action Plan on the Sendai framework.
According to the Sendai Framework, the Action Plan takes into account the four priorities as a starting point:

- Sendai Priority 1. Understanding disaster risk;
- Sendai Priority 2. Strengthening disaster risk governance to manage disaster risks;
- Sendai Priority 3. Investing in disaster risk reduction for resilience;
- Sendai Priority 4. Enhancing disaster preparedness for effective response to "Build Back Better".

In a fragmented way, several EU initiatives have already contributed to implement these four priorities. However, the Action Plan identifies a new approach that consists of four key areas based on the Sendai framework:

- Key Area 1. Building risk knowledge in EU policies;
- Key Area 2. An all-of-society approach in disaster risk management;
- Key Area 3. Promoting EU risk informed investments;

- Key Area 4. Supporting the development of a holistic disaster risk management approach.

The Key Area 1 responds to the Sendai Priority 1 and provides the following "implementation priorities": the promotion of the collection and sharing of baseline loss and damage data; the use of scenarios and risk assessments for better preparedness to existing or possible risks; the engagement with the research community in order to address disaster risk management and encourage "the science-policy interface in decision-making". Instead, in order to respond the Sendai Priority 2, the Key Area 2 is characterized by three main "implementation priorities" that are: the improvement of risk awareness and education, as a mean for reducing disaster risks and better managing their impacts; the active engagement of authorities, communities and civil society for developing inclusive local and national disaster risk reduction strategies; finally, the strengthening of the links among disaster risk management and climate change adaptation. In particular, with regards to this last priority, the Action Plan highlights the key role that urban policies and initiatives assume for a better integration of disaster risk management and climate change adaptation. However, this role seems to be also shared with the implementation of "biodiversity strategies". According to the Sendai Priority 3, for the Key Area 3 the Action Plan defines five implementation priorities that are mainly related to the promotion of risk-informed investments and risk insurance but includes also the implementation of ecosystem-based approaches for disaster risk reduction. Finally, the Key Area 4, related to the last Sendai Priority, considers the ex-post disaster actions and defines as main implementation priorities: the integration of cultural heritage in the national risk reduction strategies; the improvement of the preparedness and response capacities for disasters that can have health consequences; the support to a better integration of transnational detection and early warning and alert systems for improving the disaster preparedness and response action; finally, the promotion of the "Build Back Better" that means a stronger, faster, and more inclusive post-disaster reconstruction in order to avoid or reduce future disaster risk (Hallegatte et al., 2018).

With regards to each implementation priority, the Action Plan identifies specific activities to carry out until 2020. In particular, in order to improve the "*understanding of disaster risk management in urban settings and enhanced support and contribution to disaster-resilient towns and cities*", the main activities identified by the Action Plan are the following ones:

- develop guidance and methodologies, learn from good practices and address the needs of vulnerable groups in communities in order to define urban resilience policy and practices;
- support cities in partner countries that are mainly exposed to risks in order to strengthen their capacities in addressing disaster risks at the local level and in developing and implementing national disaster risk reduction and climate change adaptation strategies;
- integrate disaster risk management policy and practices into the European Urban Agenda and in the several European initiatives that refer to cities (e.g. Covenant of Mayors for Climate and Energy, Smart Cities, etc.).

STRENGTHENING EU DISASTER MANAGEMENT
RESCEU SOLIDARITY WITH RESPONSIBILITY

In recent years, the European Union is facing heavy impacts due to intense and unpredictable extreme natural events. These events have different consequences in terms of loss of life, destruction of properties and cultural heritage. Furthermore, the current climate variability, better known as "climate change", plays an important role in exacerbating the magnitude of natural disasters. Therefore, starting from 2001 all the Member States were included in the EU Civil Protection Mechanism that aims at fostering cooperation among national Civil Protections. However, considering the increase of natural and weather disasters in Europe, in 2017 the EU Commissions publishes the Communication "Strengthening EU Disaster Management: rescEU Solidarity with Responsibility" which states the need of a review to the current EU's civil protection response in order to strengthen it. As defined in the Communication, the main changes will refer to the following objectives:

- "Reinforce the EU's and Member States' collective ability to respond to disasters, and address recurrent and emerging capacity gaps, by putting in place a dual system of response capacity: a dedicated reserve of response capacities with command at control at Union level, to be known as rescEU; and a more effective and dynamic contribution from Member States through a European Civil Protection Pool";
- "Strengthen the focus on prevention action as part of the disaster risk management cycle, as well as reinforce coherence with other key EU policies acting, inter alia, in the field of climate change adaptation, disaster prevention and disaster response";
- "Ensure the Union's Civil Protection Mechanism is agile and effective in its administrative procedures in support of emergency operations".

