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SMART CITIES

RESEARCHES, PROJECTS AND GOOD PRACTICES FOR BUILDINGS

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EDITORIAL PREFACE:

RESEARCHES, PROJECTS AND GOOD PRACTICES FOR THE BUILDINGS FOR THE SMART CITY

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During the last decades the concept of Smart Cities arose, according to which information and communications technologies might improve the functioning of cities, enhancing their efficiency, improving their competitiveness (Harrison, 2010). Within this general framework, the specific application of ICT in buildings is rapidly advancing in applications, with the aim of creating a more sustainable and resilient built environment, an in particular for the managing of resources and energy. In fact energy use in cities has attracted significant research in recent years.

The world's energy demand is mainly characterized by urban demand and two thirds of the world's total energy consumption of 7908 Mtoe and 70% of the CO2 emissions are attributable to cities. Covering only 2% of the world's surface, cities are responsible for about 75% of the world's consumption of resources (Pacione, 2009). In cities the building stock (domestic and commercial buildings) accounts for 61% of total energy consumption.

The theme of resource management and more specifically of energy saving is growing attention in research and in urban planning practice. In literature is growing the number of studies focusing on strategies and measure finalized at energy saving and in the practice field, energy savings require the development and usage of energy-efficient appliances and retrofitting of the existing building stock. Neverthless, where energy is concerned, the neighbourhood or city cannot be considered simply as an aggregation of buildings, and emphasis is need for more systemic, multi-scale and transverse approaches to deal with the intrinsic complexity of the urban fabric (Bourdic and Salat, 2012).

Within this framework this number propose a focus on ideas, projects and good practices aimed at develop building stocks within the city capable of an effective interaction with urban context, capable of reducing energy consumption, optimizing the use of space, minimizing impacts on natural resources, assuring the safety of inhabitants, also through an efficient use of available technologies.

In the Focus section the issue proposes two articles. The first article by Francesco Domenico Moccia describes a particular application of urban planning at the municipal level within the Campania Region. The Agropoli plan, which is part of the wider system of actions taken by the City to achieve the objectives on the environment posed by the European Union with the Directive "Climate Energy 20-20-20", provides a series of actions aimed at containing the uses energy through measures to rationalize, do not waste and reduce the use of non-renewable resources. The second article by Arto Emerik Nuorkivi and Anna-Maija Ahonen is about the experience of a Pilot training of urban planners in five EU countries such Finland, Germany, Hungary, Spain and the United Kingdom to understand the basics of renewable energy sources (RES) and energy efficiency (EE) that has been carried out during 2011-2012 under co-financing of Intelligent Energy Europe.

In the LUME section this issue collects an article by Lina I. Shbeeb and Wael H. Awad on the walkability of school surroundings and its impact on pedestrian behavior, with an application in Jordan. The study looks into pedestrian environment in schools' vicinity. Seventeen schools were selected and 231 students were followed from school to home. Results showed that 15% of observed subjects were involved in conflicts. Average walking time is 17 minutes; almost half of this time is spent either by walking on street or crossing. Females are involved in less conflict and they spend less time in traffic. Drivers give priority to pedestrian in one-thirds of all observed crossing with preference to males.

The second article of the section LUME is by Alì Soltani, Davoud Karimzadeh and is titled "The Spatio-Temporal Modeling of Urban Growth Using Remote Sensing and Intelligent Algorithms, Case of Mahabad in Iran. The article aims at modeling and simulating the complex patterns of land use change by utilizing remote sensing and artificial intelligence techniques in the fast growing city of Mahabad, north-west of Iran which encountered with several environmental subsequences.

The article by Rosa Anna La Rocca starts from the consideration that the diffusion of new communication technologies (ICTs) is significantly changing the urban supply system of tourist services giving rise to new ways of enjoying the city and proposes some reflections about tourist dimension of smart city.

The article by Alessandro Bove, Carlo Ghiraldelli focuses on the relationship between new technologies and urban space, that has become, especially with the introduction of the concept of smart city, the key in the definition of management options in the city itself.

The article by Houshmand E. Masoumi studies the effects of neighborhood-level land use characteristics on urban travel behavior of Iranian cities in a microscopic scale. In this study the role of socio-economic factors is also studies and compared to that of urban form. Two case-study neighborhoods in west of Tehran are selected and considered, first of which is a centralized and compact neighborhood and the other is a sprawled and centerless one.

Finally the article by Grazia Brunetta and Valeria Baglione focuses on the epistemological dimension of the concept of resilience in spatial planning., and its purpose is to understand the extent of innovation in planning practices and urban governance. In particular, the first part of the paper provides a review of the theoretical framework of resilience and the second analyzes the Transition Towns movement, with particular reference to the role of stakeholders.

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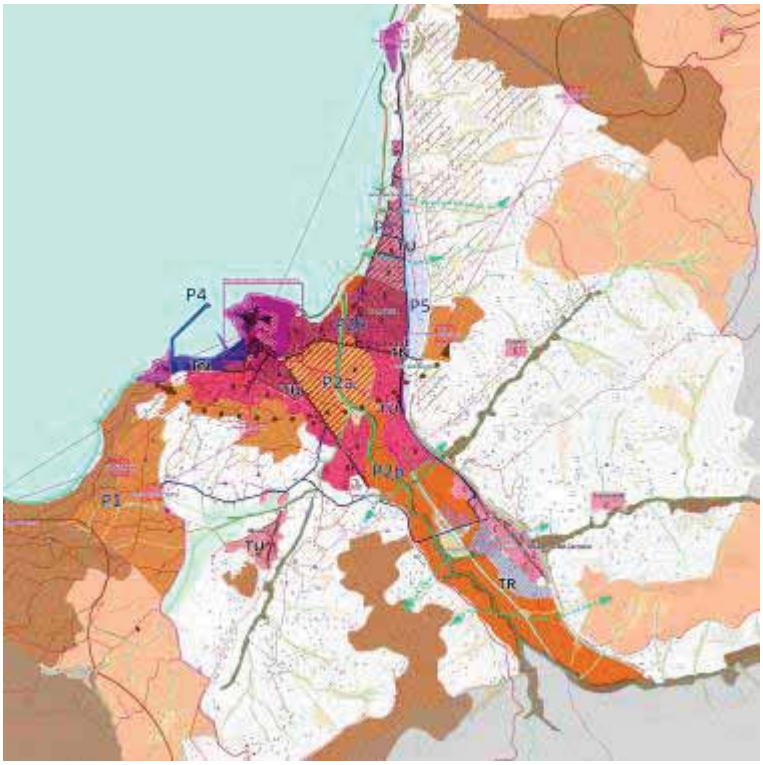

RESOURCES AND ENERGY MANAGEMENT: THE CASE OF THE AGROPOLI URBAN PLAN

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ABSTRACT

The issue of the resources management, of the energy-environment retrofitting framed in strategies to mitigate and adapt to climate change, aimed at energy saving, energy generating from alternative sources, metabolism and natural resources is one of the central topics the City Urban Planning of the City of Agropoli, currently approved by Resolution of the City Council no. 110 of 18.04.2013.

The plan is part of the wider system of actions taken by the Municipality to achieve the objectives on the environment posed by the European Union with the Directive "EP seals climate change package 20-20-20". In particular the planning tool provides a series of actions aimed at containing the energy consumption through measures to rationalize, do not waste and reduce the use of non-renewable resources, by promoting "best practices" from the management of public assets, the use of innovative technologies in all sectors and activities; the diffusion of renewable energy production, with care to avoid impacts and interference with the historical landscape, including the promotion of programs and interventions of public management. The different strategic projects will take care of specific actions also for the experimental use of innovative technologies.

The article proposes, within the framework of strategies and actions at the European level for small municipalities, the example of the City of Agropoli drawing conclusions and reflections on the issue of energy saving relative to the housing stock.

KEYWORDS:
Resource management; energy saving; small municipality

1 RESOURCE MANAGEMENT AND URBAN PLANNING

Environmental sustainability and climate change concerns have been a fundamental source of new ideas and approaches in urban planning over the last years. In fact here is increasing interest in the academic literature regarding municipal level action for sustainable development and to address climate change (Moccia, 2009).

In the 1990s the more comprehensive approach of Local Agenda 21 (LA21) received most of the attention, while local climate policy has gained much attention during the 2000s. This evolution brings a trend away from comprehensive sustainability initiatives towards energy-focused and sector-based initiatives focusing on reducing the emissions of greenhouse gases. This shift flanks a companion shift from preservation of natural assets to the reform of the city fabric where greenhouse gas emission concentrate and is moving the majority of the world population (Droege, 2008).

Recently, sustainable development is increasingly being used to guide urban planning. However, its implementation is not immediately apparent, because there has been no general agreement on how the concept should be translated into practice (Berke and Conroy, 2000; Jepson, 2001). According to the literature, resource management is a key factor for Sustainable Development, where RM refers to the conscious handling of natural resources, energy and materials and the utilization of infrastructure and technology to meet human needs; including extraction, transformation, consumption or use and disposal of resources. Hence, RM includes natural resources and manmade products (Agudelo - Veraa *et al.*, 2011).

One of the spreading concepts in the last year regards the urban metabolism concept, aims for improved resources management by closing urban cycles, applying innovative technologies and harvesting urban resources. In practice, good principles and processes stated in literature must meet aims of local communities and their political representatives in the decision making arena.

In the specific field of energy resources, in the last years the approval of the European climate change package gave a further pressure to ensure that the EU will achieve its climate targets: a 20% reduction in greenhouse gas emissions, a 20% improvement in energy efficiency, and a 20% share for renewables in the EU energy mix. At the local level of small municipality civic associations are campaigning according these general principles, strongly requiring adapting the urban planning tools with the aims of defining and putting into practice the general resources management and energy savings goals, sometimes obtaining to be heard by Majors and City Councils.Cities can lead in the reduction of CO2 emissions and the fight against climate change. Within cities, buildings are the largest energy-consuming sector, and offer the largest cost-effective opportunity for savings. Relative to almost all other investments, energy efficiency retrofit – installing newer energy efficiency technologies in older buildings –reduces emissions and improves energy security. However, considerable intensification in the delivery of ambitious whole-building energy efficiency upgrade programmes is needed.Integrated urban strategies provide the means to tackle the various challenges faced by cities. These strategies must link together the social, environmental and economic policy dimensions, connect the various levels of responsible governance, and involve the key stakeholders in the implementation of an energy efficiency policy for each municipal building stock (Owen Lewis *et al.*, 2012). Cities are ideally placed to drive action on sustainability through local action plans.

A further step is to link sustainability action plans in the general city planning process and tools. In his way, the urban form is designed according to ecological principles searching for solutions of the built environment able to assure the higher grade of resilience, the most saving of natural resources and the best metabolism of the cycles of nutrients (Moccia 2011). These objectives may regard both the new development as well as the already built up areas, some of whom are targeted by redevelopment programs while all the other are to be upgraded and retrofitted to reach the ecological standards.

This paper will describe the study case of the PUC (Piano Urbanistico Comunale) plan of Agropoli, a small Municipality in the South of Italy, focusing on the aspects of energy saving and natural resources management, in the general frame of sustainable urban planning.

2 AN EXPERIENCE IN THE SOUTH OF ITALY: THE AGROPOLI PLAN

2.1 THE CONTEXT

Agropoli is a small municipality located in the Cilento area of the province of Salerno, Campania, Italy, with a population of 21.251 inhabitants (Source: Istat 2011). It is an important coastal town, near the western Cilento, Vallo di Diano and AlburnumsNational Park, on the Tyrrhenian Sea at the southern end of the Gulf of Salerno and south of the Sele plain.

The urbanized land isthe 25% of the municipal area, which is higher of the regional value, equal to 7.5% (source: Regional land use), and the provincial value, equal to 4.5%, but it should be noted that in the provincial and regional data,the rural settlement spread is not calculated.

