TeMA

Journal of
Land Use, Mobility and Environment

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..

Tema is the Journal of Land use, Mobility and Environment and offers papers with a unified approach to planning and mobility. TeMA Journal has also received the Sparc Europe Seal of Open Access Journals released by Scholarly Publishing and Academic Resources Coalition (SPARC Europe) and the Directory of Open Access Journals (DOAJ).

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

Vol.11 n.2 August 2018

print ISSN 1970-9889 e-ISSN 1970-9870
University of Naples Federico II

TeMA Journal of
Land Use, Mobility and Environment

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

2 (2018)

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

TeMA is realized by CAB - Center for Libraries at “Federico II” University of Naples using Open Journal System

Editor-in-chief: Rocco Papa
print ISSN 1970-9889 | on line ISSN 1970-9870
Licence: Cancelleria del Tribunale di Napoli, n° 6 of 29/01/2008

Editorial correspondence
Laboratory of Land Use Mobility and Environment
DICEA - Department of Civil, Architectural and Environmental Engineering
University of Naples "Federico II"
Piazzale Tecchio, 80
80125 Naples
web: www.tema.unina.it
e-mail: redazione.tema@unina.it

Cover Image by Maria Rosa Tremiterra of Am Sandtorkai, one of the main streets of HafenCity, a new district located on the waterfront of the City of Hamburg. HafenCity can be considered "a city in the city" and one of the most resilient urban areas in the world to the flooding events thanks to its urban redevelopment strategy.

TeMA. Journal of Land Use, Mobility and Environment offers researches, applications and contributions with a unified approach to planning and mobility and publishes original inter-disciplinary papers on the interaction of transport, land use and environment. Domains include: engineering, planning, modeling, behavior, economics, geography, regional science, sociology, architecture and design, network science and complex systems.

The Italian *National Agency for the Evaluation of Universities and Research Institutes* (ANVUR) classified TeMA as scientific journal in the Area 08. TeMA has also received the *Sparc Europe Seal* for Open Access Journals released by *Scholarly Publishing and Academic Resources Coalition* (SPARC Europe) and the *Directory of Open Access Journals* (DOAJ). TeMA is published under a Creative Commons Attribution 3.0 License and is blind peer reviewed at least by two referees selected among high-profile scientists. TeMA has been published since 2007 and is indexed in the main bibliographical databases and it is present in the catalogues of hundreds of academic and research libraries worldwide.

TeMA Journal of Land Use, Mobility and Environment

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

2 (2018)

Contents

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

ROCCO PAPA
DICEA - Department of Civil, Architectural and Environmental Engineering
University of Naples Federico II
e-mail: rpapa@unina.it

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.

TeMA Journal of Land Use, Mobility and Environment

TeMA 2 (2018) 173-194
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: http://dx.doi.org/10.6092/1970-9870/5532

review paper received 10th April 2018, accepted 27th August 2018

www.tema.unina.it

Esopi, G. (2018). Urban commons: social resilence experiences to increase the quality of urban system. *Tema. Journal of Land Use, Mobility and Environment*, Issue Volume 11(2), 173-194. doi: http://dx.doi.org/10.6092/1970-9870/5532

URBAN COMMONS:

SOCIAL RESILIENCE EXPERIENCES TO INCREASE THE QUALITY OF URBAN SYSTEM

GIULIA ESOPI

Urban Project Laboratory
Department of Civil Engineering and Architecture, University of Pavia
e-mail: giulia.esopi01@universitadipavia.it
URL: uplab.unipv.it/people/eng-giulia-esopi

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.

TeMA

有关土地使用、交通和环境的杂志

TeMA 2 (2018) 173-194
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: http://dx.doi.org/10.6092/1970-9870/5532

review paper received 10th April 2018, accepted 27th August 2018

www.tema.unina.it

Esopi, G. (2018). Urban commons: social resilence experiences to increase the quality of urban system. *Tema. Journal of Land Use, Mobility and Environment*, Issue Volume 11(2), 173-194. doi: http://dx.doi.org/10.6092/1970-9870/5532

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

GIULIA ESOPI

Urban Project Laboratory
Department of Civil Engineering and Architecture, University of Pavia
e-mail: giulia.esopi01@universitadipavia.it
URL: uplab.unipv.it/people/eng-giulia-esopi

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.

		SUBJECTS		
		OWNERSHIP	USE	CARE
RESOURCE	PUBLIC			
	PRIVATE			
	COMMON	 or 		
LEGEND				
	Public subject		Private subject		Collectivity of subjects

Tab.1 Differences between public, private and common resources

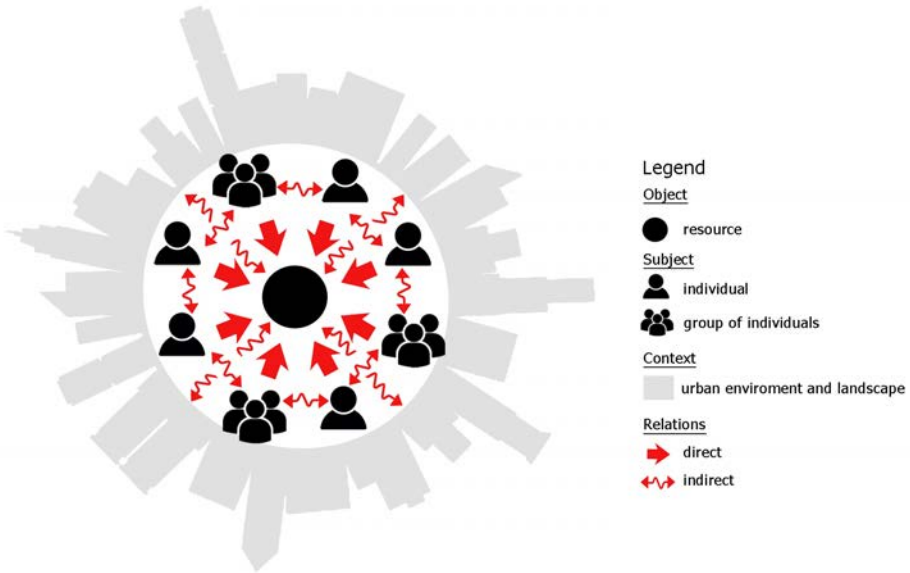


Fig.1 Urban common scheme

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.

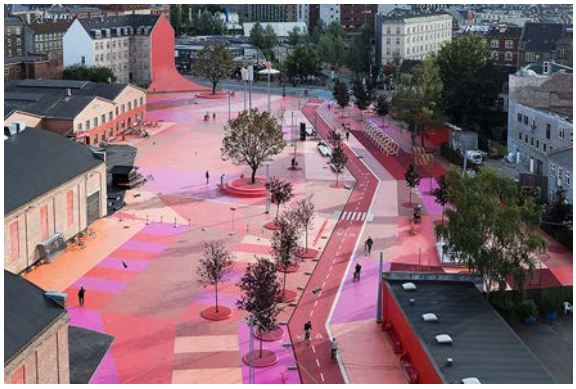


Fig. 2 - 3 Case studies I, II

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.

REFERENCES

Adger, W.N. (2000). Social and ecological resilience: are they related? *Progress in Human Geography*, *24*, 347-364. doi:http://dx.doi.org/10.1191/030913200701540465

Arena, G., & Iaione, C. (2015). *L'età della condivisione. La collaborazione fra cittadini e amministrazione per i beni comuni*. Roma: Carrocci.

Batty, M. (2005). *Cities and complexity: understanding cities with cellular automata, agent-based models, and fractals*. Cambridge, Massachusetts: The MIT Press.

Bertuglia, C.S., & Staricco, L. (2000). *Complessità, autorganizzazione, città*. Milano: Franco Angeli.

Bertuglia, C.S., & Vaio, F. (2011). The complexity approach to the study of urban systems. In: C. Beguinot (Ed.), *The city crisis …for a UN world conference …for a UN resolution* (pp. 500-515), Series of Urban Studies, XXXII.

Blackmar, E. (2006). Appropriating "the commons": the tragedy of property right discourse. In: L. Setha & S. Neil (Eds.), *The politics of public space* (pp. 49-80). New York: Routledge.

Bishop, P., & Williams, L. (2012). *The temporary city*. London: Routledge. doi:https://doi.org/10.1080/17535069.2012.762228

Blečić, I., & Cecchini A. (2016). *Verso una pianificazione antifragile. Come pensare al futuro senza prevederlo*. Milano: Franco Angeli.

Bohle, H.G., Etzold, B., & Keck M. (2009). Resilience as agency. *IHDP-Update*, *2*, 8-13.

Borch, C., & Kornberger, M. (2015). *Urban commons. Rethinking the city*. New York: Routledge.

Brunetta G., & Baglione V. (2013), Resilience in the transition towns movement. Towards a new urban governance. *TeMA, Journal of Land Use, Mobility and Environment*, *6*(2), 251-263. doi:http://dx.doi.org/10.6092/1970-9870/1524

Calcagno Maniglio, A. (n. d.), *Conoscenza e analisi del paesaggio*. Retrieved from www.architettiroma.it/monitor/d/didatticaurbana/calcagno_conoscenza_analisi_paesaggio.html. Last access March 2018.

Carpenter, S.R., Westley, F., & Turner, M.G. (2005). Surrogate for resilience of social-ecological system. *Ecosystems*, *8*, 941-944. doi:https://doi.org/10.1007/s10021-005-0170-y

Colucci A. (2012). Towards resilient cities. Comparing approaches/strategies. *TeMA, Journal of Land Use, Mobility and Environment*, *5*(2), 101-116. doi:http://dx.doi.org/10.6092/1970-9870/921

Council of Europe (2000). European landscape convention. Florence, 20 october. Retrieved from www.convenzioneeuropeapaesaggio.beniculturali.it. Last access July 2018.

European Environment Agency-EEA (2009). *Ensuring quality of life in europe's cities and towns*. Retrieved from www.eea.europa.eu/publications/qualityof-life-in-Europes-cities-and-towns. Last access July 2018.

Ferguson, F. (2014). *Make_shift city. Renegotiating the urban commons*. Berlin: Jovis.

Foster, S.R., & Iaione, C. (2016). The city as a commons. *Yale Law and Police Review*, *34*, 281-349. doi:http://dx.doi.org/10.2139/ssrn.2653084.

Frank, R.H., Bernanke, B.S., McDowell, M., Thom, R., & Pastine, I. (2012). *Principles of economics* (3rd edition). New York: McGraw-Hill.

Hardin, G. (1968). The tragedy of the commons. *Science*, 162, 1243-1248. doi:http://dx.doi.org/10.1126/science.162.3859.1243

Harvey, D. (2011). The future of the commons. *Radical History Review*, 109, 101-107. doi:https://doi.org/10.1215/01636545-2010-017

Hess, C., & Ostrom, E. (2007). Introduction: an overview of the knowledge commons. In: C. Hess & E. Ostrom (Eds.) *Understanding knowledge as a commons: from theory to practice* (pp. 3-26). Cambridge, Massachusetts: The MIT Press.

Iaione, C. (2015). Governing the urban commons. *Italian Journal of Public Law*, *7*, 170-221.

Istituto nazionale di statistica - Istat (2015). Urbes. Il benessere equo e sostenibile nelle città. Retrieved from www.istat.it. Last access July 2018.

Mattei, U. (2011). *Beni comuni un manifesto*. Bari: Laterza.

Moroni, S. (2015). Beni di nessuno, beni di alcuni, beni di tutti: note critiche sull'incerto paradigma dei beni comuni. *Scienze Regionali*, *14*(3), 137-144. doi:http://dx.doi.org/ 10.3280/SCRE2015-003008

Nijkamp, P., & Reggiani, A. (1998). *The economics of complex spatial systems*. Amsterdam: Elsevier.

Newman, P. (2010). Resilient cities. Retrieved from www.espace.library.curtin.edu.au. Last access July 2018.

Obrist, B., Pfeiffer, C., & Henley, R. (2010). Multi-layered social resilience: a new approach in mitigation research. *Progress in Development Studies*, *10*(4), 325-343. doi:http://dx.doi.org/10.1177/146499340901000402

Ostrom, E. (1990). *Governing the commons. The evolution of institutions for collective action*. Cambridge: University Press. doi:http://dx.doi.org/10.1017/CBO9780511807763

Papa R. (2012). Editorial preface: resilient cities. *TeMA, Journal of Land Use, Mobility and Environment*, *5*(2), 5-6. doi:http://dx.doi.org/10.6092/1970-9870/1156

Portugali, J. (2013). *What makes city complex?* Retrieved from www.spatialcomplexity.info. Last access April 2018.

Pumain, D., Sanders, L., & Saint-Julien, T. (1989). *Villes et auto-organisation*. Paris: Economica.

Rodotà, S. (2012). Beni comuni: una strategia globale contro lo human divide. In: M.R. Marella (Ed.), *Oltre il pubblico e il privato. Per un diritto dei beni comuni* (pp. 311-332). Verona: Ombre Corte.