In order to respond to these objectives, seven key actions are identified. They include greater coordination between the European Commission and Member States in order to increase prevention and preparedness during disasters and endorse a more cross-sectoral approach in this field. Furthermore, the European Commission highlights the need to coordinate the disaster management with other EU policies among which the climate change adaptation. Indeed, the EU Strategy on Adaptation to Climate Change can work in synergy with disaster risk management since climate change adaptation represents a "mean" to prevent the externalities of disasters. This integration has to take into account various tools and instruments that Member States have at their disposal, including specific EU funds. About the improvement of the Civil Protection mechanism, the Communication identifies nine key actions that include various tasks, among which:

- the launch of a Communication and an Advocacy Campaign on disaster prevention "with a particular focus on forest fires, heat waves and other climate-induced extreme weather events, to improve awareness of preventive action";
- the promotion of a more systematic collection and dissemination of loss data, the enhancement of the loss data collection and the use of loss data for optimising prevention and climate adaptation planning.

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04

THE RESILIENCE CITY/THE FRAGILE CITY.
METHODS, TOOLS AND BEST PRACTICES 3(2018)

REVIEW PAGES: URBAN PRACTICES

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In this number

PLANNING FOR RESILIENCE IN SOUTH 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 et al., 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 & Bourdic, 2012), also arguing that achieving resilience in urban areas requires a strong partnership between local governments, research centres, 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 honour 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 37 Resilience Strategies (with nearly 1,900 concrete actions and initiatives) have been developed. This contribution presents two relevant Resilient Strategies, developed in two South-American capitals, within the 100 Resilient Cities framework: i) the Quito (Ecuador) Resilient Strategy and ii) the Santiago (Chile) 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:

- an inadequate transportation system;
- sprawl and uncontrolled urban growth;
- environmental degradation;
- persistent social inequalities.

Furthermore, both cities have faced in the past (and might face in the future) volcanic and hearth-quake hazards.

Quito is the capital city of Ecuador and has an urban population of 2.67 million inhabitants. The city not only boasts a rich history and cultural patrimony, represented by its word-famous historic center (that received recognition as the first UNESCO World Heritage Site in 1978), but also an incredible wealth of biodiversity. The city has been exposed in the recent years to a wide range of acute shocks including earthquakes, volcanic eruptions and economic crises. Beside these shocks, there are other, smaller-magnitude and more frequent shocks like floods and forest fires. At the same time, the city continues to be affected by chronic stresses such as social exclusion, environmental degradation, lack of an efficient transportation system, and lack of a diversified economy that provides job opportunities. In order to face these and other relevant urban challenges, on October 2017, the city of Quito released its Resilience Strategy with the support of the *100 Resilient Cities* initiative. The strategy is based on 5 main pillars, 16 goals and 64 tangible actions:

- *Pillar A, Inclusive and empowered citizens* - This pillar is in response to the need to consolidate participatory processes as vectors of democracy, validate the public administration's work, and facilitate processes of co-responsibility between citizens and the municipality. To reach these aims several coordinated actions are considered in the strategy, ranging from the development of a digital platform aimed at supporting citizens participation in the decision-making process, to the activation of public areas regeneration projects finalized at creating safe and functional public spaces trough the collaboration of citizens, private stakeholders and the Quito municipality.
- *Pillar B, Robust and Sustainable Environment* - This pillar concern with the environmental dimension of urban resilience and proposes developing efficient, participatory administration mechanisms aimed at managing natural and seminatural areas and urban parks while increasing citizen environmental awareness. To address these objectives the strategy includes a green infrastructure program aimed at regenerate and create new green areas within the city, giving particular attention to deprived neighborhoods. It also includes a communication campaign in which citizens themselves can experience the benefits of nature and understand the importance of personal and collective contributions to reducing the city's environmental footprint.
- *Pillar C, Integrated and Compact City* - Scattered and uncontrolled urban sprawl is a problem that makes Quito segregated and inefficient. This third pillar controls urban sprawl, maximizes the positive impact of building the first Quito metro line, and creates an integrated and efficient mobility system

that favors active mobility. A number of coordinated actions are proposed to meet this goal. These include: i) the development of a comprehensive plan for transit-oriented development (TOD), finalized at organizing and maximizing the benefits associated with public transportation by creating dense, mixed-use settlements in the areas surrounding the new metro line stations; ii) the development of a technological tool that makes it possible to monitor dynamics involving real estate development (height and extension) using satellite images; iii) the implementation of the Urban Partial Plan for the Quito Historic City Center aimed at maintain and improve the quality of life for city center residents and visitors, coordinate different means of transport and all associated development, and develop conservation, participation, and occupancy plans and iv) the development of a new low environmental impact construction regulation finalized at incentivizing real estate projects to incorporate environmental efficiency principles into construction through regulations.