It is to underline the significant impact of the urbanized area in suburban areas almost equal in percentage terms to the urban (9.14% versus 9.43%), from which it derives considerable land consumption in rural areas. The evolutionary trend over 5 decades complaint a process of settlement of the territory, with an uncontrolled expansion of urban areas. The building development has been tremendous and progressive in the time period from 1960 to 2000 invading almost totally Testene area, the coastal area of San Felice and San Marco, and the valley of Fuonti area. The comparison over the past five years highlights in general, a significant increase in the urbanized area (+3.44%) with an average of 0.58% annually, or more than 18 ha/year (188,000 square meters) and an equally significant increase of abandonment (+2.91%). The built a total increase of about 470 manufactured from 2005 to 2011 going from 8060 to about 8530. The speedy development is fuelled by two main attraction: the first is the clustering of services of whom the surrounding municipalities are lacking, the second is the beach where people all over Campania Region, and most from the Naples metropolitan area, love to swim spending there his summer vacation.

Fig. 1 – Views of the Agropoli Municipality

Fig. 2 – Territorial framework

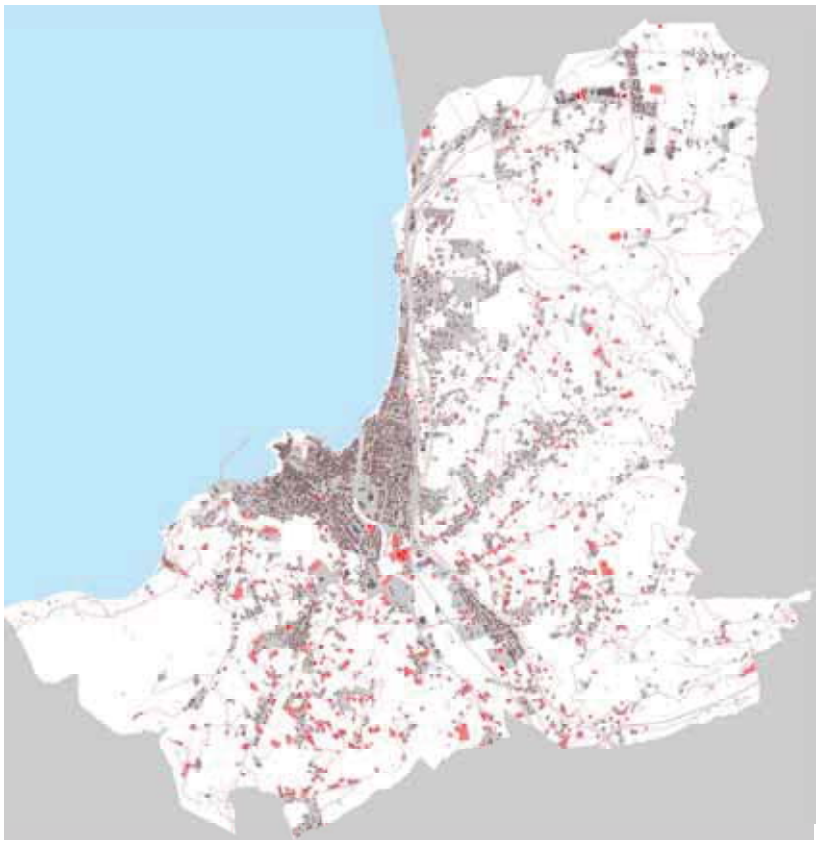

Fig. 3 – The new settlements from 2005 to 2011 (in red)

2.2 THE RM APPROACH, STRATEGIES AND ACTIONS

The resource management approach guides the plan definition and implementation (Comune di Agropoli, 2012; Comune di Agropoli, 2013). In particular the plan defines some “regulation policies”, which are referred to specific planning issues directly connected to the sustainable resources and energy:

- the issue of ecological and landscape redevelopment and mitigation of environmental degradation processes, in particular with regard to the modifications of the rural space;
- the issue of the re-use of urban building and infrastructure heritage, in order both to preserve the identity of places and to counteract the waste of land and other in responding to the demand for housing, social housing and services;
- the issue of urban redevelopment, for the reorganization of the building stock in consistent morphological patterns in relations with the public space;
- the issue of retrofitting energy-environment, framed in mitigation strategies and adaptation to climate change, aimed at saving energy, generation of energy from alternative sources, metabolism of substance and natural resources;
- the issue of ''green infrastructure” inside the urban fabric to increase permeability, depuration of areal pollution, greenery; develop ecological corridors for the preservation of biodiversity and fight heat island; with the system equipment for solid waste management, water management, sustainable energy distribution.

Based on the assumptions outlined above the PUC defines a strategic framework organized in three general objectives:

- Ob1: Protection and improvement of the ecological matrix,
- Ob2: Reorganization and strengthening of infrastructure systems,
- Ob3: Urban and landscape rehabilitation for the improvement of the social and touristic fruition.

The strategies related to the first general objective (Ob1) have a distinctly priority, as Agropoli is located in the Cilento National Park, that has been declared UNESCO world heritage. According to this, the Plan defines to locatenew urban settlementsin already developed areas (brownfield sites): here more than elsewhere is valid the principle of "do not touch the untouched” and morenot detract from the general care agricultural and forestry soils.

In detail the actions related to the objective 1 can be summarized as follows:

- Strengthening of the main nodes of the ecological system, through the active conservation and restoring of the habitats and natural resources involved, facilitating the process of naturalization in areas abandoned by agriculture.
- Protection of ecological connections for the landscaping functionality, for the preservation of eco systemic identity and integrity.
- Maintenance and restoration the bio-permeability of soils and hydrogeological balances, through thecontainment and the control of development in rural areas, expansion of traditional farming methods, and integrated control of water management, with particular attention to the recovery of the metabolism of the cycles of natural resources.
- Limiting the consumption of soil, water and other primary resources for non-agricultural uses and activitiesby monitoring and regulation measures of settlements and infrastructure, to be oriented toreuse and recovery of the discarded, abandoned or underutilized building stock.
- Containment, mitigation and prevention of environmental risks, with measures of "adaptation" toglobal change and in particular with measures and interventions to prevent and combat the erosion of the coast and to promote thebeach nourishment; measures to protect against the noise

and electromagnetic risks; control and monitoring of production activities with greatest impact, with particular attention to thosein urban areas and in vulnerable areas; measures to reduce water consumption and control over pollution by discharges.

- Containment of energy use through measures to rationalize, do not waste and decrease the use of non-renewable resources, by promoting: the spread of "best practices" fromthe management of public assets, the use of innovative technologies in all sectors and activities, thedissemination of renewable energy production, with care to avoid impacts and interference with thehistorical, landscape, including the promotion of programs and management of public interventions. The different strategic projects will take care to define specific actions also experimentalthe use of innovative technologies in order to promote and implement the objectives defined before.

The second objective (Ob2) converges into a set of actions to strengthen the role andAgropoli position not only to respond to the local demand, but also to the one intercepted on a regional scale, based on the exploitation of natural and culturalresources. The actions that are directed connected to the issue of resource management and energy saving related to the second objective can be summarized as follows:

- Activation of coordinated measures at the inter municipality scale to contain soil andprimary resources consumption in manufacturing facilities; promote economies of urbanization and improvenetwork efficiency in the integration of activities and services designed to enhance the manufacturing activities, avoiding interference with agricultural activities and the river band still intact, in order tofoster relationships of supply chain processes and the provision of common services.
- Organization, characterization and qualification of complex integrated settlementfor production, trading and services through the relocation ofactivities with significant environmental impact.
- Construction of additional new and diversified accommodation as part of interventionsoriented to the re-composition of urban edge, the qualification of underdeveloped anddegraded areas, including the redevelopment of complex manufacturing operations of discontinued operations in mixed-use areas (residential-tourist-commercial).

More articulated is the set of actions related to the third objective (Ob3), which focuses onthe need of a strong urban transformation of the lately built areas,that differ from the local tradition building models and are characterized by low value, scarcesafety, noenergy performanceand poorly equipped and infrastructured, in order to raise the overall quality of the settlement andits attractiveness,through the urban restructuring and building restoration.The actions that are directed connected to the issue of resource management and energy saving related to the third objective can be defined as the activating processes of urban regeneration in the consolidated city and in strongdegradedareas, through the redesign of the not built areas, the reconstruction of margins in urban fringe areas, with the definition of criteria of transformation inrelation to the types of building, to the materials and their characteristics, to the weaknesses and opportunities. These actions can be articulated into three main classes:

- *decongesting,* through the rationalization of the road sections and areas for motorized and pedestrian mobility, the provision of parking and green areas, standard services, the rehabilitation of buildings of historical value; incentives for thereplacement of buildings which alter the plant or the skyline;
- *completing*the building fabric, through the redistribution of settlement density with building interventions through concentration construction, functional diversification, conversion of use and replacement, with particular reference to tourism services; environmental and functional

qualification of building fabric (energy saving); enhancement of green and open spaces, also aimed at the rainwatersustainable management (Moccia and Coppola, 2009).

- *allocating*the services in urban areas that are poorly served, through the improvement and strengthening of accessibility and connectivity with more central urban areas (pedestrian and cycling pathways network), the equally distribution of standard, the consolidation of residential uses with the functional adaptation and the improvement of the quality of the buildings.

Within the same objective the plan defines other actions that are aimed at the protection and enhancement of open landscapes that surround the city and its branches, withreference to

- open spaces: active conservation of agricultural areas relatively intact, with the maintenance and consolidation oftraditional agricultural activities, strengthening the necessary infrastructure and the provision of services toagricultural production;
- landscape redesign of agricultural areas more densely urbanized, with innovative interventions likelyto improve their operation and environmental performance, in view of new balances and better conditionsenvironmental safety,
- reuse in rural areas that have been strongly and irreversibly transformed, even encouraging the provision of tourist facilities.

For the specific issue of the component atmosphere and climate change, energy and energy saving,electromagnetic pollution, noise pollution, water pollution, the plan defines specific goals:

- to contribute to the objectives of the Kyoto Protocol to reduce emissions of greenhouse gases
- to increase forest biomass and increaseconsequently the capability of fixing carbon (carbonsink)
- to improve air quality: reduce emissions ofpollutants into the atmosphere from sources and diffuse linear, eventhough recourse to the use of renewable energy sources
- to contain and prevent electromagnetic pollution
- to contain and prevent noise pollution in the environmentexternal
- to contain light pollution and consumptionenergy from outdoor lighting to protect public and privateenvironment.