Susser I., & Tonnelat S. (2013). Transformative cities: the three urban commons. *Focaal: Journal of Global and Historical Anthropology*, 66, 105-132. doi:http://dx.doi.org/10.3167/fcl.2013.660110

Archdaily, Superkilen-Topotek 1 + BIG Architects + Superflex. Retrieved from www.archdaily.com/286223/superkilen-topotek-1-big-architects-superflex. Last access March 2018.

Berlin Municipality, Park TempelhoferFeld. Retrieved from www.berlin.de/en/parks-and-gardens/3561883-4407152-park-tempelhofer-feld.en.html. Last access March 2018.

Grün-Berlin Gruppe, TempelhoferFeld. Retrieved from www.gruen-berlin.de/en/tempelhofer-feld. Last access February 2018.

Open Berlin, Nomadisch Grün gemeinnützige GmbH. Retrieved from www.openberlin.org/users/nomadisch-gr%C3%BCn. Last access March 2018.

Prinzessinnengärten. Retrieved from www.prinzessinnengarten.net/about/. Last access March 2018.

Public Space, Superkilen. Retrieved from www.publicspace.org/en/works/g057-superkilen. Last access March 2018.

Realdania. Retrieved from www.realdania.org/. Last access March 2018.

Raumlaborberlin, Tempelhof. Retrieved from www.raumlabor.net/tempelhof/. Last access March 2018.

Superflex, Superkilen. Retrieved from www.superflex.net/tools/superkilen/image. Last access March 2018.

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).

AUTHOR'S PROFILE

Giula Esopi is Ph.D. candidate in Civil Engineering and Architecture, University of Pavia. She has collaborated with Urban Project Laboratory of the University of Pavia since September 2014. She has played assistance to Urban Planning course (University of Pavia) since 2015. She received a master degree in Building Engineering and Architecture with a thesis about 'The porous city: an intervention method for open spaces regeneration'.

TeMA Journal of Land Use, Mobility and Environment

TeMA 2 (2018) 195-212
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: http://dx.doi.org/10.6092/1970-9870/5485

review paper received 3th March 2018, accepted 3th July 2018

www.tema.unina.it

Molavi, M. (2018). Meauring Urban Resilience to Natural Hazards. *Tema. Journal of Land Use, Mobility and Environment*, Issue Volume 11 (2), 195-212.
doi: http://dx.doi.org/10.6092/1970-9870/5485

MEAURING URBAN RESILENCE TO NATURAL HAZARDS

MEHRNAZ MOLAVI

Department of Urban Planning, University of Guilan
e-mail: molavi@guilan.ac.ir

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.

TeMA

有关土地使用、交通和环境的杂志

TeMA 2 (2018) 195-212
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: http://dx.doi.org/10.6092/1970-9870/5485

review paper received 3th March 2018, accepted 3th July 2018

www.tema.unina.it

Molavi, M. (2018). Meauring Urban Resilience to Natural Hazards. *Tema. Journal of Land Use, Mobility and Environment*, Issue Volume 11 (2), 195-212.
doi: http://dx.doi.org/10.6092/1970-9870/5485

城市自然灾害复原能力估量

MEHRNAZ MOLAVI

Department of Urban Planning, University of Guilan
e-mail: molavi@guilan.ac.ir

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

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.

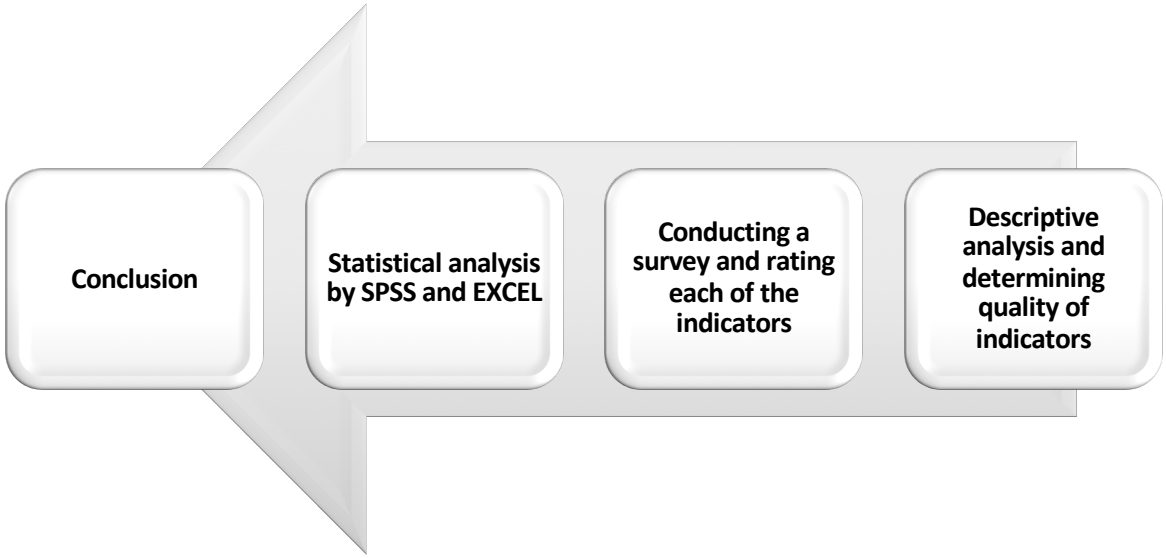


Fig. 1 The Process of resiliency analysis and evaluation

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

THE RISK OF HEAVY SNOWFALL

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.

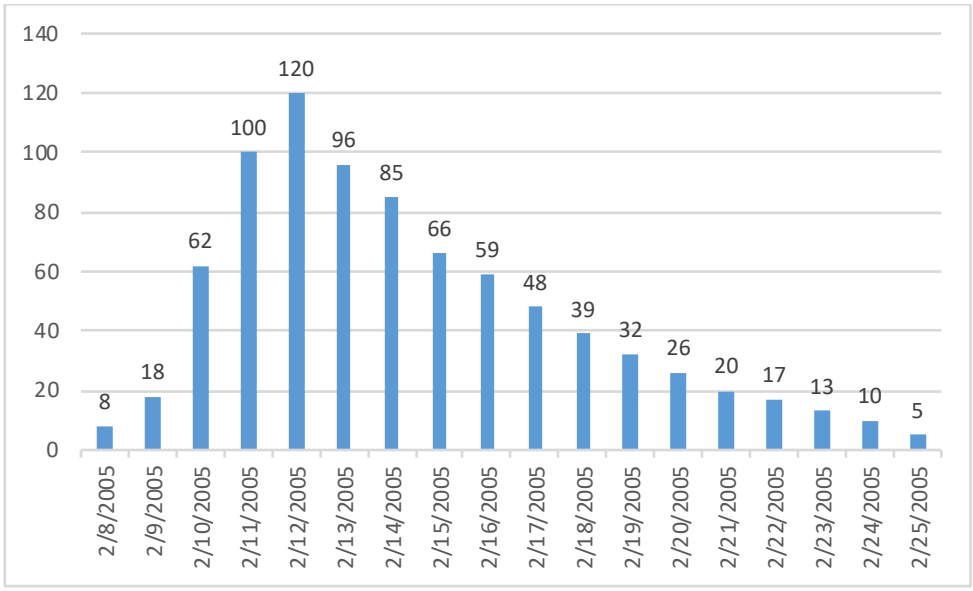


Fig. 3 Snowfall in 2005 in Lahijan

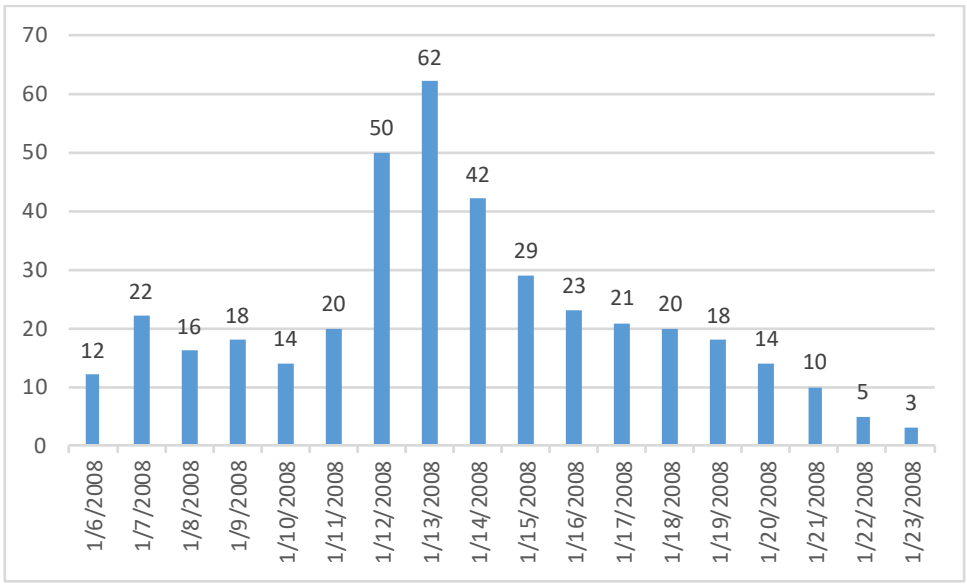
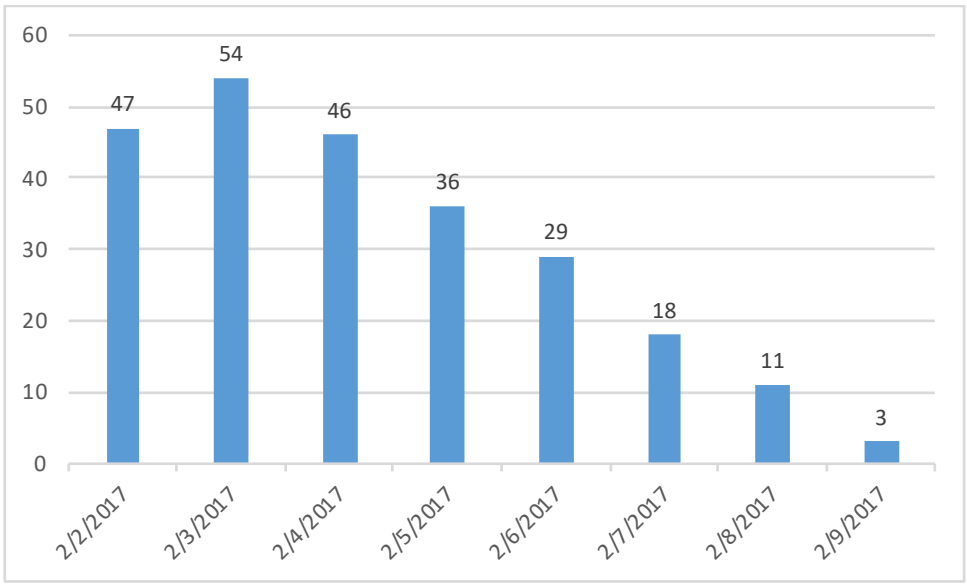


Fig. 4 Snowfall in 2008 in Lahijan



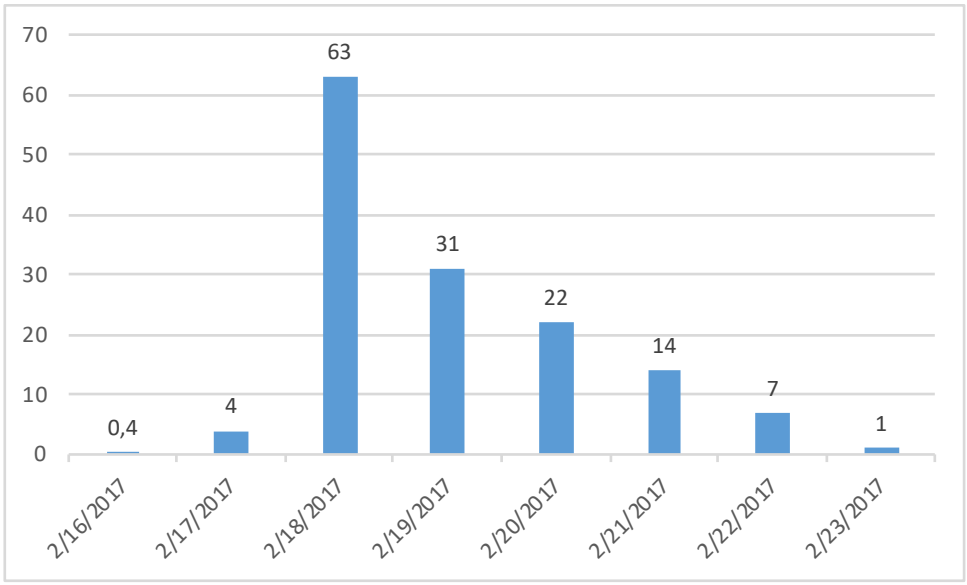


Fig. 5a & 5b Snowfall in 2016 in two dates in Lahijan

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.