- *Pillar D, Resourceful and Solid Economy* - Building economic resilience begins by strengthening productive sectors and diversifying lines of business, all with an environment-friendly focus. This fourth pillar creates an economic environment conducive to strengthening job supply and demand, with a special focus on youth. It fosters a diverse, sustainable, and innovative economy, and promotes the food-related economy as the backbone of development. Several actions are included within the pillar D, ranging from the creation of Special Economic Development Zone (ZED) in the proximity of the city's airport aimed at attracting new investments through tax incentives, to the development of industrial parks where incentivize the location of new business companies while regulate areas where residential, commercial, and industrial land uses coexist through zoning and city planning regulations. Emphasis furthermore is given within this pillar to incentivize urban and rural agriculture by developing specific mechanisms to improve both the quantity and the quality of production in urban gardens as well as the demand for such products;
- *Pillar E, Reflective and Safe Territory* - This pillar seeks to avoid creating new risks, mitigate existing ones, and prepare the city to confront potential natural and man-made disasters. In particular, to avoid new risk the strategy proposes the development of guidelines for new construction and reinforcing existing construction in low-income areas. For mitigating existing risks, the strategy proposes a new program to strengthen mechanisms for evaluating existing buildings and critical infrastructures. Finally, in order to prepare the city and its citizens to confront potential disasters, the strategy includes programs to i) promote neighborhood preparedness, ii) create disaster response neighborhood volunteer networks and iii) extend insurance against natural and manmade disasters.

SANTIAGO

Santiago is the capital city of Chile and has an urban population of 5.61 million inhabitants. Over the last decades, Santiago has undergone an explosive development characterized by a steady economic and a significant reduction in the levels of poverty. However, the built city has consolidated with a scenario of limited urban planning tools, resulting in disperse settlements and social and geographical segregation. The city has faced several shocks in the recent past related to its geography and climate including earthquakes, barrages, floods, thermal inversion and droughts.

At the same time, Santiago continues to be affected by chronic stresses such as security, transport and pollution, where social inequality is a factor that transcends all of these stresses. In response, the city of Santiago released its Resilience Strategy on June 2017. The Strategy is framed by 7 pillars, 21 objectives and 75 actions:

- *Pillar I, Urban Mobility: Connected Santiago -* The main objective of this pillar is to promote the use of public transport and encourage active mobility as a means to achieve a more sustainable and resilient transportation system. To meet this objective, the strategy presents a number of coordinated initiatives, including: i) the definition of a Metropolitan Authority to better meets the needs of a complex and evolving mobility system; ii) the definition of an Intermodal Development Plan, aimed at identifying the region's relevant transfer points; iii) the implementation of a fare integration model for the region's urban-rural transport system.; iv) the development of smart urban logistic solutions aimed at minimizing costs for businesses and reducing the environmental impacts of transportation and v) the renovation of pedestrians and cycling spaces through greenway projects.
- *Pillar II, Environment: Green and Sustainable Santiago* - This pillar is aimed at reducing the shortage of green areas within the city by integrating natural systems into the urban fabric, fostering a sustainable waste-management system and establishing a sustainable and equitable energy system. In particular, the City intends to target investment into green infrastructure and nature-based solutions especially in the most vulnerable neighborhoods. A sustainable waste management system is also envisioned in the strategy and is supported by the development of a waste recovering program, as well as investments in applied research. Finally, in order to establishing a more sustainable energy system, the city will lunch different initiatives targeting the reduction of energy consumption in the public sector as well as in the commercial and residential sector;
- *Pillar III Human Security: Safe Santiago* - The third pillar promotes the peaceful coexistence of Santiago inhabitants and addresses the multi-causality of crime in a collaborative, coordinated, strategic and intelligent manner. Action included in this pillar are mainly targeted toward the realization of situational prevention projects such as tele-protection systems, providing lights in unsafe areas with high public rates, renovation of empty lots, bus stops, stands, street furniture, among other things; as well as self-care promotion and citizen education;
- *Pillar IV, Risk Management: Prepared Santiago* - This pillar is devoted at design intelligent systems to mitigate risks and face emergencies, recognize and anticipate existing risks in the metropolitan area and prepare the citizenship against threats and disasters. To meet these objectives the strategy proposes the creation of the Integrated Emergency and Disaster Management Centre for monitoring, collecting, analyzing, and sharing information among institutions and for prioritizing actions in times of crisis and disasters. Furthermore, the strategy proposes the development of three specific programs: the Seismic Risk program, the Hydro-meteorological Hazard program and the Fire Prevention and Control program. Finally, the strategy proposes the creation of a network of volunteers that will be activated in case of natural or man-made disasters;
- *Pillar VI, Economic Development and Competitiveness: Global and Innovative Santiago*. This pillar is aimed at positioning Santiago as a global city by strengthen the regional ecosystem of innovation and entrepreneurship. To this end a coordinated mix of action will take place, including: i) the development of a Strategic Plan to promote the Santiago City brand; ii) the creation of an international convention center, which will attract business and thematic tourism to the region; iii) the creation of mechanism to fund startups, research and small and medium enterprises within the city-region;
- *Pillar VII, Social Equity: Inclusive Santiago* - This pillar addressed the social dimension or urban resilience ad aims at generating inclusion opportunities for those at social risk or in situations of violence. It also aims at guarantee access and standard to urban goods and services to all the