Fig. 4 – view of the Agropoli Selva

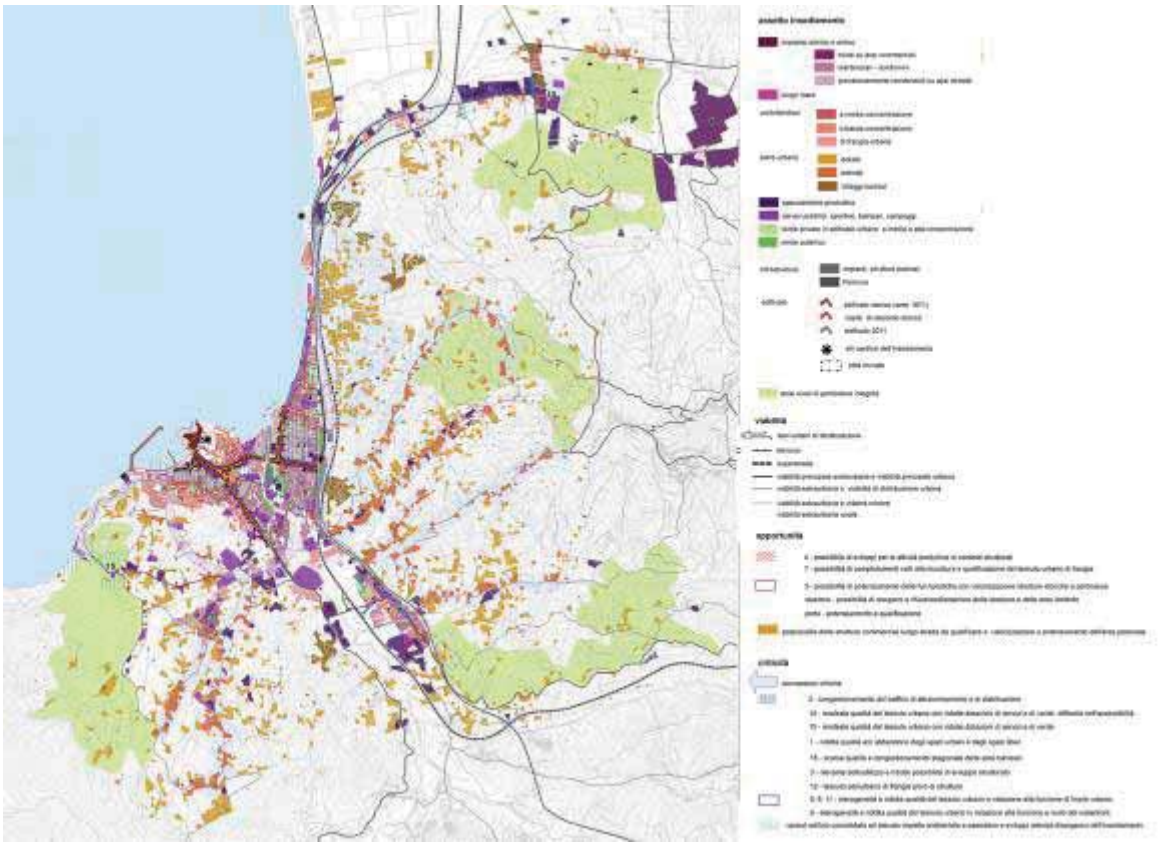

Fig. 5 – Settlement structure of the Agropoli Municipality (Source: Agropoli Urban Plan)

2.3 ENERGY SAVING AND BUILDING STOCK: THE PROJECTS

A significant part of the proposed strategies refers, in addition to regulation measures directly defined by the PUC in itsbody of regulation,to projects, more or less complex and extended. Some of them are directly related to the issue of resource management and energy saving.

Energy efficiency over the past four decades has focused on individual buildings. More recently, building environmental assessment systems and methods are being extended to address sustainability issues at neighbourhood and district scales. Where energy is concerned, the neighbourhood or city cannot be considered simply as an aggregation of buildings. According to this, different actions are defined in the PUC.

The first action regards the building stock retrofitting. The existing building stock must undergo an energy efficient transformation. In particular for the all Municipality, the plan defines rules and interventions for upgrading the energy efficiency of buildings to favour with the provisions of the building code, with the improved thermal insulation and the provision of energy-saving appliances.The challenge lies in how to communicate the benefits of energy efficiency and retrofitting to the wider community, and how to address the upfront capital costs. Understanding what motivates consumers to undertake retrofit works is an integral component of stimulating retrofit demand in sustainable cities.

The second action regard the energy saving, according to the general objective of containing light pollution and energy consumption by public and private outdoor lighting to protect the environment. Containment of energy use through measures to rationalize, do not waste and reduce the use of non-renewable resources, by promoting: the spread of "best practices" from the management of public assets, the use of innovative

technologies in all sectors and activities, the dissemination of renewable energy production, with care to avoid impacts and interference with the historical landscape, including through the promotion of programs and management interventions

The Agropoli administration, also under the pressure of the PUC, is working at Action Plan for Sustainable Energy (PAES), which shall consist of a document in which to bring together the efforts of the City and of public and private actors operating in the area, with the ambitious goal of achieving the reduction of CO2 emissions, and in drawing up a basic inventory of emissions. Within the PAES, the consumption of energy throughout the city is being detected, starting from the Town Hall, and then check the Schools, the Public Transport, until to monitor emissions in Agriculture, Industry, Commercial, residential buildings, private transport. To date, not many Italian municipalities have completed the process of SEAP, both for the complexity of the work to be done, both for the harsh review of the same made by the analysts of the European Community. Agropoli is one of the first municipalities in the province of Salerno that started to realize the PAES, the main instrument to access grants and funding provided by the EU in environmental matters. The implementation of the SEAP will make a significant contribution to private entrepreneurship that will be called to carry out the works that are going to plan and provide jobs for young people. After a first draft the SEAP, will hold a meeting aimed at stimulating suggestions and nominations for investments in the fields identified by specialists for the environment, particularly in innovative sectors such as, heat accumulation, biomass, insulation of housing, urban forestry, mobility, lighting. It is a path of extraordinary importance to ensure Agropoli also to be at the forefront on the Environment and Sustainability.

Furthermore,with the Act - Rational Use Of Energy (n.372/2012) the Municipality is developing in the field of maintenance and public works, actions aimed at rational use of energy and energy efficiency and the use of renewable energy sources, highlighting, in particular, its intention to support the introduction of equipment and/or high-efficiency technologies in the field of public lighting(such as LED, fluorescent lights, low-power, cogeneration, etc..), as well as actions aimed at the promotion and use of renewable energy sources, including measures to provide information and raise awareness on the issue.