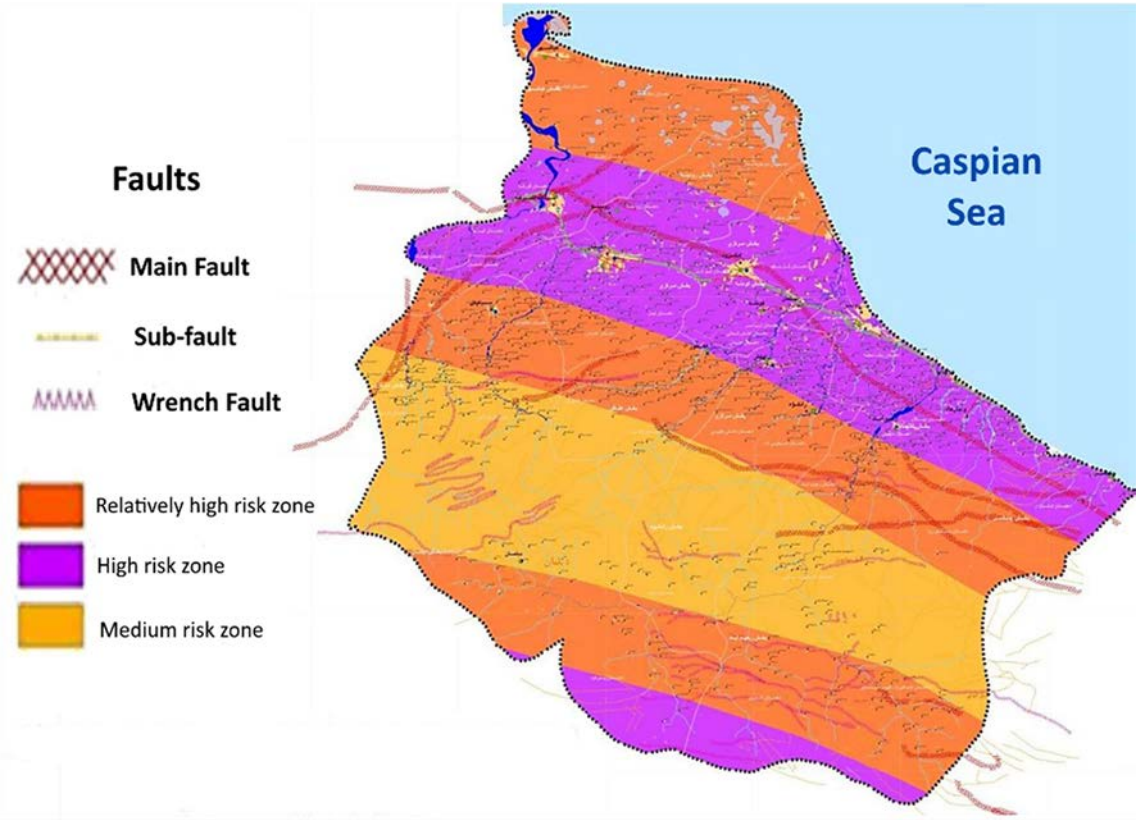


Fig. 6 Faults in the east of Guilan; Lahijan is located in a zone with high risk of earthquake, where the main Khazar fault passes through it.

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.

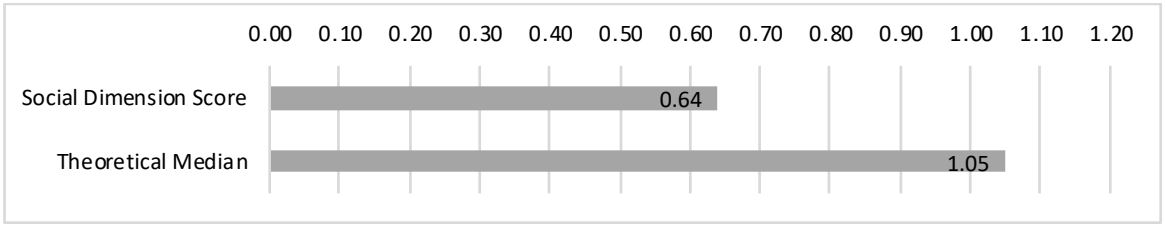


Fig. 7 The difference between the social dimension of Lahijan and the theoretical median

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.

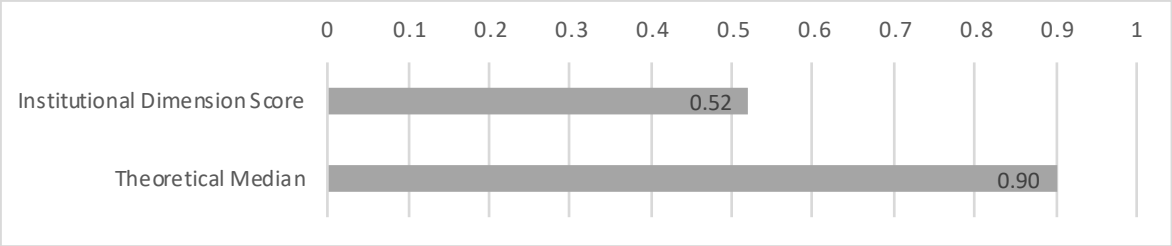


Fig. 9 The difference between the institutional dimension of Lahijan and the theoretical median

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.

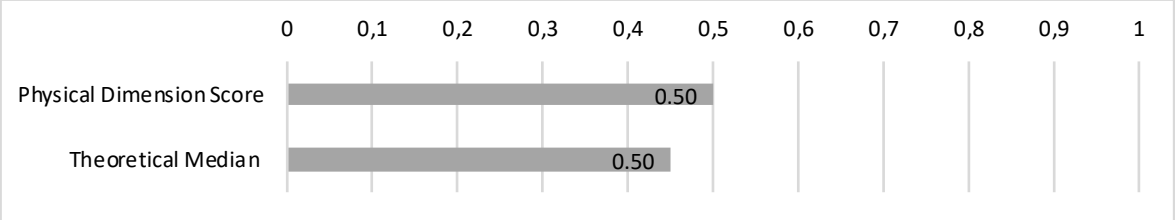


Fig. 10 The difference between the physical dimension of Lahijan and the theoretical median

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.

REFERENCES

Ainuddin, S., Routray, J.K. (2012). Community resilience framework for an earthquake prone area in Baluchistan. *International Journal of Disaster Risk Reduction*, *2*, 25-36. doi:https://doi.org/10.1016/j.ijdrr.2012.07.003

Amaratunga, D. & Haigh, R. (2011). *Post-disaster reconstruction of the built environment: Rebuilding for resilience*. London: Blackwell Publishing Ltd.

Asprone, D., Latora, V., Manfredi, G., Nicosia, V., & Cavallaro, M.(2013). *City ecosystem resilience analysis in case of disasters* (No. arXiv:1302.3263). Retrieved from https://arxiv.org/pdf/1302.3263.pdf. Last access July 2018.

Beall, J., & Piron, L. (2005). *DFID Social Exclusion Review.* London: LSE. Retrieved from https://www.researchgate.net/profile/Jo_Beall/publication/283729778. Last access July 2018.

Brugmann, J.(2012). Financing the resilient city. *Environment and Urbanization*, *24*(1), 215-232. doi:https://doi.org/10.1177/0956247812437130

Campanella, T. (2006). Urban resilience and the recovery of New Orleans. *Journal of the American planning association*, *72*(2), 141-146. doi:https://doi.org/10.1080/01944360608976734

Carpenter, S., Walker, B., Anderies, J.M. & Abel, N. (2001). From metaphor to measurement: Resilience of what to what? *Ecosystems*, 4(8), 765-781. doi:https://doi.org/10.1007/s10021-001-0045-9

Chelleri, L. (2012). From the «Resilient City» to Urban Resilience. A review essay on understanding and integrating the resilience perspective for urban systems. *Documents d'Anàlisi Geogràfica*, *58*(2), 287-306. doi:https://doi.org/10.5565/rev/dag.175

Christopherson, S., Michie, J. & Tyler, P. (2010). Regional resilience: theoretical and empirical Perspectives. *Cambridge Journal of Regions, Economy and Society*, *3*(1), 3–10. doi:https://doi.org/10.1093/cjres/rsq004

Coaffee, J. (2013). Rescaling and responsibilising the politics of urban resilience: From national security to local place-making. *Politics*, *33*(4), 240-252. doi:https://doi.org/10.1111/1467-9256.12011

Ministry of roads and housing. (2008). *Comprehensive Plan of Lahijan (Iran).*

Cutter, SL., Barnes, L., Berry, M., Burton, C., Evans & Tate, E. (2008). *Community and regional resilience: Perspectives from hazards disasters and emergency management* (CARRI Research Report 1). Retrieved from http://www.resilientus.org/wp-content/uploads/2013/03/FINAL_CUTTER_9-25-08_1223482309.pdf. Last access July 2018

Da Silva, J., Kernaghan, S. & Luque, A. (2012). A systems approach to meeting the challenges of urban climate change. *International Journal of Urban Sustainable Development*, *4*(2), 125-145. doi:https://doi.org/10.1080/19463138.2012.718279

Davis, M. (2006). *Planets of slums*. New York: Verso.

Desouza, K.C. & Flanery, T.H. (2013). Designing, planning, and managing resilient cities: A conceptual framework. *Cities*, 35, 89-99. doi:https://doi.org/10.1016/j.cities.2013.06.003

de Falco, S. (2018). Geographic determinism Vs urban resilience: italian scenario analysis. Tema. Journal of Land Use, Mobility and Environment, 11(1), 65-88. doi:http://dx.doi.org/10.6092/1970-9870/5370

Forgette, R. & Boening, M.V. (2009). *Measuring and Modeling Community Resilience:SERP and DyME*. Retrived from https://www.researchgate.net/profile/Mark_Van_Boening/publication/228490028_Measuring_and_Modeling_Community_Resilience_SERP_and_DyME/links/544042f50cf2be1758cfff12/Measuring-and-Modeling-Community-Resilience-SERP-and-DyME.pdf. Last access July 2018.

Godschalk, D. R. (2003). Urban hazard mitigation: creating resilient cities. *Natural hazards review*, *4*(3), 136-143. doi:https://doi.org/10.1061/(ASCE)1527-6988(2003)4:3(136)

Gunderson, L. (2008). Comparing ecological and human community resilience. *White Paper to Community Resilience Initiative, Southeastern Regional Research Initiative, Oak Ridge National Lab, TN. Who Are We*. Retrieved from http://www.resilientus.org/wp-content/uploads/2013/03/Final_Gunderson_1-12-09_1231774754.pdf. Last access July 2018.

Hamilton, J.D. (2009). *Causes and consequences of the oil shock of 2007-08* (No. w15002). National Bureau of Economic Research. Retrieved from http://www.nber.org/papers/w15002. Last access July 2018.

Henstra, D. (2012). Toward the climate-resilient city: extreme weather and urban climate adaptation policies in two Canadian provinces. *Journal of Comparative Policy Analysis: Research and Practice*, *14*(2), 175-194. doi: https://doi.org/10.1080/13876988.2012.665215

Jalali, T., Fallahi, A, & Golkar, K. (2012). *Resilience reconstruction after the earthquake of 2003 in Bam from urban design perspective* (Unpublished Master's thesis). Shahid Beheshti University, Tehran.

Keck, M. & Sakdapolrak, P.(2013). What is social resilience? Lessons learned and ways forward. *ERDKUNDE: Scientific Geography*, *67*(1), 5-19. Retrieved from http://www.jstor.org/stable/23595352

Lucini, B. (2013). Social capital and sociological resilience in megacities context. *International Journal of Disaster Resilience in the Built Environment*, *4*(1), 58-71. doi:https://doi.org/10.1108/17595901311299008

Maguire, B. & Hagan, P.(2007). Disasters and communities: understanding social resilience. *Australian journal of emergency management*, *22*(2), 16-19.

Mayunga, J. S. (2007). Understanding and applying the concept of community disaster resilience: a capital-based approach. *Summer academy for social vulnerability and resilience building*, *1*, 16. Retrieved from https://www.u-cursos.cl/usuario/3b514b53bcb4025aaf9a6781047e4a66/mi_blog/r/11._Joseph_S._Mayunga.pdf. Last access July 2018.

Oxfam (2005). The tsunami's impact on women (Briefing Note). *Oxfam International*. Retrieved from https://policy-practice.oxfam.org.uk/publications/the-tsunamis-impact-on-women-115038. Last access July 2018.