inhabitants of the region. Different programs are thus envisioned, targeting specific vulnerable social groups including children and adolescents, immigrants, and the elderly. The strategy furthermore includes an update of the Santiago Metropolitan Zoning Plan for the promotion of socio-spatial equity.

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05

THE RESILIENCE CITY/THE FRAGILE CITY.
METHODS, TOOLS AND BEST PRACTICES 3(2018)

REVIEW PAGES: NEWS AND EVENTS

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In this number

FROM URBAN RESILIENCE TO "EVERY MAN FOR HIMSELF" STRATEGIES

At the Resilent cities 2019 conference, which for years has been one of the most important events on this topic, another theory on the evolution of the concept of resilience appeared in the "innovation for resilience" section: it is the urban tinkering, title of a paper released this year; according to the authors of the paper urban tinkering is "a mode of operation, encompassing policy, planning and management processes, that seeks to transform the use of existing and design of new urban systems in ways that diversify their functions, anticipate new uses and enhance adaptability, to better meet the social, economic and ecological needs of cities under conditions of deep uncertainty about the future" (Elmqvist et al., 2018).
This theory comes from the analysis of the studies of François Jacob. In his essay "Evolution and Tinkering," published in Science in 1977, the scientist argues that a common analogy between the process of evolution by natural selection and the methods of engineering is problematic. Instead, he proposes to describe the process of evolution with the concept of bricolage (tinkering). In this essay, Jacob does not deny the importance of the mechanism of natural selection in shaping complex adaptations. Instead, he maintains that the cumulative effects of history on the evolution of life, made evident by molecular data, provides an alternative account of the patterns depicting the history of life on earth.
Urban tinkering is supposed to be the application of evolutionary thinking to urban design, engineering, ecological restoration, management and governance in order to "substantially complement and augment conventional urban development, replacing predictability, linearity and monofunctional design with anticipation of uncertainty and non-linearity and design for multiple, potentially shifting functions" (Elmqvist et al., 2018).
The capacity of being able to live in uncertainty, the main theme of the Taleb theory of antifragility (Angiello et al., 2018), is reached in the urban tinkering principles through new multifunctional elements able to solve a problem by themselves.
In an attempt to disengage from the determinism of the last century, unable to cope with the unpredictability and rapidity of change in the socioeconomic phenomena of contemporary society, the current scientific landscape tends to successfully welcome theories that make the ability to live in indeterminacy the main value to build the future; although they pose interesting issues, the feeling is that

these theories shift attention from the city as an interconnected organism to the city as a sum of elements. But the city as a collective phenomenon must be imagined, shared and finally the tools must be created so that this image becomes real. Furthermore, in this way the scientific community seems to raise the white flag by renouncing to make a real contribution to the development of the cities of the future. The only way to build cities that survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience, is taking responsibility for imagining the future rather than preparing places and people to face it whatever happens, by offering in other words "every man for himself" strategies.
Therefore, the selected conferences deliberately deal with different issues not necessarily related to the theme of resilience, but which basically question on the future of cities.