Fig. 6– Example of settlements in Agropoli

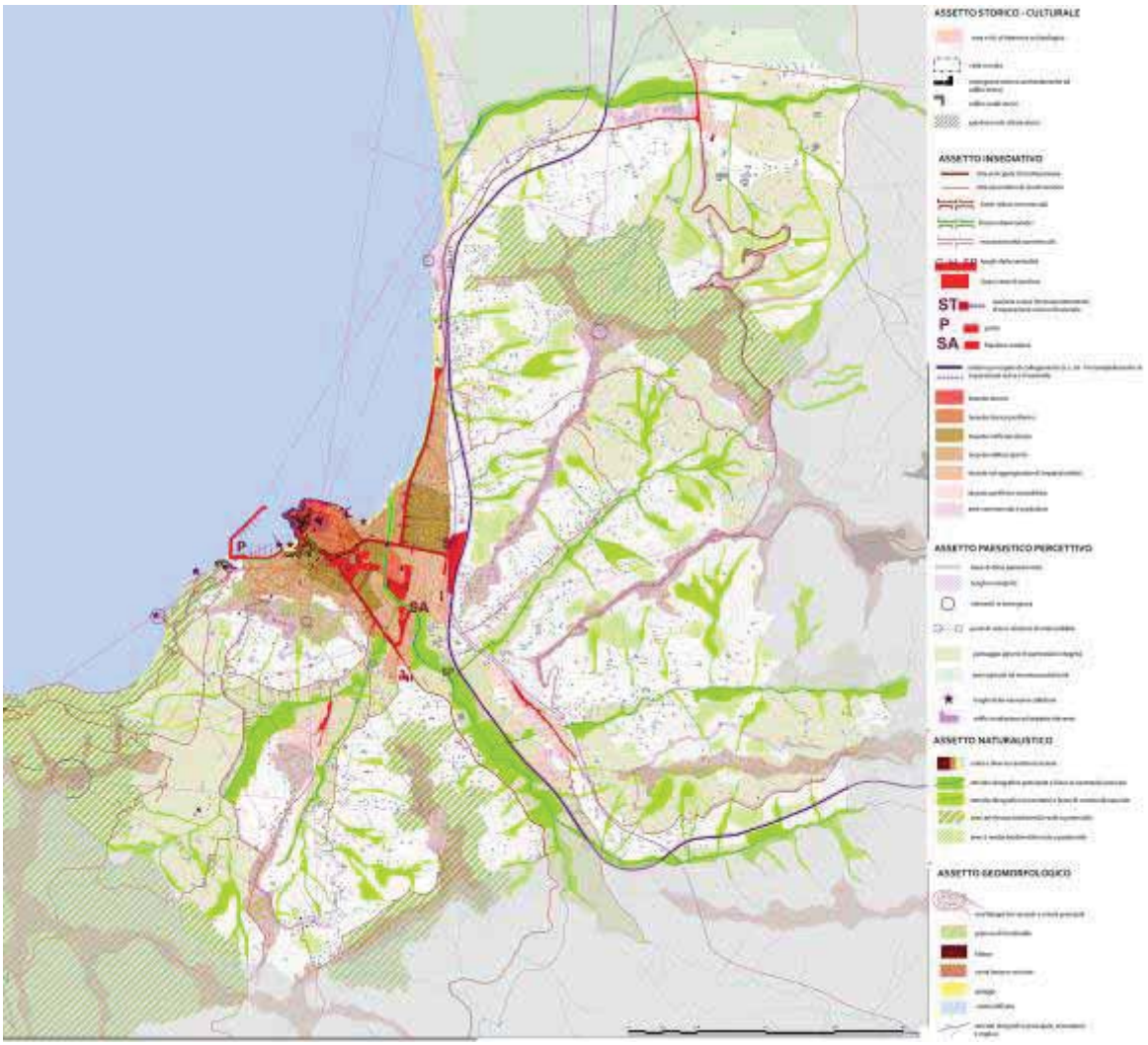

Fig. 7– Structural plan

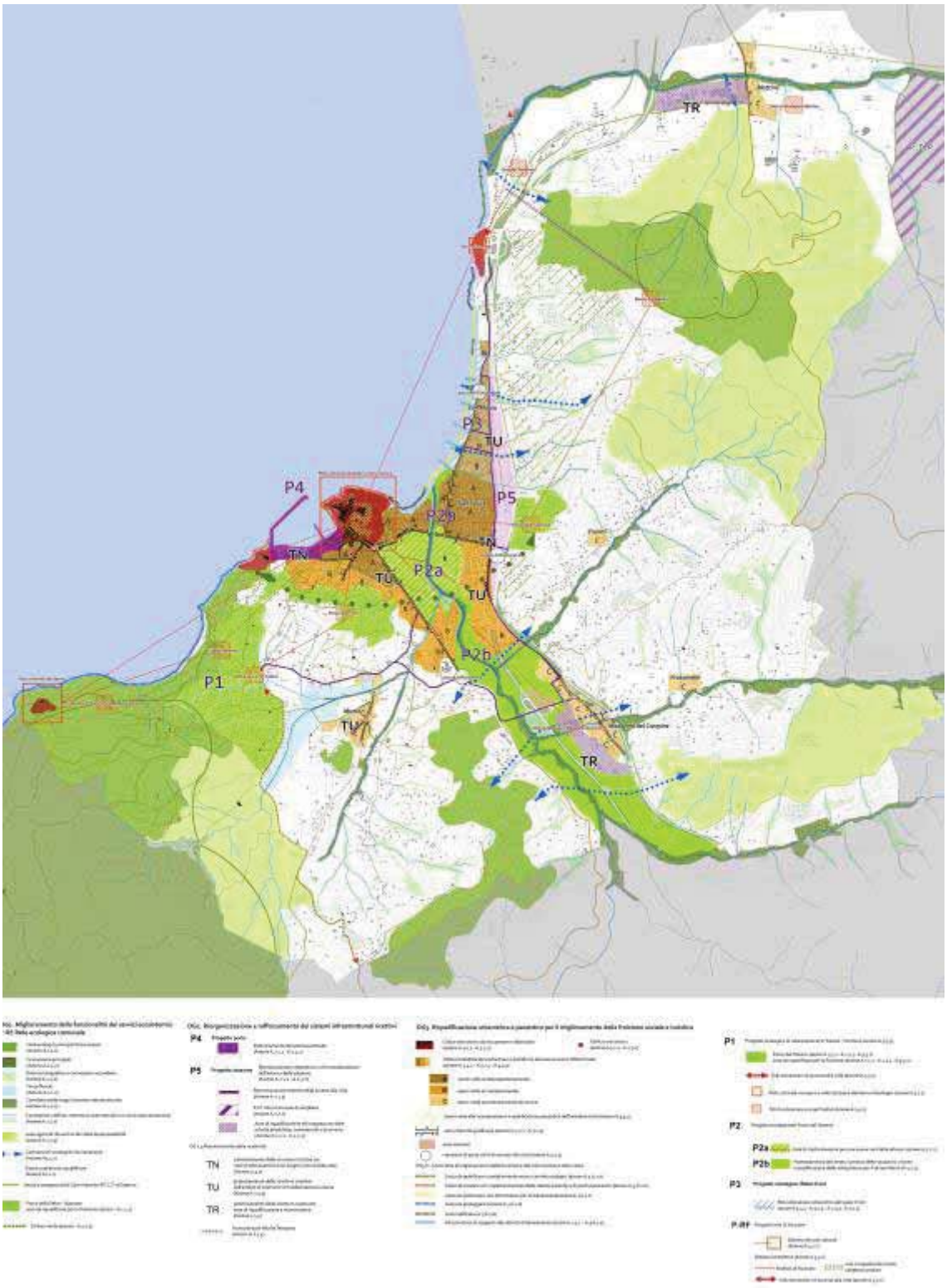

Fig. 9 – Strategic plan

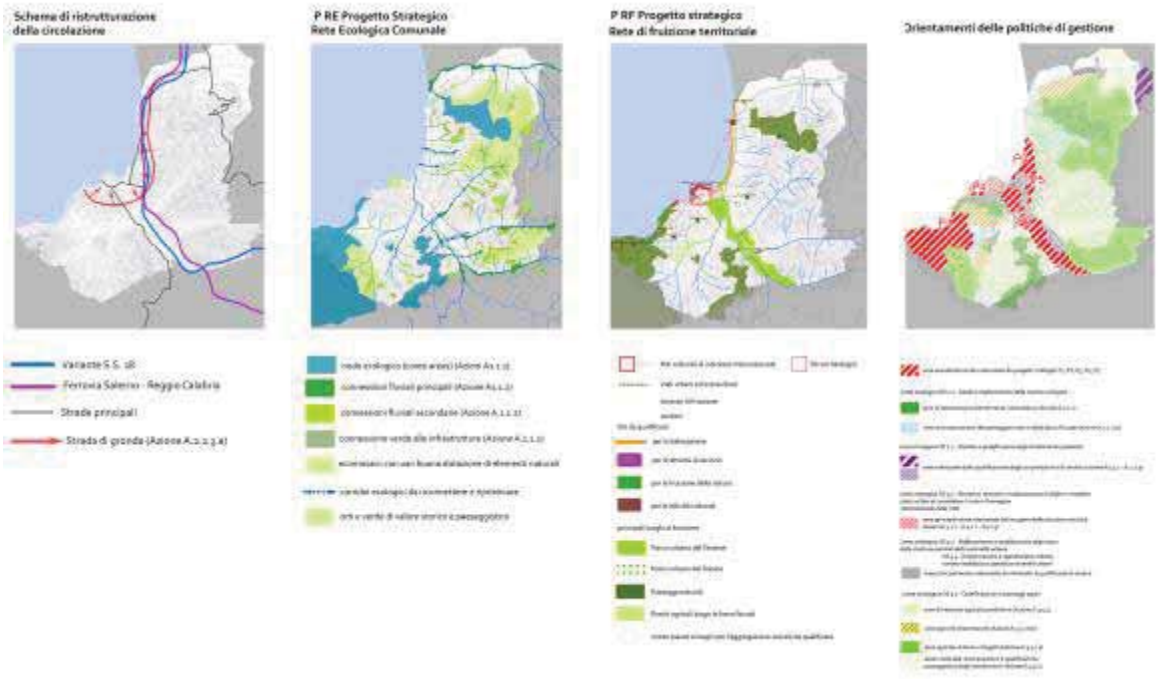

Fig. 10 – Strategies and actions for the mobility network, the ecological network, the territorial fruition and the management

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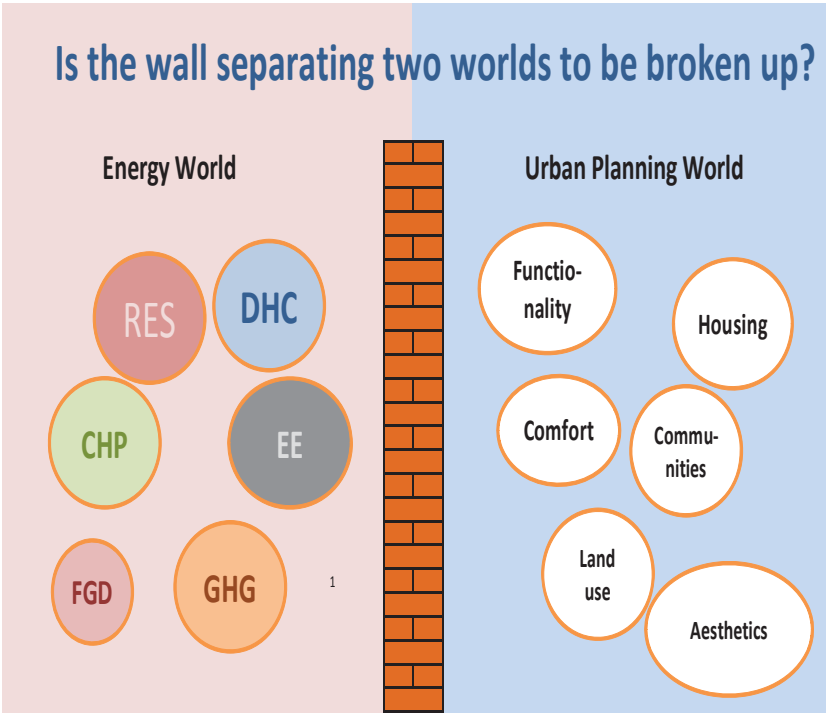

URBAN PLANNERS WITH RENEWABLE ENERGY SKILLS

TRAINING DESCRIPTION

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ABSTRACT

The paper at hand describes the need, methodologies and results of pilot training of urban planners in order them to become familiar with renewable energy systems (RES) and energy efficiency (EE).
There is little tradition in the world to integrate energy and emissions to urban planning even though energy mainly used in housing and transportation is the main reason to Climate Change, and the urban planner is the first actor to decide how renewable energy and energy efficiency can or cannot be applied in the community to be planned.
Therefore, pilot training of urban planners with energy skills has been carried out in five European countries to start filling the gap of the needed skills.
The objective is that similar training be extended to other countries and universities both to continuing professional as well as master level training of urban planners.
Thus, a training package of 3 000 slides and related explanatory texts have been made freely downloadable in 10 European languages.

KEYWORDS:
urban planning, renewable energy, energy planning

1 NEED OF CO-PLANNING OF ENERGY AND URBAN STRUCTURES

In very few planning schools in the world, the urban and regional planners are educated with understanding on energy, and on renewable energy sources (RES) and energy efficiency (EE) in particular. Based on the survey made in year 2009, only one such planning school was identified in North America (Canada) and three in Europe, namely in Germany (Stuttgart), Denmark (Arhus) and Finland (Oulu). Later on, a few other planning schools have adopted energy issues to their urban planning curricula.

AESOP – the Association of European Schools of Planning is the largest global association in the area of urban planning – not only European anymore. In the annual conferences of AESOP there are about 700 participants from both Europe and elsewhere. More than 1 000 papers have been submitted for review every year. In the last three annual conferences (2012 Ankara, 2011 Perth, 2010 Helsinki) there has been only a session or two with only some 20-40 participants to learn of how energy should be adopted as a new element to urban planning. The international urban planning audience has not yet recognized energy and emissions as a new element in urban planning, but traditional topics dominate discussion.

Therefore, there is rather no research available on combined energy and urban planning as the subject is new to the research community. Otherwise, any training is based on the results of the relative research. In this case, however, training had to start from the scratch as research material was not available.

Nevertheless, such combined skills of energy and urban planning have become vital while fighting the Climate Change: the urban planner is the first actor in the planning process, the plans of whom will either restrict or enable optimal RES and EE implementation later on.

The traditional way is that a municipality creates a general location plan in which the buildings can be easily built and connected to reads, and defines the physical dimensions of the buildings. The building code ensures the new buildings meet the EE norms. Thereafter, the energy and water utilities connect the buildings to their infrastructure in the best way still possible. In such away, however, it may be too late to optimize the RES and EE!

In the existing urban structures we have barriers to introduce RES and EE as well as district heating to integrate them to customers.

Therefore, training of urban planners with energy skills has been carried out as pilot training in five countries such as Germany, Hungary, Spain, U.K. and in Finland, the latter country to cover the coordination responsibility of the project with the acronym UP-RES (Urban Planners with Renewable Energy Skills). Because the training topic was new, it was challenging to attract participants to the pilot training courses. Normal marketing of training was not adequate as most urban planners considered the energy and emission issues too mathematical and complicated, and they were afraid of that the energy issues would set new constraints to the already challenging and comprehensive urban planning task. Without strong financial support from the EU amounting to 70% of the total project costs, the pilot training would not had materialized.

2 MANAGEMENT INNOVATON – CO-PLANNING OF CITY AND ENERGY INFRA

In the new way, the energy experts and the urban planners start working together in the general plan stage already. The impacts of various plans will be quantified in terms of energy consumption, investment and operation costs as well as emissions. The particular plan will be chosen for implementation which offers the lowest lifecycle costs and emissions. In city of Porvoo case in Finland, for instance, the new urban plan that was based on maximizing the share biomass fuelled CHP and DH appeared to be the best choice from environmental point of view, and moreover, with the overall life-cycle costs much lower than the traditional plan would have caused. In other words, the new combined energy and urban planning was a win win approach from both the reduced emission and the lowest cost point of view that was highly appreciated by the local decision makers.

In the Finnish city of Porvoo, a new management approach was adopted in planning of the new urban area, named Skaftkärr. In the very initial stage of planning both the urban and energy planners were invited to work together. As the reference for their co-planning, the Skaftkärr plan from year 2007 was adopted, but assuming that passive energy houses would be used apart to those assumed in the plan of 2007. The reference plan was a sub-urban plan traditionally dominated by small houses to be located so that personal cars would need to be used. As heating sources in the reference plan, a combination of district heating, electricity and heat pumps was assumed.

Co-planning started with a few studies about how people live, move and what are their expectations. Co-operation among the urban and energy planners was not that simple in the beginning, but some time was needed for them to learn each others' way of work and thinking. A year was mentioned as a period of time that was needed to harmonize their co-operation.

Finally, the co-planning methodology provided four options to the urban scheme to be applied in Skaftkärr. All four options had the primary energy consumption and the emissions 30-70% lower than the reference plan.

The four options generated by the co-planning were as follows:

Option 1

- A dense new area that is supported by the existing city structure.
- The passive energy buildings are connected to the DH.
- Effective public and light transport routes are created to the city center.

Compared to Reference case:

- Primary energy consumption 40% lower
- CO_2 emissions 34% lower

Option 2

- Effective small-house characterized Option, where 50% of heat is based on DH and the balance of other 50% on ground water heat pumps.
- Effective public and light transport routes are created to the city center.

Compared to Reference case:

- Primary energy consumption 36% lower
- CO_2 emissions 31% lower

Option 3

- A loose land use Option, where heat and power are produced inside the buildings 100% based on RES.
- Passive energy houses.
- Traffic like in Reference Case based on private cars and a little public transport.

Compared to Reference case:

- Primary energy consumption 67% lower
- CO_2 emissions 48% lower

Option 4

- Community type land use Option, in which the focus was on reducing the need of transport and by locating working places and services in the area.
- Effective public and light transport routes are created to the city center.
- Passive energy houses served 100% by solar heating. The area will supply solar heating to all citizens of Porvoo.

Compared to Reference case:

- Primary energy consumption 45% lower
- CO_2 emissions 62% lower

The life-cycle costs of the four options (M1 - M4) in terms of Euro per inhabitant during 30 years to come are presented in the next picture. In three of four options the life cycle costs were lower than in Option 3. In the latter one, the investment costs of RE as well as the individual heat pumps using the electricity produced in the building itself became extremely high.