Papa, R. (2012). Editorial Preface: Resilient city. *Tema. Journal of Land Use, Mobility and Environment*, *5*(2), 5-6. doi:http://dx.doi.org/10.6092/1970-9870/1156

Papa, R. (2018). Editorial Preface: TeMA Journal of Land Use Mobility and Environment 1 (2018). *Tema. Journal of Land Use, Mobility and Environment, 11*(1), 5-6. doi:http://dx.doi.org/10.6092/1970-9870/5539

Rezaei, M. R. & Rafieyan, M. (2012). Conceptualization of resilience and its indicators in community-based disaster management (CBDM). *Teacher of humanities - space planning and design, 15*(4), 37-49.

Romero-Lankao, P., & Gnatz, D.M. (2013). Exploring urban transformations in Latin America. *Current Opinion in Environmental Sustainability*, *5*(3), 358-367. doi:https://doi.org/10.1016/j.cosust.2013.07.008

Rose, A. (2004). Defining and measuring economic resilience to disasters. *Disaster Prevention and Management*, *13*(4), 307-314. doi:https://doi.org/10.1108/09653560410556528

Sapirstein (2006). *Social resilience: The forgotten element in disaster reduction*. Retrieved from http://theicor.org /art/present/art/ARSR0008.pdf. Last access July 2018.

Thornbush, M., Golubchikov, O. & Bouzarovski, S. (2013). Sustainable cities targeted by combined mitigation–adaptation efforts for future-proofing. *Sustainable Cities and Society*, *9*, 1-9. doi:https://doi.org/10.1016/j.scs.2013.01.003

Tobin, G. (1999). Sustainability and community resilience: The holy grail of hazards planning. *Global environmental changes*, *9*(1), 13-25. doi:https://doi.org/10.3763/ehaz.1999.0103

Wagner, I. & Breil, P. (2013). The role of ecohydrology in creating more resilient cities. *Ecohydrology & Hydrobiology*, *13*(2), 113-134. doi:https://doi.org/10.1016/j.ecohyd.2013.06.002

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

AUTHOR'S PROFILE

Mehrnaz Molavi is an architect, in Urban Design, PhD in urban Planning, Associate Professor of Department of Urban Planning, Faculty of Architecture and Art, University of Guilan. Her research interest mainly refers to urban livability, urban resilient and urban sustainability.

TeMA
Journal of
Land Use, Mobility and Environment

TeMA 2 (2018) 213-230
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: http://dx.doi.org/10.6092/1970-9870/5484

review paper received 8th March 2018, accepted 9th July 2018

www.tema.unina.it

Hernandez Palacio, F., Scherzer, S., Froyen, Y.(2018). The Value of Urban Density. An exploratory of the relationship between urban density and housing prices in Trondheim, Norway. *Tema. Journal of Land Use, Mobility and Environment*, Issue Volume 11 (2), 213-230. doi:http://dx.doi.org/10.6092/1970-9870/5484

THE VALUE OF URBAN DENSITY

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

FABIO HERNANDEZ PALACIO[a], SABRINA SCHERZER[b], YNGVE FROYEN[c]

[a]Institute of Safety, Economics and Planning; University of Stavanger
e-mail: fabio.hernandez@uis.no / URL: https://www.uis.no/faculty-of-science-and-technology/

[b] Department of Geography, Norwegian University of Science and Technology
e-mail: sabrina.scherzer@ntnu.no / URL: https://www.ntnu.edu/geography

[c] Department of Architecture and Planning, Norwegian University of Science and Technology
e-mail: yngve.froyen@ntnu.no / URL: https://www.ntnu.edu/iap

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.

TeMA
有关土地使用、交通和环境的杂志

TeMA 2 (2018) 213-230
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: http://dx.doi.org/10.6092/1970-9870/5484

review paper received 8th March 2018, accepted 9th July 2018

www.tema.unina.it

Hernandez Palacio, F., Scherzer, S., Froyen, Y.(2018). The Value of Urban Density. An exploratory of the relationship between urban density and housing prices in Trondheim, Norway. *Tema. Journal of Land Use, Mobility and Environment*, Issue Volume 11 (2), 213-230 doi:http://dx.doi.org/10.6092/1970-9870/5484

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

FABIO HERNANDEZ PALACIO[a], SABRINA SCHERZER[b], YNGVE FROYEN[c]

[a]Institute of Safety, Economics and Planning; University of Stavanger
e-mail: fabio.hernandez@uis.no / URL: https://www.uis.no/faculty-of-science-and-technology/

[b] Department of Geography, Norwegian University of Science and Technology
e-mail: sabrina.scherzer@ntnu.no / URL: https://www.ntnu.edu/geography

[c] Department of Architecture and Planning, Norwegian University of Science and Technology
e-mail: yngve.froyen@ntnu.no / URL: https://www.ntnu.edu/iap

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).

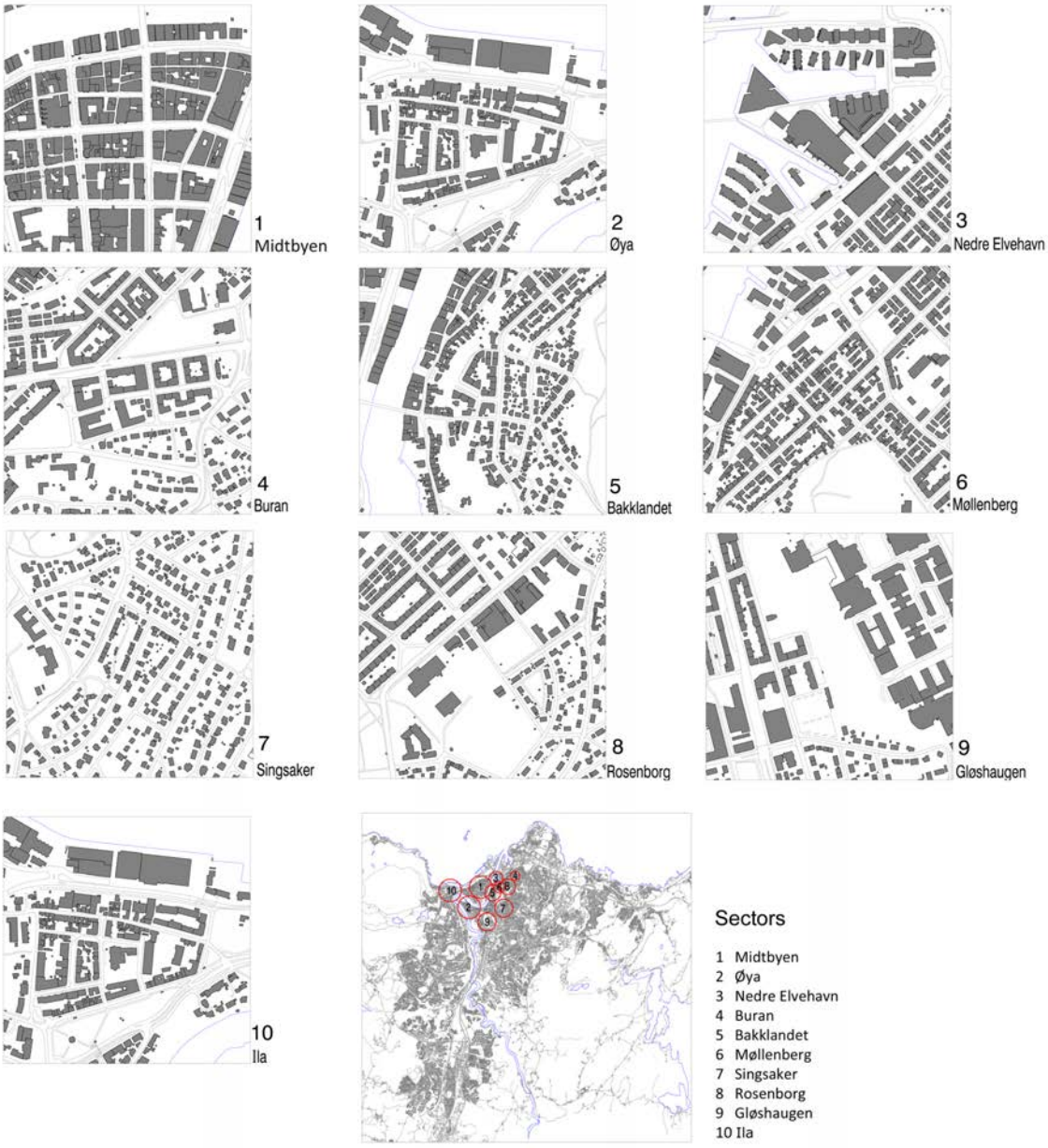


Fig. 1 Analysed areas in Trondheim city centre

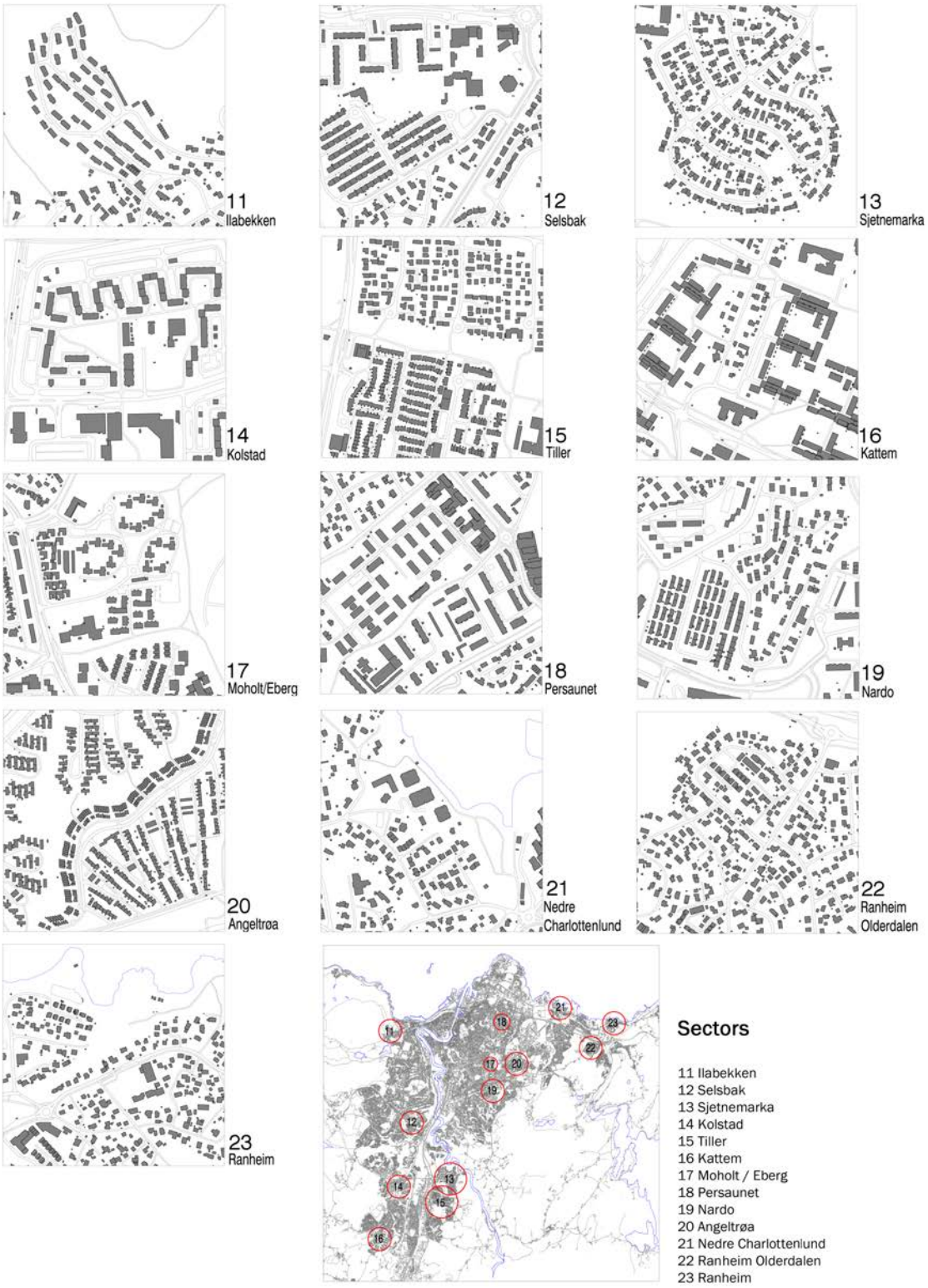


Fig. 2 Analysed areas in Trondheim periphery

		GRUNNKRETS-BASED DENSITIES*			AVERAGE HECTARE CIRCLE-BASED DENSITIES**		
urban area	average NOK price per m^2	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.