URBAN CHALLENGE CONFERENCE 2019

Where: Copenhagen, Denmark
When: 25 April 2019
http://www.urbanchallengealliance.com/new-index-1/#conference

European Union, with its long experience on academic mobility, plays an important role in the construction of a scientific network built on shared experiences essential to create broad and multi-cultural visions of the future cities.
One of such kind of project founded by EU is the Urban Challenge Programme where academic institutions, municipalities, and corporations converge and cooperate to address urgent challenges and sustainability issues across urban settings by offering courses to graduate students enrolled at one of the six partnering Universities-Aalto University, Copenhagen Business School, University of Edinburgh, HafenCity Universität, University of Latvia, and Sapienza Università di Roma.
Part of the program is the Urban Challenge Conference, that will take place in Copenhagen on April 25th, 2019. It will be a day to showcase results from the Urban Challenges partnerships together with influential renowned practitioners such as Justin Kliger, member of Future Cities Catapult's Digital Planning and Standards Team, Bruce J. Kats, co-Founder of "New Localism Advisors", and Aleksandra Kazmierczak, an expert in urban climate change adaptation at the European Environment Agency of Copenhagen.

URBANISM NEXT CONFERENCE 2019

Where: Portland, USA
When: 7-9 May 2019
https://www.urbanismnext.com

In all the vision of the cities of the future, technology plays a fundamental role (Papa et al., 2015). Is not a case that, the first annual Urbanism Next Conference, held in March 2018, bringing together over 500 planners, architects, landscape architects, developers, technology experts, elected officials, academics, and many others, was focused on the topic "how technology is changing cities".
The topic was so successful that one year later technology is still the leading actor of the conference: on 7th of next May the debate will focus on the ways that technological innovations can be harnessed to achieve desired outcomes. What has been tried? What has worked? What has not worked? What should we try next?

How can the private and public sectors collaborate to ensure that desired outcomes drive technological innovation rather than the other way around?
Advances in technology such as the advent of autonomous vehicles (AVs), the rise of e-commerce, and the proliferation of the sharing economy are having profound effects not only on how we live, move, and spend our time in cities, but also increasingly on urban form and development itself. Researchers are working with leaders from the public, private, and academic sectors across North American and Europe to better understand the secondary impacts of emerging technologies on cities and ensure that governments from the local to federal level have the information they need to make informed decisions that improve equity and health outcomes, as well as help achieve community goals related to the economy and the environment.

URBAN FUTURE global conference

URBAN FUTURE 2019

Where: Oslo, Norway
When: 22-24 May, 2019
https://www.urban-future.org/

Technology is not the only key to a sustainable future of our planet. The Urban Future global conference offers a different point of view on this issue: what is most important for solving the urban challenges are the people driving positive change. It is the world´s largest meeting dedicated exclusively to "city changers" – decision makers who actively, passionately and effectively make cities more sustainable. In this edition the thematic areas are changed slightly from the last year, taking into consideration all the discussions with stakeholders who are sharing their view on the most relevant topics for the future of cities.
Among the 10 tracks proposed this year, divided in 4 thematic focus (Urban Mobility, Built Environment & Architecture, Leadership and Green Business & Innovation) the following are strictly connected with the urban resilience:

- car-free City Life;
- cutting Carbon Emissions;
- green Public Procurement;
- electrification.

ECCA

ECCA 2019

Where: Lisbon, Portugal
When: 28-31 May 2019
https://www.ecca2019.eu/

The Ecca 2019 Conference offers a more concrete and structured approach to the discussion about the future of cities more focused on the climate risk management. Data, co-productions and communication are the main topic driving the discussion together with the following themes:

- institutions, governance, citizens and social justice;
- global climate challenges;

- climate risk management and resilience.

Each theme is articulated around specific questions that will drive the discussion in order to return a detailed picture of the research in these issues. Some of the more interesting questions of the conference are shown below:

- what are the examples on using seasonal forecasting and regional climate change projections in climate change vulnerability and risk assessments?
- how should we evaluate the success of adaptation options?
- how can we involve citizens to improve and implement adaptation solutions?
- what tools are available to access useful and credible climate data, information and knowledge on climate vulnerability and risk?
- how can we increase trans-boundary collaboration and solutions?
- what are the roles of climate change adaptation and disaster risk reduction in facing this century's societal challenges?
- what are current and needed innovative solutions to increase climate resilience in cities?

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IMAGE SOURCES

The image shown in the first page is taken from:

https://www.keepcalm-o-matic.co.uk/p/keep-calm-and-every-man-for-himself-2/

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