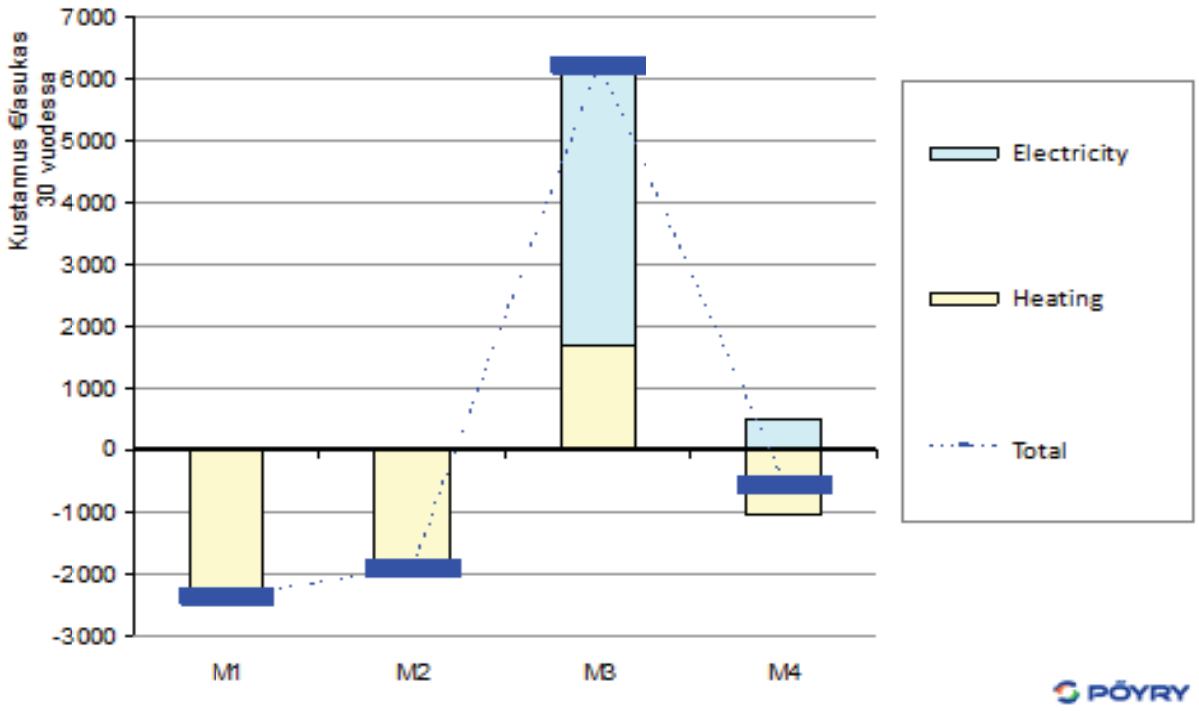

Fig. 1 - The life-cycle costs of the different options (M1 - M4) in terms of Euro per inh. during 30 years

The final option selected for implementation was based on prioritizing light and public transport (biking highway, for instance), using district heating in most buildings and enabling solar heating to be used later on. District heating as the primary source in Porvoo is a special case as 92% of the heat energy in Porvoo is from the co-generation of heat and power (CHP) plant, the fuel of which is 70% from biomass (wood chips).

The city management of Porvoo was happy with the results as well, as the infrastructure costs (streets, pipelines, etc.) were substantially reduced as well.

The new co-planning approach in Porvoo was supported and monitored by the Finnish Ministry of Environment and the Finnish Innovation Fund - Sitra. The co-planning approach is currently expanding to other cities in Finland, sooner or later maybe to other cities in Europe as well. Such expansion, however, will need training similar to that used in UP-RES pilot courses and adjusted to local conditions and country specific differences.

3 COUNTRY SPECIFIC DIFFERENCES

Designing and implementing the training depends on the local circumstances, and should therefore be adjusted to the local needs and conditions. The awareness and establishment level of various RES components in the five countries is different as illustrated in Table below:

RES	Initial	Scarce	Dense	Established
Solar	FI	UK	DE, HU	ES
Wind	FI	UK	ES, HU	DE
Biomass	ES, HU	DE, UK		FI
Waste heat	ES, HU, UK		FI, DE	
District heating	ES , UK	HU	DE	FI
District cooling	HU, UK	DE, ES	FI	
	⇩	⇩	⇩	⇩
Level:	Awareness	Knowledge	Competence	Professional practice

Tab.1 - The awareness and establishment level of various RES components in the five considered countries

District heating and cooling, for instance, is a well-established practice in Finland, but neither in U.K. nor Spain. On the other hand, solar and wind power are largely used in Spain and Germany, but are still at a very initial stage in Finland.

For instance, different approaches were taken in the five countries, in which the pilot training was carried out, including the following:

- In Finland, there was the 9 month 'long' course taught to urban and regional planners. The course consisted of 8 modules each of two days duration from Fall 2011 to Spring 2012. The trained planners now work in the different parts of the country to adjust their plans to adopt new features that favor RE and EE. The training of 20 CETS took place in Aalto University.
- In Hungary, the long pilot course was organized as a normal university course to students. The course having had lasted 9 months as well as comprised even 60 ECTS credits was organized at University of Debrecen.
- In Germany, the long two-year lasting long has started to both urban and energy planners combined. The benefit of educating both professions to together is expected to create mutual understanding on the way of thinking, terms and objectives, way of working. All training takes place in Frankfurt.
- In Spain, the long course of 9 months duration both for students and officers of urban planning was organized in Barcelona.
- In the United Kingdom, there were no such long course, but 20 charettes of three days each were organized in different cities of the country. To each charette, the local stakeholders such as city planners, developers, politicians, energy experts were collected to learn the main features of Climate Change oriented urban planning. Based on the outcome, the attending stakeholders were asked to select a real planning case in their city to which RE and EE could be incorporated.

In the five countries above, the pilot training covered about 500 experts, which can be considered a decent start towards co-planning of energy and urban structures in the future.

4 LEARNING OBJECTIVES OF TRAINING

There is very little tradition of spatial planners and energy experts working together anywhere in the world. Their educational backgrounds (physical versus visual sciences) and their linguistic backgrounds are different, which creates a communication barrier between the two professions.

The training was focused on introducing the energy technologies, together with the opportunities and implications associated with them from the urban planning perspective.

5 TRAINEES

The trainees comprised urban and regional planners and developers working in city planning offices, regional councils, planning schools, construction and consulting companies. In Germany in particular, energy experts were also invited to participate the pilot training. Moreover, in U.K. all key stakeholders who would need to work closely with the planners in developing future energy systems were also invited – notably including environmental, sustainability and housing professionals.

In all five partner countries, the UP-RES materials and methodologies will be used for Master level education as well.

6 PILOT TRAINING APPROACH

The structure of the long pilot courses comprises ten modules, from M1 to M10. Each module typically consisted of two days of training.

The module titles and summarized motivations to urban /spatial planners are as follows:

M1	SUSTAINABILITY CONCEPTS IN REGIONAL AND URBAN PLANNING: A HOLISTIC VISION As introduction, the main reason to Climate Change is energy production based on fossil fuels. Housing and transportation cover more than half of all primary energy consumption, both sectors being under influence of regional and urban planners. Many countries in the world (mainly EU) have set targets to reduce primary energy consumption and greenhouse gas emissions. In practise, however, behaviour of people and scattered urban structures create barriers to expansion of EE and RES. Those barriers should be phased out, in which the urban planner has an important role. Measures and policies to phase out such barriers are discussed in the 9 modules to follow.
M2	ENERGY. FORMS - TRANSFORMATION - MARKET OUTLOOK Fossil fuels increasingly dominate the energy market, and new reserves are found constantly. How to convert various forms of energy to uniform concepts of primary energy and GHG emissions in order to compare “energy” to “energy”. How can be fossil fuel replaced by RES, and what would such replacement require from planning. A spreadsheet tool was used which gives the energies and emissions of various power and heat production plants and fuels.
M3	ENERGY DEMAND REDUCTION STRATEGIES: POTENTIAL IN URBAN PLANNING The module introduces two real examples, in which RES and EE have been successfully adopted, (i) one implemented in Germany (Freiburg), where solar and biomass have successfully penetrated to the local energy market as well as both public transport and bicycles have successfully conquered market share from private cars; (ii) and another one introducing a new integral urban and energy planning concept in Finland (Porvoo), which was described in Management Innovation Chapter in detail. In both cases new ways of city planning have taken place as having integrated RES and EE issues with the traditional urban planning process
M4	ENERGY DEMAND REDUCTION STRATEGIES: POTENTIAL IN NEW BUILDINGS AND REFURBISHMENT The Module presents the possible ways how RES and EE can be adopted in the building level. Integration of solar panels and collectors to structures based on appropriate facing of the building walls and roofs,, waste heat recovery allowing air conditioning and high energy efficiency in parallel, for instance, are examples of such measures. In the life cycle analysis, the relative importance of construction materials increases as expanding RES and EE reduce primary energy consumption and emissions. Energy labelling of buildings sets requirements to the planners and designers of buildings.

M5	ENERGY RESOURCES AND RENEWABLE ENERGY TECHNOLOGIES There are several forms of RES to be considered such as solar, wind, biomass, wastes, sea water, geothermal heat, hydro power, and new ones (wave energy) are invented as well. The planner needs to understand the feasibility of the RES options in the urban structures. Solar energy requires surfaces facing the sun in an optimal way, bio mass can be most economic and ecological in large scale, municipal and industrial waste can be integrated to local energy palette either as distributable heat or fuel to be used for power and/or heat generation, etc. Gasification instead of traditional combustion offers environmental and economic benefits to the community, but requires different technologies.
M6	ENERGY DISTRIBUTION: DISTRICT HEATING AND COOLING District heating (DH) and cooling (DC) are effective ways to enhance the economy of scale and integration of various RES options, mainly bio fuels and waste energies to be used in energy supply of the community. Co-generation of heat and power (CHP) as the most efficient way to use any fuel to produce electric energy will be introduced. Existing DH system is the precondition to CHP as much as waterfall to hydropower. Nevertheless, feasibility of DH, DC and CHP sets requirements to city planning in terms of location of energy sources, piping networks, consumer connections. Sufficient heat load density is vital to economy of DH and DC. Urban planner is the first actor to influence the heat and cooling load density of any community.
M7	THE RIGHT SCALE FOR EVERY ENERGY CONCEPT: HEAT AND COOL DENSITY (DEMAND SIDE), POTENTIAL ON SUPPLY SIDE The Module introduces various modes of energy, and their feasibility in terms of optimal scale. Some energy modes are transmittable to short (district heating and cooling) or long (electricity, fuels) distance, but some other not (steam). Some can be optimal in small and local scale (solar, hydro power) whereas others require large scale (biomass, municipal waste). Many energy modes are easy to be stored (fuels) but some others face challenges in long term storing (steam, hot water, electricity). The objective of the module is to let the planner understand the restrictions set and opportunities offered by various modes of energy.
M8	NEW MANAGEMENT CONCEPTS IN THE ENERGY MARKET There are different ways to extend RES and EE market in a community. Various management methods, such as energy service companies (ESCO) and agencies are introduced in the Module to give an idea to the planner how RES and EE expansion can be effectively organized.
M9	ENERGY PLANNING Both spatial and energy planning use maps, have interdisciplinary approaches, customer surveys and other common methodologies. In practice, however, real co-planning of urban and energy seldom takes place due to different educational backgrounds and planning objectives of the planners. The module offers tools and ideas for integrated energy and urban planning.
M10	NEW TRANSPORT MODELS AND URBAN AND INTERURBAN MOBILITY All transport creates emissions, some more than the others. Spatial planning influences the need of mobility and the feasibility of various means of transportation. In the Module some facts are given on sustainability of various transportation modes as well as examples of best practices to the planner to consider. Such examples emphasize public transport, car pooling and light transport (walking, bicycles) to private cars. Success stories are available from some cities to be shared with many others.

Tab.2 - The training modules

7 EXAMPLE OF TRAINING MODULE

Here is an example of the contents of a training module. It is a combination of delivered lectures, team-work, and a site visit.