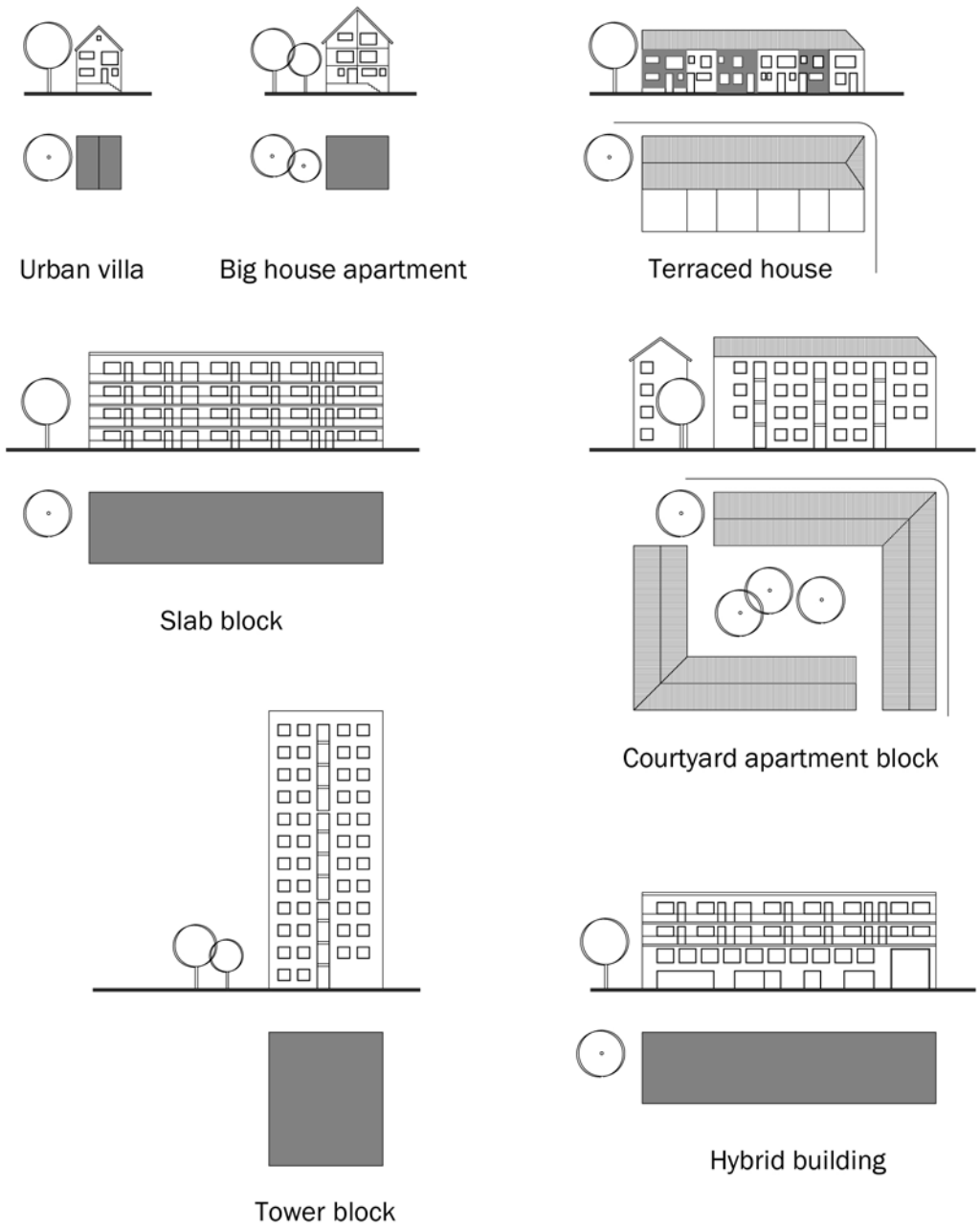


Fig. 3 Building types

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_M^2. 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.

REFERENCES

Amrusch, P. (2005). The impact of urban traffic and environmental conditions on the housing market: An analysis of Italian and Slovenian urban areas. In: C.A. Brebbia, L.C. Wadhwa & P. Amrusch (Eds.), *11th International Conference on Urban Transport and the Environment in the 21st Century* (pp. 809–16). Algarve: WIT Press. doi: https://doi.org/10.2495/UT050781

Bartholomew, K., & Ewing, R. (2011). Hedonic Price Effects of Pedestrian- and Transit-Oriented Development. *Journal of Planning Literature*, *26*(1), 18-34. doi:https://doi.org/10.1177/0885412210386540

Benevolo, L. (1993). *The European City*. Oxford: Blackwell.

Bengochea Morancho, A. (2003). A hedonic valuation of urban green areas. *Landscape and Urban Planning*, *66*(1), 35–41. doi:https://doi.org/10.1016/S0169-2046(03)00093-8

Berghauser Pont, M., & Haupt, P. A. (2009). *Space, Density and Urban Form*. Delft: Delft University of Technology.

Carriazo, F., Ready, R., & Shortle, J. (2013). Using stochastic frontier models to mitigate omitted variable bias in hedonic pricing models: A case study for air quality in Bogotá, Colombia. *Ecological Economics*, *91*, 80–8. doi:https://doi.org/10.1016/j.ecolecon.2013.04.005

Chang, J. S., & Kim, D.-J. (2013). Hedonic estimates of rail noise in Seoul. *Transportation Research Part D: Transport and Environment*, *19*, 1–4. doi:https://doi.org/10.1016/j.trd.2012.11.002

Cheshire, P., & Sheppard, S. (1995). On the price of land and the value of amenities. *Economica*, *62*(246), 247–67. doi:https://doi.org/10.2307/2554906

Coppola, E. (2012). Densificazione vs dispersione urbana. *Tema. Journal of Land Use, Mobility and Environment, 5*(1), 131-144. doi:http://dx.doi.org/10.6092/1970-9870/747

Dekkers, J. E., & van der Straaten, J. W. (2009). Monetary valuation of aircraft noise: A hedonic analysis around Amsterdam airport. *Ecological Economics*, *68*(11), 2850-2858. doi:https://doi.org/10.1016/j.ecolecon.2009.06.002

Dempsey, N., Brown, C., & Bramley, G. (2012). The key to sustainable urban development in UK cities? The influence of density on social sustainability. Progress in Planning, 77(3), 89-141. doi:https://doi.org/10.1016/j.progress.2012.01.001

Dodman, D. (2009). Urban density and climate change. *Analytical review of the interaction between urban growth trends and environmental changes*, (1). Retrieved from http://www.uncclearn.org/sites/www.uncclearn.org/files/inventory/UNFPA14.pdf. Last access July 2018.

Fatone, S., Conticelli, E., & Tondelli, S. (2012). Environmental sustainability and urban densification. In: M. Pacetti, G. Passerini, C.A. Brebbia & G. Latini (Eds.), *Sustainable City VII: Urban Regeneration and Sustainability* (pp. 217-228). Ancona: WIT Press. doi:https://doi.org/10.2495/SC120191

Freeman III, A. M., Herriges, J. A., & Kling, C. L. (2014). *The Measurement of Environmental and Resource Values: Theory and Methods*. Oxford: RFF Press.

Hermann, H. (2015, April 8). Vil ha avklaring om fortetting. *Adressa.* Retrieved from http://www.adressa.no/nyheter/sortrondelag/article10830645.ece. Last access July 2018.

Hernandez-Palacio, F. A. (2014). On the feasibility and effectiveness of urban densification in Norway. *Nordic Journal of Architectural Research*, *2*, 83–112. Retrieved from http://arkitekturforskning.net/na/article/view/496/444

Hjorthol, R., Engebretsen, Ø., & Uteng, T. P. (2014). 2013/14 Norwegian travel survey. TØI Report 1383/2014. *Institute of Transport Economics, Norwegian Centre for Transport Research*. Retrieved from https://www.toi.no/getfile.php/1339538/Publikasjoner/T%C3%98I%20rapporter/2014/1383-2014/1383-2014-sum.pdf

Jim, C. Y., & Chen, W. Y. (2006). Impacts of urban environmental elements on residential housing prices in Guangzhou (China). *Landscape and Urban Planning*, *78*(4), 422–34. doi: https://doi.org/10.1016/j.landurbplan.2005.12.003

Jim, C. Y., & Chen, W. Y. (2009). Value of scenic views: Hedonic assessment of private housing in Hong Kong. *Landscape and Urban Planning*, *91*(4), 226–34. doi:https://doi.org/10.1016/j.landurbplan.2009.01.009

Lazrak, F., Nijkamp, P., Rietveld, P., & Rouwendal, J. (2014). The market value of cultural heritage in urban areas: An application of spatial hedonic pricing. *Journal of Geographical Systems*, *16* (1), 89–114. doi:https://doi.org/10.1007/s10109-013-0188-1

Malpezzi, S. (2002). Hedonic pricing models: A selective and applied review. University of Wisconsin Center for Urban Land Economics Research. Retrieved from http://ww.bus.wisc.edu/realestate/documents/Hedonic%20Pricing%20Models%20Survey%20for%20Maclennan.pdf. Last access July 2018.

Sander, H., Polasky, S., & Haight, R. G. (2010). The value of urban tree cover: A hedonic property price model in Ramsey and Dakota Counties, Minnesota, USA. *Ecological Economics*, *69*(8), 1646–1656. doi:https://doi.org/10.1016/j.ecolecon.2010.03.011

Sjaastad, M., Hansen, T., & Medby, P. (2007). *Bokvalitet i by og Etterspurte Bebyggelsestyper*. Oslo: SINTEF.

Srour, I. M., Kockelman, K. M., & Dunn, T. P. (2002). Accessibility indices: Connection to residential land prices and location choices. *Transportation Research Record: Journal of the Transportation Research Board*, 1805, 25–34. doi:https://doi.org/10.3141/1805-04

Statistisk Sentralbyrå (SSB). (2015). *Table: 04861: Population and land area in urban settlements*. Retrived from https://www.ssb.no/en/statbank/table/04861/. Last access July 2018.

Sved, B. (2015, April 9). Flere 'nei' enn 'ja' til kommunens fortetting. *Adressa*. Retrieved from https://www.adressa.no/nyheter/trondheim/article10833507.ece. Last access July 2018.

Tapsuwan, S., Ingram, G., Burton, M., & Brennan, D. (2009). Capitalized amenity value of urban wetlands: A hedonic property price approach to urban wetlands in Perth, Western Australia. *Australian Journal of Agricultural and Resource Economics*, *53* (4), 527–545. doi:https://doi.org/10.1111/j.1467-8489.2009.00464.x

Tondelli, S., & Scarsi, F. (2012). The New Cispadana Motorway. Impact on Industrial Buildings Property Values. *Tema. Journal of Land Use, Mobility and Environment, 5*(3), 21-31. doi:http://dx.doi.org/10.6092/1970-9870/928

Trondheim Kommune. (2008). *Trondheim Kommunes Miljøpakke for Transport. Trondheim Environmental Policy for Transport*. Retrieved from https://miljopakken.no/wp-content/uploads/2011/02/Bystyret-i-Trondheim-vedtok-24.04.08-en-milj%C3%B8pakke-for-transport.pdf. Last access July 2018.

Urhahn, G., & Bobic, M. (1994). *A Pattern Image: A Typological Tool for Quality in Urban Planning*. Bussum: Thoth Publishers.

Vesely, É.-T. (2007). Green for green: The perceived value of a quantitative change in the urban tree estate of New Zealand. *Ecological Economics*, *63* (2–3), 605–615. doi:https://doi.org/10.1016/j.ecolecon.2006.12.019

Vitale Brovarone, E. (2010). Pianificazione urbana e comportamenti di viaggio: più di una relazione. *Tema. Journal of Land Use, Mobility and Environment*, *3*(1). doi:http://dx.doi.org/10.6092/1970-9870/135

Xifilidou, A., Karanikolas, N., & Spatalas, S. (2012). The effect of central metro stations on real estate values. A case study of Thessaloniki, Greece. *Tema. Journal of Land Use, Mobility and Environment, 5*(2), 185-194. doi:http://dx.doi.org/10.6092/1970-9870/860

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

AUTHOR'S PROFILE

Fabio Hernandez Palacio, PhD, is an associate professor in urban planning and design at the Department of Industrial Economy, Risk Management and Planning at the University of Stavanger, Norway. His research interests are on sustainable city planning, urban densification, and urban form.

Sabrina Scherzer is a PhD research fellow at the Department of Geography at the Norwegian University of Science and Technology. Her current research interests are community resilience to natural hazards and food security.

Yngve Karl Frøyen is a professor at the department of Architecture and Planning at the Norwegian University of Science and Technology. He is an expert on transport planning and geographical information systems (GIS) and other computer-based tools for planning purposes.

TeMA
Journal of
Land Use, Mobility and Environment

TeMA 2 (2018) 231-246
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: http://dx.doi.org/10.6092/1970-9870/5652

review paper received 27th June 2018, accepted 28th August 2018

www.tema.unina.it

How to cite item in APA format:
Pappu, H. (2018). Analysing the Spatial structure of the Street network to understand the Mobility pattern and Landuse - A case of an Indian city - Mysore. *Tema. Journal of Land Use, Mobility and Environment*, 11 (2), 231-246. doi: http://dx.doi.org/10.6092/1970-9870/5652

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

HARCHARAN PAPPU

Assistant Professor, Sri Venkateshwara College of Architecture, Hyderabad, India.
e-mail: harcharanreddy@gmail.com

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.