M5	**ENERGY RESOURCES AND RENEWABLE ENERGY TECNOLOGIES**
Fasilitator: N.N.	**13.-14.2.2012**
Time	**1st Day: Familiarization with RES**
9.00-9.15	Introduction to Module Topics
9.15-10.30	Presentation of RES technologies and applications
10.30-10.45	*Break*
10.45-12.00	Based on the presentation, five groups of trainees search for information from Internet. One group specifically for solar electric, solar heat, wind, biomass and the fifth group for waste to energy.
12.00-12.45	*Break*
12.45-14.00	Five groups continue
14.00-14.15	*Break*
14.15-15.30	Presentation of the results of five group works
15.30-16.00	Conclusion
	2nd Day: Rural Energy Supply
9.00-10.30	Local economy: impacts of RES on rural economy and survival
10.30-10.45	*Break*
10.45-12.00	Off-grid village based on RES (Kempele, Finland)
12.00-12.45	*Break*
12.45-14.00	Agricultural waste to liquid fuel
14.00-14.15	*Break*
14.15-16.15	Excursion to a bio mass fuelled CHP plant

Tab.3-Structure and contents of a training module

8 TRAINING METHODS

In the pilot training several methodologies were applied, as follows:

- Facilitator to be chosen for each module to link the learned energy issues to urban planning. As the topic of integrated energy and urban planning is new, guidance and stimulation is needed to emphasize the key issues and links of energy to urban planning.
- Lectures based on slides and discussions. Discussions among the trainees and the trainer were found useful to stimulate the learning process.
- Excursions both locally and internationally to best practice locations. Excursions helped the trainees understand the lessons learned on a real practical level.

- Exercises carried out by the trainees in small groups and individually about issues combining RES and EE to spatial planning helped trainees quantify the energy issues, not only use qualitative expressions and terms in their plans.
- Simple spreadsheet tools developed for specific planning areas such as heat planning of a city or urban district, quantification of energy balance and emissions of various heat and power sources, economy of district heating depending on the heat load density, life-cycle cost analysis comparing fossil to biomass fuelled boilers in district heating.
- Distance learning reduced the need of travelling of trainees, thus a little contributing to cleaner environment
- Movies (Inconvenient Truth, District Cooling,..) as ready-made and well-designedaudio-visual means clearly expressed the key messages of Climate Change and applicable measures to fight the Change to the trainees.
- Expert panel (clinic) advisory services to support the trainees to carry out their exercises was found helpful to support the trainees to carry out their homework. In the middle of the homework, the trainees met with the top experts of either energy or urban planning to learn to which direction to carry out the homework.

9 TOOLS

Six simplified tools using common spreadsheets were developed for energy and urban planning in Germany and Finland, and used in the pilot training of the country of tool origin. The tools and their short descriptions are as follows:

- **Energy and emission balance of energy production:** the energy balance comprising inserted fuel, output heat and electric power as well as CO_2 and SO_2 emissions can be calculated for various types of energy sources such as heat only boiler, power only plant, CHP based on natural gas, coal, fuel oil and biomass.
- **Energy and GHG balance of a community:** The spreadsheet calculates the rough estimate of an energy and greenhouse gas (GHG) emission balance in a community. The word "balance" does not really apply at the moment, because only energy consumption is summed up. Energy supply is only modelled through emission factors, which assign a certain amount of emissions to an energy unit.
- **Economy of district heating**: the economy f district heating depends on the linear heat load density in terms of sold heat energy divided by the network length. As a rule of thumb, the densities equal and larger than 2 MWh/m clearly indicate that DH is the least cost heating option, whereas at the densities below 1 DH would not succeed under commercial terms but individual solutions should be considered instead. If DH is regulated, as in Denmark for instance, even low density values may allow DH survive on the market. On the economic basis, the density values between 1 and 2 MWh/m require a life-cycle analysis of the available heating options to be carried out before the heating selection can be made.
- **Economy of heat pumps in a CHP system:** Economy of individual heat pumps may be questionable in a CHP system as the heat pump substitutes the heat load of the CHP plant. as the heat load of CHP declines, so does the efficient power generation of CHP. Conclusively, power alone production is needed to compensate the not generated power of CHP and the power need of heat pumps, thus leading to increased primary energy consumption and GHG emissions.
- **Life-cycle costs of fossil and biomass fuel boiler in DH**: The spreadsheet tool can be used to compare the economy of fossil fuel boiler to biomass boiler depending on the investment costs, fuel and other operation and maintenance costs.
- **Heat demand of residential buildings**: The tool provides an estimate to a building's transmission heat loss, based on predefined surface parts. Solar radiation, physical properties of the building envelope and the size and location (city) are taken into account. As example the climate conditions of the cities Barcelona,

Budapest, Glasgow, Hamburg, Helsinki, London, Munich, Oulu and Sevilla are available in the tool, and new ones can be inserted as necessary. The tool calculates the heat demand of various buildings.

10 TRAINING MATERIAL IN 10 LANGUAGES

The training material had to be compiled from existing practices, as no research material combining energy to urban planning was available.

The major deliverable of the pilot training is the compilation of the selected material to a training package.

The package can be used in other planning schools in Europe as it has been translated to 10 languages. The package comprises the material of ten modules, each in about 300 slides and explanatory texts. In addition to Italian, the package is freely downloadable in English, Finnish, French, German, Hungarian, Polish, Romanian, Spanish and Swedish.

The pilot training was a part of Intelligent Energy Europe (IEE/EACI) research program that promotes RES access on the energy market. The other partners of UP-RES were the universities of Augsburg and Debrecen, University of Technology in Munich, The District Heating Association in Germany (AGFW), BRE Ltd (Watford) U.K.), and SAaS (Barcelona).

11 CHALLENGES

The pioneering UP-RES training was first of its kind implemented on the European level. In a few planning schools such combined urban and energy planning has been adopted already, but it still a rare practice in Europe. UP-RES training implementation faced five major challenges, as follows:

- Traditionally at any education branch, there is first research and thereafter outcome of the research, which creates the basis for training. In UP-RES, however, as there was practically no research tradition combining urban planning with energy and emission issues anywhere, the controversial approach had to be adopted: Teaching had to be started from scratch as no research results on integrating urban planning with energy and emissions was available.
- Energy and emissions as engineering, mathematics and physics based science did not fit with the urban planners background being mainly architectural. Some fear was identified among the urban planner towards quantitative analysis of energy and emissions, even though the quantitative analysis of energy and emissions related to the individual plans should be crucial for evaluation of various planning schemes .
- Urban planning is already a multidisciplinary, comprehensive and a challenging activity. No new expansions such as economy, energy, emissions, for instance, are welcomed to come in anymore.
- The actual financial crisis in Europe has reduced training budgets of public institutions, such as municipalities, regional councils and planning schools. The reduced budgets made the pioneering UP-RES training more challenging to implement as less funding for even the traditional training was available. In Finland, for instance, even though not being on the worst side of the crisis, more than 100 phone calls were made to city planning offices, regional councils and consultants in order to have 25 trainees on the long training course, still five less than the targeted 30 trainees. Traditional invitations based on emails and public advertisement were rather ineffective.
- In all partner countries, lack of co-operation between the urban and energy planners was identified. Typically, those two planner professions work in different organizations. Traditionally and typically, the co-operation between the two organizations has been based on commenting the plans of the others in writing, having common meetings rather rarely, asking and providing comments sometimes without response from the other, neglecting requests or comments because of misunderstanding the idea, etc.

In general, the main challenge was to attract trainees to the courses because of the challenges mentioned above. Finally, after completion of the pilot training courses in five countries, the trainees (and other stakeholders) expressed their satisfaction in an independent evaluation survey. The satisfaction level ranged from 5 to 6 as medians out of the maximum of 7 in the sample of 53 replies.

	Finland	Germany	Hungary	Spain	United Kingdom	mean	median	deviation
The UP-RES project has communicated effectively on its goals and objectives.	5,4	4,3	6,5	5,4	6,9	**5,7**	5	1,0
The UP-RES project has communicated effectively on its activities (such as courses).	5,4	3,2	6,2	5,9	6,8	**5,5**	6	1,4
The UP-RES project has improved the awareness of the role of renewable energy sources in urban planning in my country.	5,1	4,7	6,5	5,6	5,7	**5,5**	6	0,7
The UP-RES project has increased the interest on renewable energy sources in urban planning in my country.	4,9	3,1	5,8	5,3	5,0	**4,8**	5	1,0
The UP-RES project has fulfilled its promises with its actions.	5,5	4,2	6,2	4,8	6,1	**5,4**	6	0,9
The UP-RES project has increased the practical skills of urban planners.	5,5	4,4	6,3	6,3	6,8	**5,9**	6	0,9
The UP-RES project has motivated the participants to deepen their professional development.	6,2	4,7	6,6	5,9	6,9	**6,1**	6	0,9
The UP-RES project has created a community of interested urban planners in the field renewable energy sources.	4,5	3,8	4,4	5,1	4,9	**4,5**	5	0,5
The UP-RES project has created a sustainable training concept for urban planners.	5,1	4,2	5,6	5,8	5,5	**5,2**	6	0,6
The UP-RES project has improved the communication and co-operation between the different key actors in professional development according to renewable energy sources in urban planning in my country.	4,6	4,5	5,6	4,8	4,6	**4,8**	5	0,4

Tab.4- Human Capital Investments as UP-RES project evaluator.

12 CONCLUSION

During the past decades, Urban Planning has been complemented with social and environmental assessments. Now RES and EE shall be included as a means to reduce primary energy consumption and extend RES to fight Climate Change. It is the time now to include quantitative analysis energy and emission impacts on the urban planning.

Finland, for instance, has been famous for its nature related architecture and highly efficient energy systems. However, combined urban and energy planning was a virgin area until UP-RES and Porvoo cases were implemented. Situation is likely even worse in most European countries.

Both above together indicate a huge **training demand** in order to make urban and energy planners, not only to co-operate, but to co-work together in the near future.

In addition to training, **planning guidelines** in all levels should take into account RES implementation and EE. This would change and direct planning practices, enable impact assessment and also reinforce co-operation and co-planning.

REFERENCES

As there is practically no research material available so far on integrated energy and urban planning, the below listed links provide support in search of moredetailedinformation.

The training material package: http://aaltopro2.aalto.fi/projects/up-res

The Skaftkärr case in the city of Porvoo, Finland: http://www.skaftkarr.fi/en

AESOP - Association of European Schools of Planning: http://www.aesop-planning.eu
Advanced city planning in Germany: http://www.freiburg.de/pb/,Lde/232045.html

IMAGES SOURCES

Cover Image, Tables 1,2,3,4: elaborated by the Authors.

Fig. 1: http://www.skaftkarr.fi/en

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WALKABILITY OF SCHOOL SURROUNDINGS

AND ITS IMPACT ON PEDESTRIAN BEHAVIOR

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ABSTRACT

Pedestrian safety due to traffic accidents is seen as a serious problem in Jordan. It is believed that walking environment is a contributory factor. This study looks into pedestrian environment in schools' vicinity. Seventeen schools were selected and 231 students were followed from school to home. Pedestrian walking environment for each student trip was assessed by considering the sidewalk and crossing facilities; driver and pedestrian behavior; attractiveness and school location. Analysis indicated that pedestrian environment is rather poor and very few walking paths are in good conditions. Behavior of each pedestrian was observed by considering the trip time; walking time on sidewalk and on pavement; crossing time; number of crossings; and involvement of conflicts. Results showed that 15% of observed subjects were involved in conflicts. Average walking time is 17 minutes; almost half of this time is spent either by walking on street or crossing. On average, children cross two junctions on their way back from school. Females are involved in less conflict and they spend less time in traffic. Drivers give priority to pedestrian in one-thirds of all observed crossings with preference to males.

KEYWORDS:
Pedestrians, walking behavior, pedestrian safety, school routes, children accidents.