TeMA

有关土地使用、交通和环境的杂志

TeMA 2 (2018) 231-246
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: http://dx.doi.org/10.6092/1970-9870/5652

review paper received 27th June 2018, accepted 28th August 2018

www.tema.unina.it

How to cite item in APA format:
Pappu, H. (2018). Analysing the Spatial structure of the Street network to understand the Mobility pattern and Landuse - A case of an Indian city - Mysore. *Tema. Journal of Land Use, Mobility and Environment*, 11 (2), 231-246. doi: http://dx.doi.org/10.6092/1970-9870/5652

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

HARCHARAN PAPPU

Assistant Professor, Sri Venkateshwara College of Architecture, Hyderabad, India.
e-mail: harcharanreddy@gmail.com

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 & lida, 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

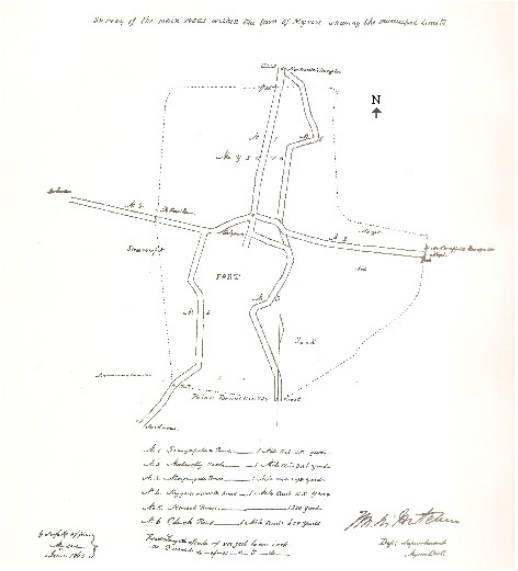


Fig. 2: Mysore City Map in 1865

Fig. 3: Mysore City Map in 1897

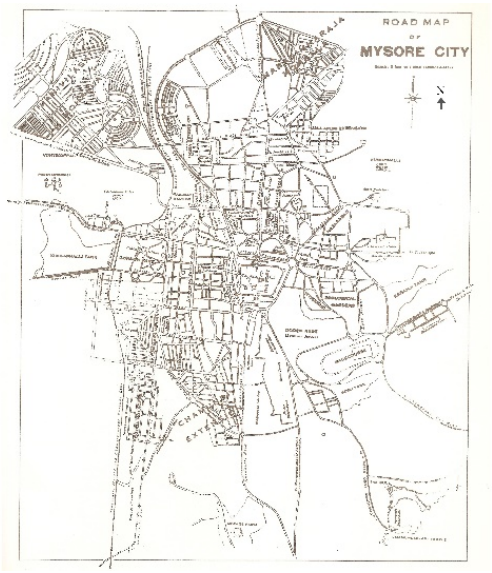


Fig. 4: Mysore City Map in 1930

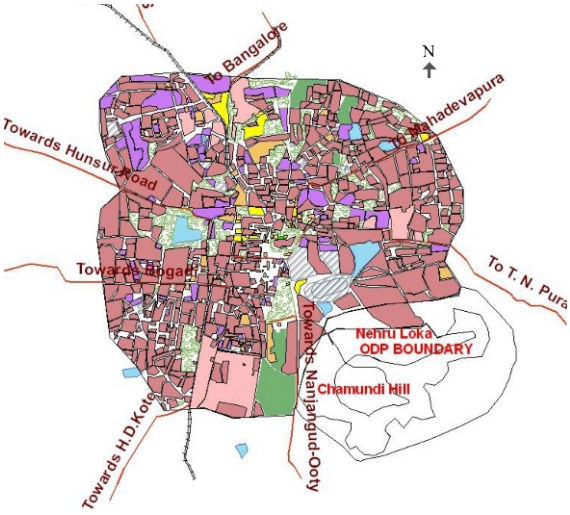


Fig. 5: Mysore Land-use Map in 1976

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.

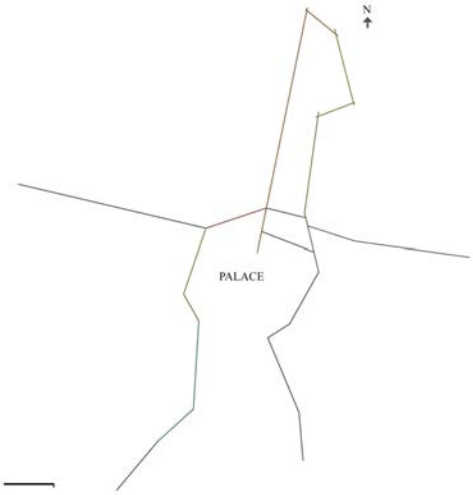


Fig. 6a: Integration - 1865

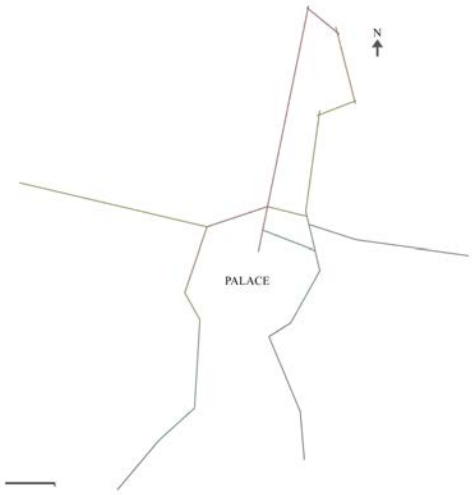


Fig. 6b: Choice - 1865

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.

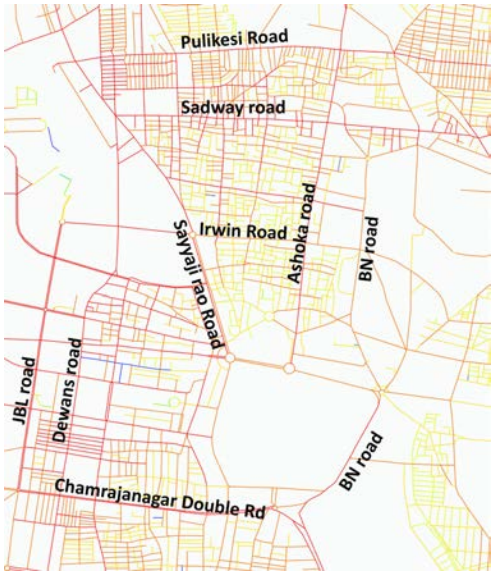


Fig. 11a: CBD Integration Graph

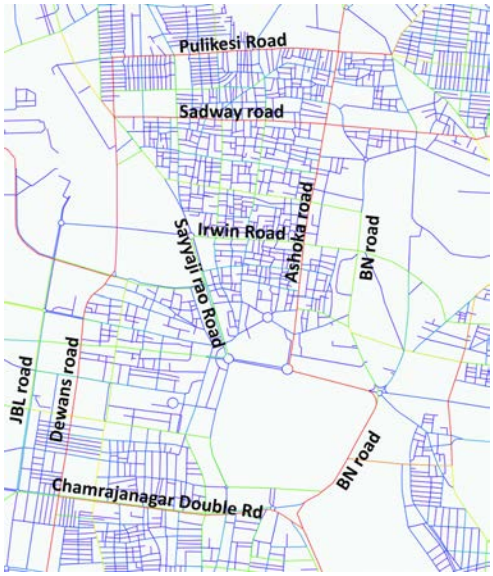


Fig. 11b: CBD Choice Graph

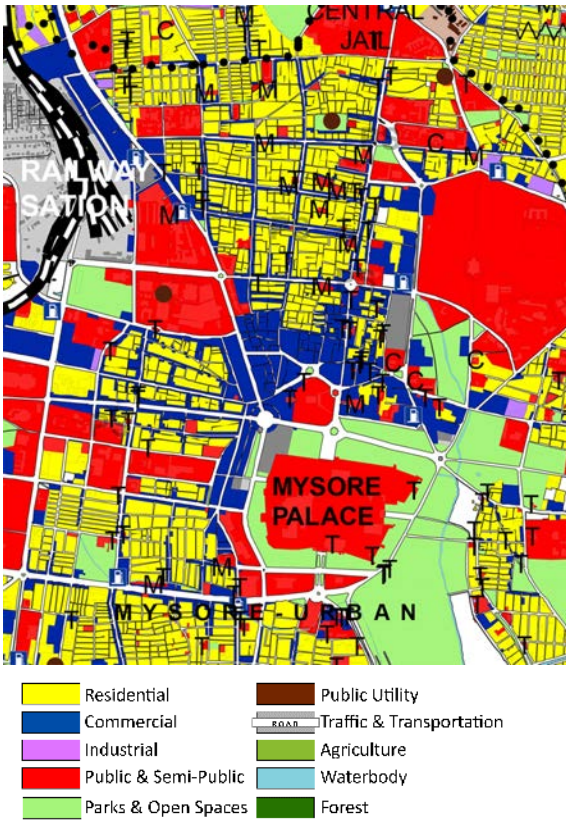


Fig. 11c: CBD Land-use Map (MUDA, 2016c)

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.

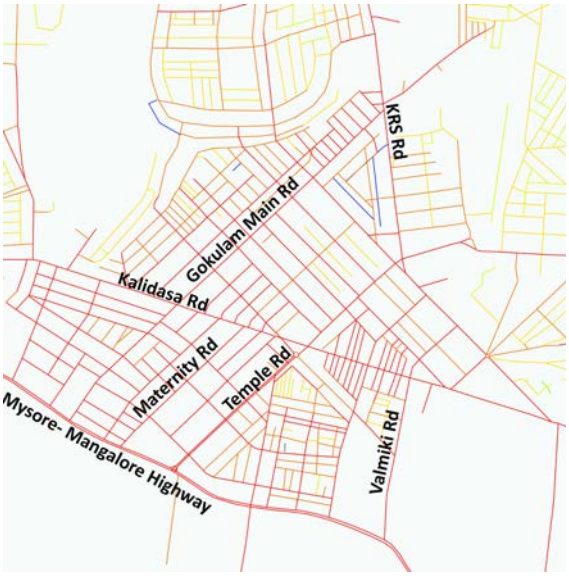


Fig. 12a: Centre C1 Integration Graph

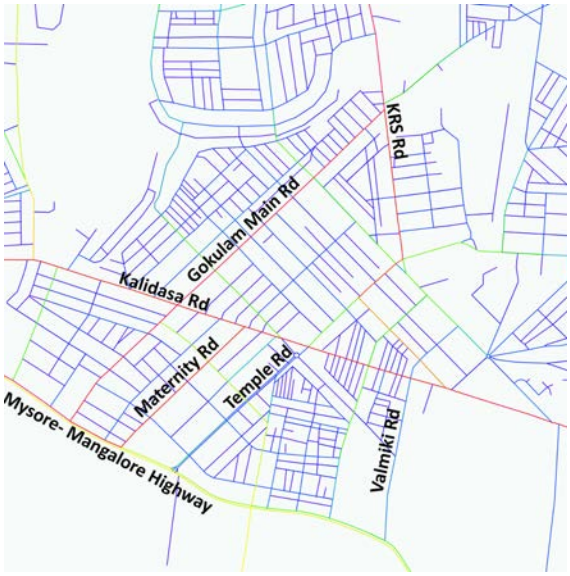


Fig. 12b: Centre C1 Choice Graph

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.

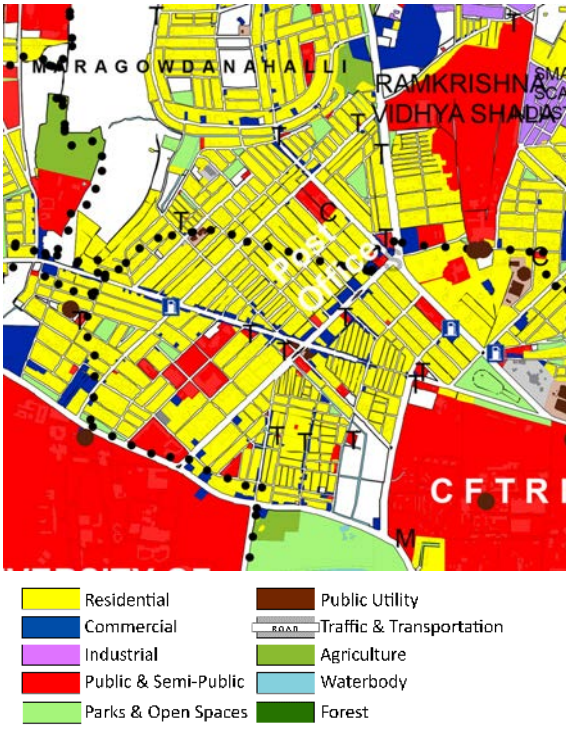


Fig.12c: Centre C1 Land-use Map (MUDA, 2016c)

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).