1 INTRODUCTION

Worldwide and for many years, road accident fatalities and injuries were major life threats for humanity (WHO, 2009). In Jordan, road accident fatalities and injuries were increasing with no sign of being under control but not after 2007, when a set of firm measures were considered. In 2007, a total of 110,630 crashes were reported by police compared to 140,014 in 2010, which mounts up to an increase of 8.1%. The deaths, on the other hand, reduced in 2007 from 992 (17.3 deaths per 100,000 inhabitant) to 670 (11 deaths per 100,000 inhabitant) in 2010 (JTI, 2010). Pedestrian accidents that compose 6% of all accidents lead to 33% of all deaths in traffic (3.57 deaths per 100,000 inhabitants). Half of death toll in traffic was among children under age of 15 years (4.55 deaths per 100,000 inhabitants). Pedestrian children are considered a high risk group. Globally, over 400,000 pedestrians are dying every year (Naci *et. al.*, 2009).

This may be due to children understanding and perception of traffic situations, which is not always well developed (Gibby, Ferrara, 2001). Children are not young adults and it is important to understand their limitations in understanding traffic as mainly they have a limited sense of danger. Children are described as impatient and impulsive, concentrating on only one thing at a time. They have a narrower field of vision than adults, about 1/3 less; they cannot easily judge the speed and distance of approaching vehicles, assuming that if they can see a vehicle, the driver must be able to see them.

In general, pedestrians are facing higher risks in urban areas where more pedestrians and vehicular activities take place (Zegeer, Bushell, 2012). A study in Montreal, Canada revealed that children pedestrian accidents are more likely to happen at mid-block in residential areas (David, Rice, 1994), male children between the ages 5 to 8 are the main victims. Cheng (1991) investigated the trend of Utah's pedestrian accident rate and discussed factors involved. His study produced similar results to David and Rice (1994). Jordan (1998) analyzed 2,167 pedestrian accidents in Philadelphia. He found that more children are injured in route to/or from school, but not near the school. A greater number of children are injured while playing after returning home from school rather than during their trips to/or from school. In Netherlands, 90% of children accidents occurred on foot or on bicycles are within built-up areas (Westdijk, 2001).

Walkability is a measure of how friendly an area is to walking. Walkability takes into account the quality of pedestrian facilities, roadway conditions, land use patterns, community support, security and comfort for walking (VTPI, 2012). **Bikeability** is also a term for the extent to which an environment is friendly for bicycling. Moudon and Lee (2003) reviewed existing environmental audit instruments used to capture the walkability and bikability of environments and to provide an understanding of the essential aspects of environments influencing walking and bicycling for both recreational and transportation purposes.

Zegeer and Bushell (2012) suggested a set of actions to improve traffic safety for pedestrians; eight actions were recommended covering engineering; education; and enforcement treatments. A cross-sectional study (Zhu, Lee, 2008) examined disparities in the environmental support for walking around 73 public elementary schools in Austin – Texas. Field audits were conducted to assess the street-level walkability and GIS was used to measure the neighborhood-level of walkability and safety. The study showed that economic and ethnic disparities exist in the environmental support for walking, suggesting the need for tailored interventions in promoting active living. Children in low income areas are more likely to live in unsafe areas with poor street environments but with some favorable neighborhood-level conditions (Zhu, Lee, 2008). Safe route to school program in El Paso was introduced in 90 elementary schools (Schatz *et al.*, 2009). The program addressed the 5 E's (Education, Encouragement, Engineering, Enforcement, and Evaluation). The study looked into the perception of parents and children based on before and after field survey.

Committee on injury, violence, and poison prevention of American Academy of Paediatrics (Pediatrics, 2009) reviewed the contributory factors that lead to high death toll among pediatric pedestrians younger than 19 years, which include lack of playground in low income areas and the high speed.

In Jordan, children pedestrian accidents and behavior have been investigated to some extent (Shbeeb, Mujahed, 2002). The pilot study looked into school environment and its walkability. Ten schools in Amman, the capital City of Jordan were selected and a sample of 200 students is selected to assess their level of traffic safety education. The study revealed that the school plays minor role in educating children and their families are the main source of information in this regard. The study looked also into pedestrian behavior on their way back home from school and examined the surroundings environment. The study indicated that pedestrians are exposed to frequent hazardous situations. Walking environment is relatively poor. Pedestrian facilities are lacking in most locations, and they are not used for pedestrian crossing when such facilities exist. If pedestrian crossings are provided, pedestrians are rarely given priority.

This paper further looks into pedestrians' behavior in Jordan and is a continuation of the pilot study made to assess school surroundings from pedestrians' perspective. The environment that surrounds schools is assessed with regard to its walkability. The size of observed sample is enlarged to provide better understanding of pedestrians' behavior within school vicinities. Particular emphasis is given to children (age of 18 years or less). The outcome of this study is expected to provide insight into the local environment of deficiencies facing walkability, which should be treated in the future, where safer routes to school must be provided through introducing a set of guidelines to select school locations, and develop procedure for safety auditing in the surrounding roads.

2 RESEARCH OBJECTIVES

This research paper main goal is to explore pedestrians' behavior in traffic on their way back home from school. The way back home has been proven in literature to be more hazardous than the way to school, in addition to that justification, data collection would be very difficult to track students in their way to school due to spatial distribution of homes and to the temporal variation in trip time from one student to another. Two other objectives are required to fulfill the main goal: first to analyze accident data to identify the nature and size of pedestrians' accident problem with emphasis on children. And second to appraise school route environment from pedestrian children safety perspective.

3 METHODOLOGIY

Police reported accident data in Jordan in 2010 and 2011 were reviewed and analyzed. Observations of children behavior while walking and crossing roads were analyzed to assess their actual behavior. Inventory of routes leading to school were made to assess how friendly their environment is to students? The school surrounding is the area that includes all streets within 1-2 km radius from the school site. The observations were completed by examining behavioral actions and physical conditions, such as pavement conditions; characteristics of pedestrians' crossing; behavior at crossings (drivers and pedestrians); whether users comply with traffic rules or not? The next paragraphs describe the nature of observations.

Routes pavement condition were assessed in terms of width, maintenance conditions, continuity, slipperiness, usage for other purposes [vendors, parked cars] and the existing of light and advertisements poles. Pedestrian crossing areas were checked; the checked items covers looking into pedestrian crossing marking and if appropriate road signs were provided. Road environment in the crossing vicinity was assessed [wide road, high speed traffic; parked vehicle or trees that obscured the view]. Observations include checking if traffic calming devices ahead of the crossing were installed. Streets were considered

wide, if pedestrians need to cross more than one lane per direction. High traffic speed is defined as high if it exceeds 30 km/h. Observers are trained to assess if speed exceeds such a threshold.

Driver behavior on pedestrian crossing [if available] included driver speed at crossing and whether drivers comply with the traffic rule of giving pedestrians the priority on the crossing? Also, pedestrian ability to comply with traffic rules; such as stopping safely at the pavement adjacent to the crossing? Is he/ she visible to drivers; are crossings designed in such a way to allow pedestrians to visually search before crossing? School location was characterized by answering questions like is the school located on a main road with high speeds; is school main entrance on a minor road? Has the site been provided with the necessary marking, signing, and if speed humps are present? The attractiveness of the routes for walking was explored by answering questions like is the road lit? Are plants grown on road side? Have benches been provided? Are shops available on road sides? Are roads and pavements clean?

Observations included monitoring pedestrians' behavior in traffic around 17 schools in the Greater City of Amman. A general description of the selected schools is shown in Table 1; school administrative staff (with few exceptions), are few in numbers and the teacher /student ratios for schools are high particularly for boy schools, which may limit the possibility of assigning role for teacher related to traffic safety issues. On average in Organization for Economic Co-operation and Development (OECD) countries, there are 16 students for every teacher in primary schools whereas it is 14 students per teacher at the secondary level in Jordan (OECD, 2011). Primary school is the first stage of compulsory education and is followed by secondary education.

Schools	Student Gender	School statistics (numbers)				Teacher students ratio
		Classes	Students	Teachers	Administrative	
Al-Lttehad Secondary	Girls	80	1670	130	32	12.8
Al-Esra' Secondary	Co-educ.	23	950	36	9	26.4
Sameer Al-Rrefa'I Basic	Boys	11	350	15	5	23.3
Princess Iman Basic	Boys					
Ibn Tofeell Basic	Boys	37	1600	58	8	27.6
Jubile Secondary	Boys	26	1529	42	6	36.4
Nafeesah Bent Al – Hasan	Girls	6	100	7	2	14.3
Shmeisani Basic	Girls					
Um Hutheefa Basic	Girls	21	774	35	6	22.1
Swelieh Secondary	Boys					
Daheeat Prince Hasan Basic	Boys	7	200	9	2	22.2
Youcoub Hashem Basic	Boys	25	930	38	6	24.5
Um Kulthoum Basic	Girls	21	712	42	18	17.0
Aaka Basic Basic	Co-educ.	23	870	31	6	28.1
Um Mutta'a Basic	Girls	18	670	27	7	24.8
Ali Reda Ar Rekabi	Boys	52	1131	52	31	21.8
Princess Bassma Basic	Boys	39	1300	80	12	16.3

Table 1. General description of studied schools

All selected schools are located in densely populated areas with low and middle class income and low levels of vehicle ownership.

To assess pedestrian behavior, 231 students (111 Females and 120 males) were followed from the moment they left the school until they arrived home. The decision to track students in their way back home rather than tracking them in their way to school was made to simplify the data collection process, since the home of each student is different and unknown. For each observation, total walking trip time in minutes is measured from the moment the student leaves the school gate until he arrives at his/her home. The time spent walking on street instead of the pavement due to the lack of sidewalk continuity; pedestrians are often

forced to step-down from the sidewalk and walk on street. The observers were asked to measure the time once the pedestrian step-down until s/he comes back to the sidewalk. In addition, observers were instructed to write down number of times pedestrians are forced to leave the sidewalk.

The crossing behavior pattern was investigated by reporting the number of crossings, where the observers are instructed to count how many streets the pedestrian needs to cross during their trip from school to home. The crossing time is the time (minutes) spent from the moment the pedestrian begins to wait by the curb or edge of the street (if there is no curb) to cross the street to the moment he reached the other side of the street, including the waiting time by the median, if any. The observers were also asked to identify the type of crossing locations; the observation forms list five crossing types (un-marked crossing at intersection or at mid-block, marked crossing at intersection or at mid-block of crossing, mid-block with hump in place, signalized intersection, and footbridge).

In addition, the observers were asked to identify pedestrian crossing style and it is defined by speed. Two options are given in the observation form (normal walking speed (≤ 1.8 m/s) or running speed (≥ 3 m/s). Huang, Yang and Eklund (2006) compared pedestrian walking speed to running speed. The average 15th, 50th and 85th normal walking speeds in their study are found to be 1.33, 1.55 and 1.85 m/s. The corresponding 15th, 50th and 85th pedestrian running speeds are 3.11, 3.8 and 4.5 m/s. For the purpose of this study, the observers were trained to differentiate between normal walking speed and the running speed but during the observations, observers were not asked to measure the speed during crossings.

Visual search involved looking for vehicles before and during the crossing manoeuvre in order to avoid a possible collision, the observer is supposed to check one of two options of each observation: whether the pedestrian is looking or not looking for vehicles before crossing. Pedestrians can rely on their hearing ability to look for traffic, but this is hard to observe besides it can't be the only sense used by pedestrian before crossing. Visual search and eye contact give the pedestrian the confident to perform the crossing.

The Highway Code in Jordan obligates motorists to give pedestrians priority. If a pedestrian is crossing the street or waiting by the curb at pedestrian crossing, the driver is expected to yield for the pedestrian and give him/ her priority. The observers were asked to identify driver interaction with pedestrian (slowing down or stopping to let the pedestrian crossing or continue driving at the same speed).