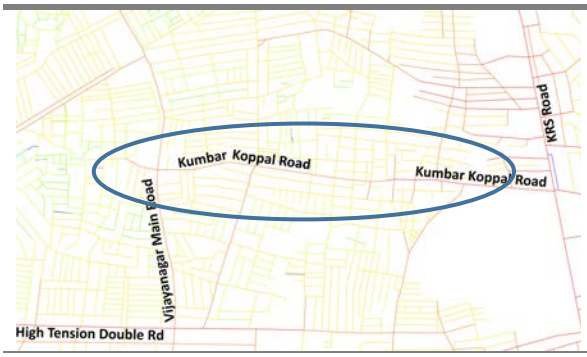
Kumbar Koppal Road which has 10% higher integration value and 10% higher choice value than Tenali Rama Road, has 67% more mobility volume (Tab.3). The land-use of Kumbar Koppal Road has 80% commercial, and 20% public and semi-public land-use, while Tenali Rama Road has 20% commercial and 80% residential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

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

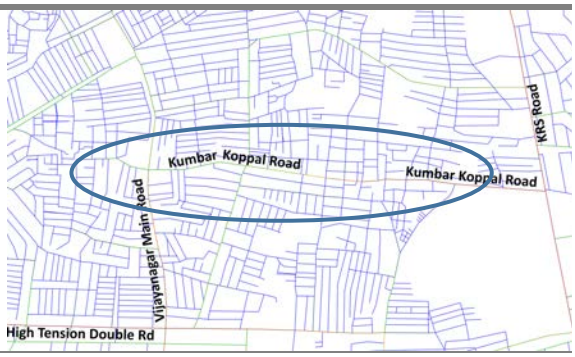
	KUMBAR KOPPAL ROAD	TENALI RAMA ROAD
Integration Value	5,047	4,580
Choice Value	1.93879 X 10^7	1.91876 X 10^6
Average Road Width (in metres)	15	21
Mobility Volume (Motor Vehicle Count)	5000 (approx.)	3000 (approx..)
Major Land-Use	Commercial	Residential

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

INTEGRATION

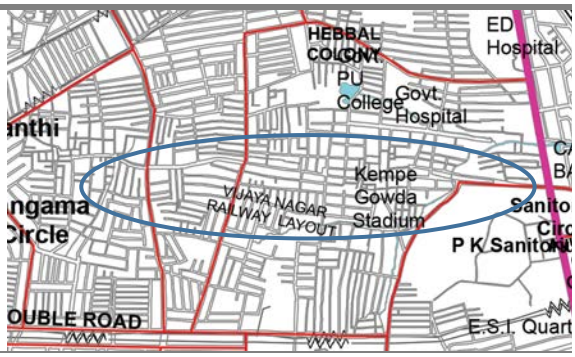


CHOICE



LAND USE

CONNECTIVITY



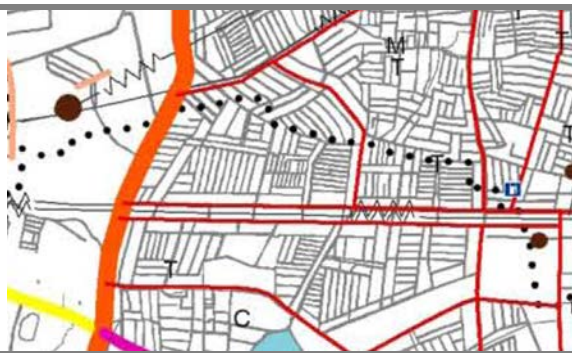
Tab.4: Kumbar Koppal Road's Integration Graph, Choice Graph, Land-use Map and Connectivity Map (MUDA, 2016b and MUDA 2016c)

INTEGRATION

CHOICE

LAND USE

CONNECTIVITY



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.

REFERENCES

Batty, M., Rana, S. (2002). *Reformulating Space Syntax: The Automatic Definition and Generation of Axial Lines and Axial Maps.* Centre for Advanced Spatial Analysis Working Paper Series 58, University College: London. Retrieved from http://discovery.ucl.ac.uk/185/1/working-paper58.pdf

City Form Lab. (Broadcaster). (2012, June 26). Massachusetts institute of technology, Urban Network Analysis Toolbox for ArcGIS. Podcast retrieved from http://cityform.mit.edu/projects/urban-network-analysis.html

Crucitti, P., Latora, V., Porta, S. (2004). Centrality measures in spatial networks of urban streets. *The American Physical Society.* Physical Review E 73, pp:1-5. doi: https://doi.org/10.1103/PhysRevE.73.036125

Henk, M., Bert van, W. (2003). Land Use and Mobility: A Synthesis of Findings and Policy Implications. *European Journal of Transport and Infrastructure Research (*ISSN*:1567-7141),* 3, no. 2, pp. 219-233. doi: http://www.ejtir.tudelft.nl/issues/2003_02/pdf/2003_02_06.pdf

Hillier, B., Hanson, J. (1984). The Social Logic of Space, Cambridge University Press: Cambridge. pp.108-109.

Hillier, B., Burdett, R., Peponis, J., Penn, A. (1987). Creating Life: Or, Does Architecture Determine Anything? *Architecture et Comportment / Architecture and Behaviour, Volume 3, n. 3, 233 - 250. pp.237.* Retrieved from http://discovery.ucl.ac.uk/101/1/hillier-etal-1987-creating-life.pdf

Hillier, B. (1999). The hidden geometry of deformed grids: or why space syntax works, when it looks as though it shouldn't. *Environment and Planning B: Planning and Design, Volume* 26, pp.169-191. doi:https://doi.org/10.1068/b4125

Hillier, B. (2007). *Space is Machine.* Cambridge University Press: Cambridge. pp. vi. Retrieved from http://discovery.ucl.ac.uk/3881/1/SITM.pdf

Hillier, B., Lida, S. (2005). *Network and psychological effects in urban movement*. In Cohn, A. G., Mark, D. M. (eds) Spatial Information Theory: COSIT 2005, Lecture Notes in Computer Science number 3693, 475-490, Springer-Verlag, Berlin.

Hillier, B., Vaughan, L. (2007). The city as one thing. *Progress in Planning, 67 (3) pp. 205-230*. doi: https://doi.org/10.1016/j.progress.2007.03.001

Jiang, B., Claramunt, C. (April 25th -27th 2002). Structural approach to the model generalization of an urban street network. *5th AGILE Conference on Geographic Information Science, Palma, Mallorca, Spain*: pp. 157 – 171. doi: https://doi.org/10.1023/B:GEIN.0000017746.44824.70

Karimi, K., Nooshin, M. (2003). The tale of two cities: Urban planning of the city Isfahan in the past and present. In *4th International Space Syntax Symposium*, (Vol. 1, pp. 14-1). Location: London. Retrieved from http://www.spacesyntax.net/symposia-archive/SSS4/fullpapers/14Karimipaper.pdf

Karnataka Archives. (1865). *Mysore city map in 1865.*

McClure, W. R., Bartuska, T. J. (2007). *Introduction: Definition, Design, and Development of the Built Environment, Part 1, Chapter 1, Page 4.* Location: New Jersey. Publisher: John Wiley & Sons, Inc. Retrieved from https://pdfs.semanticscholar.org/ebad/e2fc6bae8ca5c8e825fbbd34e0fef7f27192.pdf

Moeinaddini, M., Asadi-Shekari, Z., & Zaly Shah, M. (2012). The Relationship between Urban Structure and Travel Behaviour: Challenges and Practices. *Tema. Journal of Land Use, Mobility and Environment, 5(3)*, 47-63. doi:http://dx.doi.org/10.6092/1970-9870/1289

Mysore Urban Development Authority, MUDA. (2016a). *Mysore Master Plan Report 2031, Volume I. Chapter 1, Pages 1-5.* Mysore: India. Retrieved from: http://mudamysore.gov.in/master_plan.htm [accessed on 5 April 2018].

Mysore Urban Development Authority, MUDA. (2016b). *Mysore Master Plan Report 2031, Mysore Circulation _LPA*. Retrieved from: http://justmysuru.com.md-in-23.webhostbox.net/mudamysore.gov.in/MasterPlan/Maps/6.%20ROAD%20CLASSIFICATION%2053000%20V4.pdf [accessed on 5 April 2018].

Mysore Urban Development Authority, MUDA. (2016c). *Mysore Master Plan Report 2031, Mysore Proposed Land use Mysore city*. Retrieved from: http://justmysuru.com.md-in-23.webhostbox.net/mudamysore.gov.in/MasterPlan/Maps/4.20PROPOSED%20LANDUSE%20CITY%20V3.pdf

Parthasarathi, P. (2014). Network structure and metropolitan mobility. *The journal of Transport and Land Use* (ISSN: 1938-7849). *pp153-170.* doi. https://www.jtlu.org/index.php/jtlu/article/view/494/436

Parsons, Constance E. (1930). *Mysore City: Mysore city map in 1930. pp 202.* Oxford University Press. Retrieved from: *https://archive.org/details/MysoreCity1930*

Penn, A., Turner, A. (2003). Space layout affects search efficiency for agents with vision, proceedings from 4th International Space Syntax Symposium, London. pp.9.1-16. Retrieved from: http://www.spacesyntax.net/symposia-archive/SSS4/fullpapers/09Penn-Turner.pdf

Rice, Benjamin Lewis. (1897). *Mysore city map in 1897.* Retrieved from: *https://commons.wikimedia.org/wiki/File:Mysore_city_Gazetteer_map_1897.jpg*

Salheen M. A. (2003), An application of universal distance using space syntax analysis, proceedings from *4th International Space Syntax Symposium,* London. pp.36.1-13 Retrieved from: http://www.spacesyntax.net/symposia-archive/SSS4/fullpapers/36Salheenpaper.pdf

Space Syntax. (2011). *Create Space: Create Value*. pp.19. Retrieved from: http://www.spacesyntax.com/wp-content/uploads/2011/11/Space_Syntax_General-Practice-Brochure_1209.pdf [Accessed on September 17, 2017].

Space Syntax Network. (2017). *Software*. Retrieved from: http://www.spacesyntax.net/software/ [Accessed on 5th April 2017].

Tim Stonor. (2009a). *New settlements and Urban Extensions* [Lecture Notes Online]. Retrieved from: https://timstonor.wordpress.com/2009/03/26/new-settlements-urban-extensions/#more-91 [Accessed on 17 September 2017].

Tim Stonor. (2009b). *Place making in a regional setting* [Power Point Slides], Slide 4. Retrieved from: http://www.slideboom.com/presentations/82687/Placemaking-in-a-regional-setting [Accessed on June 10 2017].

Tim Stonor. (2010). *The role of space in the creation of place* [Power Point Slides], Slide 13. Retrieved from: http://www.slideboom.com/presentations/82687/Placemaking-in-a-regional-setting [Accessed on 20 May 2017].

Tim Stonor. (2011). *Intro to Space Syntax Day 1. In: Harvard University Graduate School of Design Cambridge: UCL Space Syntax* [Power Point Slides]. Slide 10. Retrieved from http://www.slideboom.com/presentations/292558 [Accessed on 18 May 2017].

Tim Stonor. (2014). *Predictive Analytics for urban planning, building design and spatial economics.* [Power Point Slides]. Slide 4. Retrieved from https://www.slideshare.net/tstonor/tim-stonor-predictive-analytics-using-space-syntax-technology [Accessed on 10 June 2017].

Turner, A. (2012). Depthmap (Version 10.14) [software]. Retrieved from https://www.ucl.ac.uk/bartlett /architecture/research/space-syntax/depthmapx

UCL Space Syntax. (2017). *Overview*. Retrieved from: http://otp.spacesyntax.net/overview-2/ [Accessed on 5th April 2017].

IMAGE AND TABLE SOURCES

Fig. 1: Mysore Urban Development Authority (2016)

Fig. 2: Karnataka Archives (1865)

Fig. 3: Rice, Benjamin Lewis (1897)

Fig. 4: Constance E Parson (1930)

Fig. 5: Mysore Urban Development Authority (2016)

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

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

Fig. 7a: Integration Graph of Mysore city in 1897, generated by author using Depthmap software.

Fig. 7b: Choice Graph of Mysore city in 1930, generated by author using Depthmap software.

Fig. 8a: Integration Graph of Mysore city in 1930, generated by author using Depthmap software.

Fig. 8b: Choice Graph of Mysore city in 1865, generated by author using Depthmap software.

Fig. 9a: Integration Graph of Mysore city in 1976, generated by author using Depthmap software.

Fig. 9b: Choice Graph of Mysore city in 1976, generated by author using Depthmap software.

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

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.

AUTHOR'S PROFILE

Pappu Harcharan. Architect and Urban Planner; Assistant Professor at Sri Venkateshwara College of Architecture, Hyderabad, India. During his Bachelor's studies at School of Planning and Architecture Vijayawada, he was a recipient of the Prime Minister's Scholarship for academic excellence. He received his Master's degree in Urban and Regional Planning from School of Planning and Architecture, University of Mysore. His research interests lie in Space Syntax, Spatial Planning, Urban Studies and Environmental Planning.

TeMA
Journal of
Land Use, Mobility and Environment

TeMA 2 (2018) 247-268
print ISSN 1970-9889, e- ISSN 1970-9870
doi: http://dx.doi.org/10.6092/1970-9870/5784

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
Tema Lab - Università degli Studi di Napoli Federico II, Italy
e-mail: rosa.morosini@unina.it

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

author: Gerardo Carpentieri
Tema Lab - Università degli Studi di Napoli Federico II, Italy
e-mail: gerardo.carpentieri@unina.it

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

author: Maria Rosa Tremiterra
Tema Lab - Università degli Studi di Napoli Federico II, Italy
e-mail: mariarosa.tremiterra@unina.it

04_UBAN PRACTICES
Urban practices describes the most innovative application in practice of the journal theme.

author: Gennaro Angiello
Tema Lab - Università degli Studi di Napoli Federico II, Italy
e-mail: gennaro.angiello@unina.it

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

author: Andrea Tulisi
Tema Lab - Università degli Studi di Napoli Federico II, Italy
e-mail: andrea.tulisi@unina.it

TeMA
Journal of
Land Use, Mobility and Environment

TeMA 2 (2018) 247-268
print ISSN 1970-9889, e- ISSN 1970-9870
doi: http://dx.doi.org/10.6092/1970-9870/5784

www.tema.unina.it

评述页：

提高城市系统对自然及人为变化顺应能力的方法、工具和最佳实践

TeMA 从城市规划和流动性管理之间的关系入手，将涉及的论题逐步展，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。

author: Gerardo Carpentieri
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: gerardo.carpentieri@unina.it

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
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: mariarosa.tremiterra@unina.it

04_URBAN PRACTICES
城市的实践描述了期刊主题在实践中最具创新性的应用。

author: Gennaro Angiello
那不勒斯菲里德里克第二大学民用建筑与环境工程系 TeMA 实验室 e-mail: gennaro.angiello@unina.it

05_NEWS AND EVENTS
新闻与活动部分让读者了解与期刊主题相关的会议、活动及展览。

author: Andrea Tulisi
那不勒斯菲里德里克第二大学民用建筑与环境工程系 TeMA 实验室 e-mail: andrea.tulisi@unina.it

01

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

REVIEW PAGES: WEB RESOURCES

ROSA MOROSINI
TeMALab – Università degli Studi di Napoli Federico II, Italy
e-mail: rosa.morosini@unina.it

In this number

SOIL 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.

REFERENCES

Mazzeo, G. & Russo, L. (2016). Aspects of Land Take in the Metropolitan Area of Naples. *Tema. Journal of Land Use, Mobility and Environment*, 9(1), 89-107. doi:http://10.6092/1970-9870/3727

Munafò, M., Salvati, L., & Zitti, M. (2013). Estimating soil sealing rate at national level - Italy as a case study. *Ecological indicators*, 26, 137-140. doi:http/10.1016/j.ecolind.2012.11.001

Gardi, C. (2013). Strategie europee per il contenimento dei consumi di suolo. *Il progetto sostenibile,* 33, 24-31. ISSN 1974-3327

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

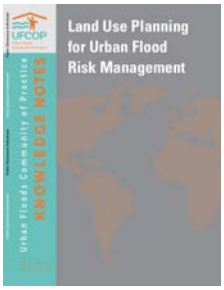
GERARDO CARPENTIERI
TeMALab – Università degli Studi di Napoli Federico II, Italy
e-mail: gerardo.carpentieri@unina.it

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.

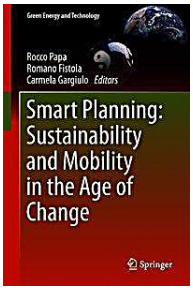
Title: **Building urban resilience: A guide for Red Cross and Red Crescent engagement and contribution**
Author/editor: Partnership on Urban Disaster Risk Reduction and Management
Publisher: International Federation of Red Cross and Red Crescent Societies
Publication year: 2017
ISBN code: -

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.

REFERENCES

Balaban, O., & Şenol Balaban, M. (2015). Adaptation to Climate Change: Barriers in the Turkish Local Context. *Tema. Journal of Land Use, Mobility and Environment*, 0, 7-22. doi:http://dx.doi.org/10.6092/1970-9870/3650

Jolanta Kryspin-Watson (2017). Land Use Planning for Urban Flood Risk Management. Available at http://documents.worldbank.org/curated/en/858461494250358652/pdf/114816-WP-PUBLIC-P15665-GSU08-add-series-4UFCOPKnowledgeNoteMay.pdf

Salata, K., & Yiannakou, A. (2016). Green Infrastructure and climate change adaptation. *Tema. Journal of Land Use, Mobility and Environment*, 9(1), 7-24. doi:http://dx.doi.org/10.6092/1970-9870/3723

Partnership on Urban Disaster Risk Reduction and Management (2017). Building urban resilience: A guide for Red Cross and Red Crescent engagement and contribution. Available at http://media.ifrc.org/ifrc/wp-content/uploads/sites/5/2017/12/1317300_GuidanceUrbanResilience_LR25b15d.pdf

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

MARIA ROSA TREMITERRA
TeMALab – Università Federico II di Napoli, Italy
e-mail: mariarosa.tremiterra@unina.it

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:

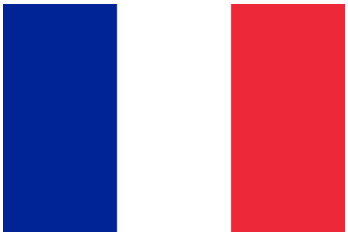
- Flood and Coastal Erosion Risk Management, that set the basis for introducing strategies for flood and coastal erosion risk management for England and Walles;
- Miscellaneous part, related to several aspects such as the need to include in the Building Act 1984 the statement that building interventions 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).

REFERENCES

De Gregorio Hurtado, S., Olazabal, M., Salvia, M., Pietrapertosa, F., Olazabal, E., Geneletti, D., D'Alonzo, V., Di Leo, S., & Reckien, D. (2015). Understanding How and Why Cities Engage with Climate Policy: An Analysis of Local Climate Action in Spain and Italy. *Tema. Journal of Land Use, Mobility and Environment*, *8*, 23-46. doi:http://dx.doi.org/10.6092/1970-9870/3649

Defra and EA (2011). *Understanding the risks, empowering communities, building resilience: the national flood and coastal erosion risk management strategy for England*. Retrieved from https://www.gov.uk/government/publications/national-flood-and-coastal-erosion-risk-management-strategy-for-england

Morel, M., Basin, B., Vullierme, E. (2016). French national policy for flood risk management. *E3S Web of Conferences, 7*(23002). doi: https://doi.org/10.1051/e3sconf/20160723002

Papa, R., Gargiulo, C., & Zucaro, F. (2014). Climate Change and Energy Sustainability. Which Innovations in European Strategies and Plans. *Tema. Journal of Land Use, Mobility and Environment, 0*. doi: http://dx.doi.org/10.6092/1970-9870/2554

Serre, D., Barroca, B., Balsells, M., & Becue, V. (2018). Contributing to urban resilience to floods with neighbourhood design: the case of Am Sandtorkai/Dalmannkai in Hamburg. *Journal of Flood Risk Management*, *11*, S69-S83. doi: 10.1111/jfr3.12253

Slomp, R. (2012). *Flood risk and water management in the Netherlands: a 2012 update. Rijkswaterstaat/Ministry of Infrastructure and the Environment*. Retrieved from http://edepot.wur.nl/241151

Wiering, M., & Winnubst, M. (2017). The conception of public interest in Dutch flood risk management: Untouchable or transforming?. *Environmental Science & Policy*, *73*, 12-19. doi: https://doi.org/10.1016/j.envsci.2017.03.002

04

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

REVIEW PAGES: URBAN PRACTICES

GENNARO ANGIELLO
TeMALab – Università degli Studi di Napoli Federico II, Italy
e-mail: gennaro.angiello@unina.it

In this number

PLANNING FOR 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.

REFERENCES

City of Athens (2017). *Athens Resilience Strategy for 2030*. Retrieved from https://www.100resilientcities.org/strategies/athens/. Last access July 2018.

City of Rome (2018). Rome Resilience Strategy. Retrieved from https://www.100resilientcities.org/strategies/rome/. Last access July 2018.

Galderisi, A. (2014). Climate Change Adaptation. Challenges and Opportunities for a Smart Urban Growth. *Tema. Journal of Land Use, Mobility and Environment, 7*(1), 43-68. doi:http://dx.doi.org/10.6092/1970-9870/2265

Galderisi, A., Mazzeo, G. & Pinto, F. (2016) Cities dealing with energy issues and climate-related Impacts: Approaches, strategies and tools for a sustainable urban development. In: R. Papa & R. Fistola (Eds.), *Smart Energy in the Smart City. Urban Planning for a Sustainable Future* (pp. 199-217). Springer International Publishing, Switzerland. doi: https://doi.org/10.1007/978-3-319-31157-9_11

Salat, S., & Bourdic, L. (2012). Systemic resilience of complex urban systems. *Tema. Journal of Land Use, Mobility and Environment*, *5*(2), 55-68. doi:http://dx.doi.org/10.6092/1970-9870/918

Stumpp, E. M. (2013). New in town? On resilience and "Resilient Cities". Cities, 32, 164-166. doi:https://doi.org/10.1016/j.cities.2013.01.003

IMAGE SOURCES

The 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

ANDREA TULISI
TeMALab – Università degli Studi di Napoli Federico II, Italy
e-mail: andrea.tulisi@unina.it

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?

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).

REFERENCES

Balaban, O., & Şenol Balaban, M. (2015). Adaptation to Climate Change: Barriers in the Turkish Local Context. *Tema. Journal of Land Use, Mobility and Environment, 0*, 7-22. doi: http://dx.doi.org/10.6092/1970-9870/3650

Papa, R., Gargiulo, C., & Zucaro, F. (2014). Climate Change and Energy Sustainability. Which Innovations in European Strategies and Plans. *Tema. Journal of Land Use, Mobility and Environment, 0*. doi: http://dx.doi.org/10.6092/1970-9870/2554

Rockefeller Foundation (2016), City Resilience [online]. Avaliable at: http://www.100resilientcities.org/resilience.

Taleb, N. N. (2012). *Antifragile: how to live in a world we don't understand* (Vol. 3). London: Allen Lane.

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

AUTHORS' PROFILES

Gennaro Angiello

Engineer, Ph.D. in Civil Systems Engineering at the Federico II University of Naples. His research interests are in the field of accessibility analysis and modeling, land-use and transport interactions and sustainable mobility. He is currently involved in the research project Smart Energy Master and in the COST Action TU1002 accessibility Instruments for Planning Practice in Europe.

Gerardo Carpentieri

Engineer, Ph.D. in Civil Systems Engineering at University of Naples Federico II. Research Fellow of Land Use Planning at the Department of Civil, Architectural and Environmental Engineering at University of Naples Federico II. He received a master's degree in Environmental and Land Engineering with a thesis on "The integrated government of land use and mobility for environmental sustainability in the metropolitan areas: evaluation techniques of different scenarios for the city of Rome". In July 2013 he won a scholarship within the PRIN project on the "Impacts of mobility policies on urban transformability, environment and property market". He is currently involved in the research project "Smart Energy Master" at the Department of Civil, Architectural and Environmental Engineering – University of Naples Federico II and in the COST Action TU1002 Accessibility Instruments for Planning Practice in Europe.

Rosa Morosini

Engineer, Ph.D. student in civil systems engineering at University of Naples Federico II. Her research topic concerns the urban planning transformations and soil consumption. The purpose is to identify supporting tools for the local authorities with the aim of minimizing the use of this resource and make it a sustainable use.

Maria Rosa Tremiterra

Engineer, Ph.D. student in Civil Systems Engineering at University of Naples Federico II. She received a master's degree in Architecture and Building Engineering with a thesis on sustainable mobility in the European cities. In 2014, she won a one-year grant for post-lauream education and research within the Project Smart Energy Master at the Department of Civil Engineering, Building and Environmental Engineering, University of Naples Federico II.

Andrea Tulisi

Architect, graduated in Architecture from the University Federico II in Naples in 2006. In January 2014 holds a PhD in Environmental Technology with a research focused on rehabilitation strategies for semi-enclosed spaces in the "Compact City". He is currently involved in the project Smart Energy Master at the DICEA department of the University of Naples Federico II. His research activity is focused on the link between urban open spaces and energy consumption.