Traffic conflict involvement: A traffic conflict is an observable situation in which two or more moving road users approach each other in space and time to such an extent that a collision course is imminent if their movements remained unchanged (Amundsen, Hydén, 1977). The observers were trained to detect if there is a collision course, evasive action type and urgency. During the survey, observers were asked to detect the conflict occurrence during the crossing.

The walking environment for each trip was assessed according to the above listed items. The survey involves two observers for each pedestrian trip. The first observe rate trip walkability environment while the other record the pedestrian behavior.

To rate the safety impacts of the inspected items that has been used to assess the walkability environment of the school surrounding, a questionnaire was prepared and distributed among a group of highway and traffic experts (engineers working in highway design and traffic with at least five years of experience). The experts were asked to rate the impact of each variable on pedestrian safety that is used to assess the walking environment on scale from 1 to 5. The lower scale (1) is used if the tested item has no effect. In total, 16 experts participated in the rating. The sample includes academician, practitioners from public and private sectors.

In addition to the field survey that was completed in this study, a questionnaire was prepared and distributed for each selected school. The principal in the selected schools were asked to fill in the

questionnaire that was formulated to investigate safety conditions in the school area. Only 14 duly filled in forms and returned back, which composes 82% of total distributed forms.

4 ANALYSIS AND RESULTS

4.1 PEDESTRIA ACCIDENTS IN JORDAN

The road safety in Jordan in relation to countries was compared by considering pedestrian fatality population-based rates. The analysis is based on police reported accident data. Accident reporting system falls under police authority. In every hospital, there is a police officer who will be notified about any case admitted to the hospital or treated in the emergency unit if it related to road accidents. The insurance company will not process any claim unless police report is attached. A study is made to assess the under-reporting indicated that all fatal accidents are reported to police and only 5% of injury accidents are not reported (Shbeeb *et. al.*, 2004).

Road accident fatality population-based rate of Jordan compared to 29 countries that contribute data to IRTAD shows that Jordan appears to perform rather poor and it is ranked the worst among the listed countries using pedestrian fatality-population scale, as it has the highest rate (Figure 1). In 2010, pedestrian fatality rate in Sweden was 0.34 per 100,000 inhabitants while it was in Jordan 3.57 fatality per 100,000 inhabitants, which almost 11 folds the rate in Sweden.

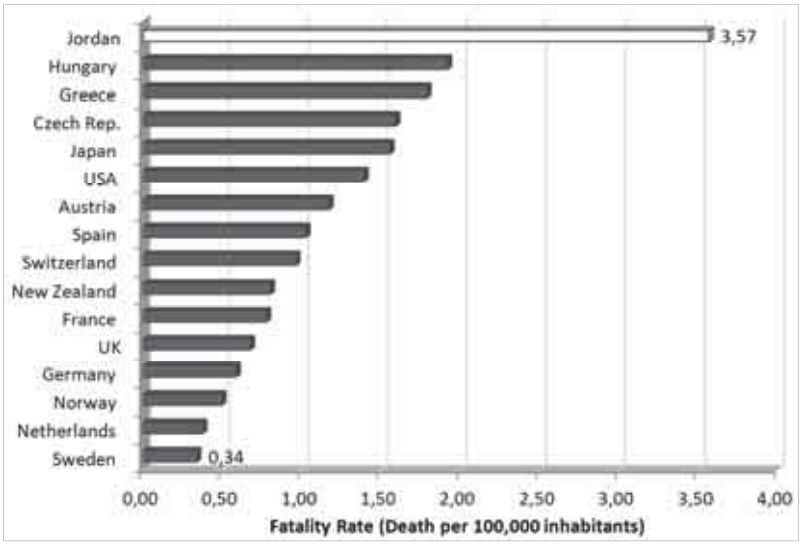


Figure 1. Pedestrian fatality rate-population based (2010)-IRTAD and JTI.

Pedestrian fatalities compose a considerable proportion of road fatalities in developing countries and smaller proportion in developed countries. In Jordan, pedestrian accidents accounts for 33% of all fatalities compared to only 9% in New Zealand (Figure 2). Comparing the road fatalities in Jordan with other countries indicated that fatality rate for the age group 0-15 is three to five times as high as in the industrialized countries. The risk of being involved in fatal accident of elderly pedestrian is half that of corresponding rate in the industrialized countries. Of course, that is partially due to differences in exposure and to the proportions of elderly in the society. Figure 3 indicates that the fatality rate for road-user of young age group (15-24) is within the rates reported for a number of industrialized countries, but tends to fall within the upper range of fatality rates. Fatality rate of age group 25-64 falls in the lower range of industrial countries fatality rates.

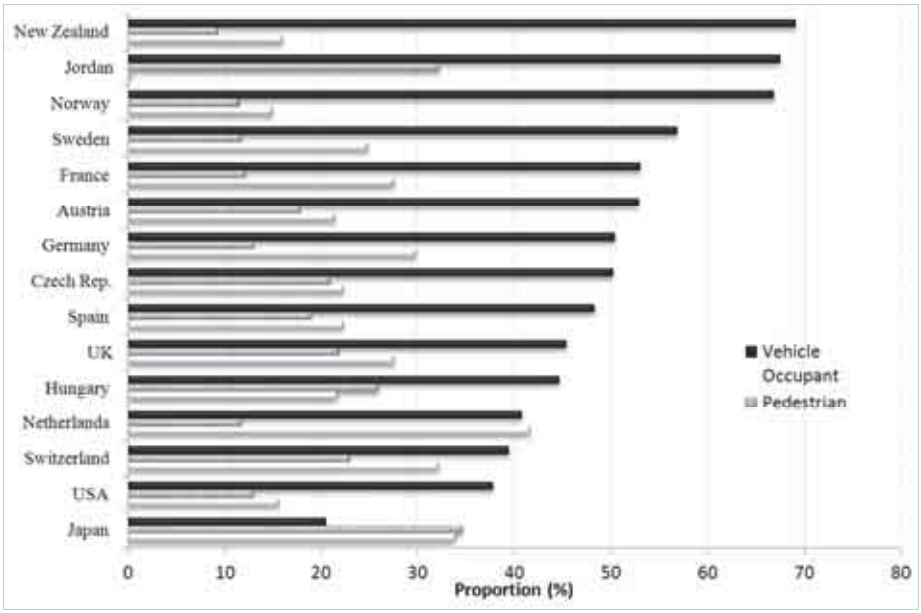
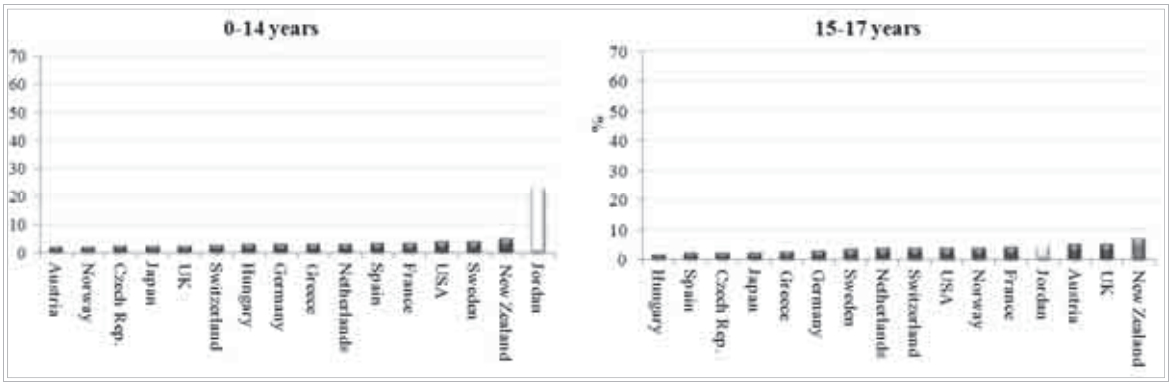


Figure 2. Road accident fatality proportion by mode of transport (2010)-IRTAD and JTI.

4.2 CHILD PEDESTRIAN ACCIDENTS

For the purpose of this comparison, children were defined as those under the age of 15 years. They were further subdivided into three groups [<5, 6-9, and 11-14]. Children were 49% of all pedestrian fatalities in 2010 (JTI, 2010). Females constitute only 19% of all fatalities. This may be a reflection of the fact that females are not equally represented in traffic as males. The highest pedestrian fatality rate is among children under age of 5 years. The highest injury rate is reported also for the same age group (Figure 4). Fatality rates for the age groups of less than 5 years old are higher than the corresponding rate for all age groups (approximately two folds). Serious injuries rate for all age groups is lower than that of the three age groups of children. This is an indicative that such groups are at a high risk of being killed in traffic. Children are often left unaccompanied in traffic. A study was made to assess the effectiveness of safety measures in school vicinity showed that only 30% of children are accompanied by one of their family members (Shbeeb, Awad, 2012). Pedestrians are one of the most vulnerable groups in traffic. If they are involved in an accident, the consequences are serious.



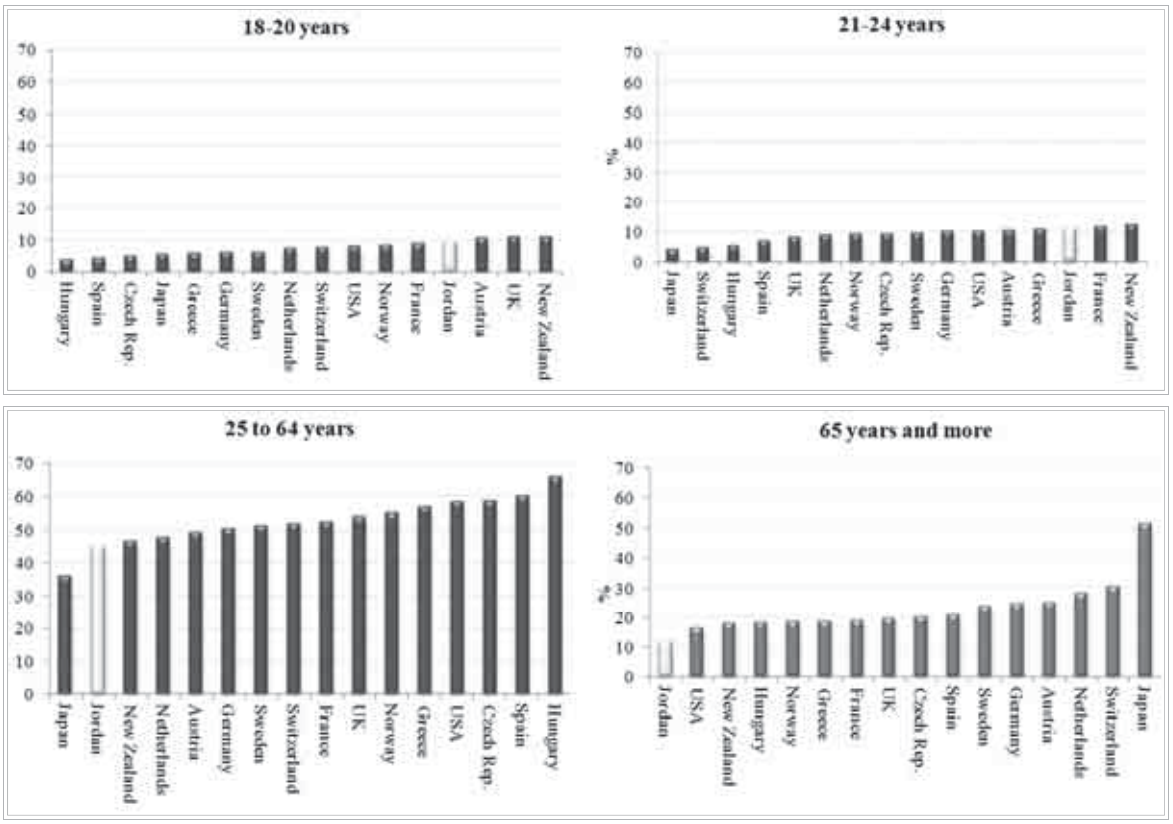


Figure 3. Road fatalities by age group for a number of Countries (IRTAD, 2010 and JTI, 2010).

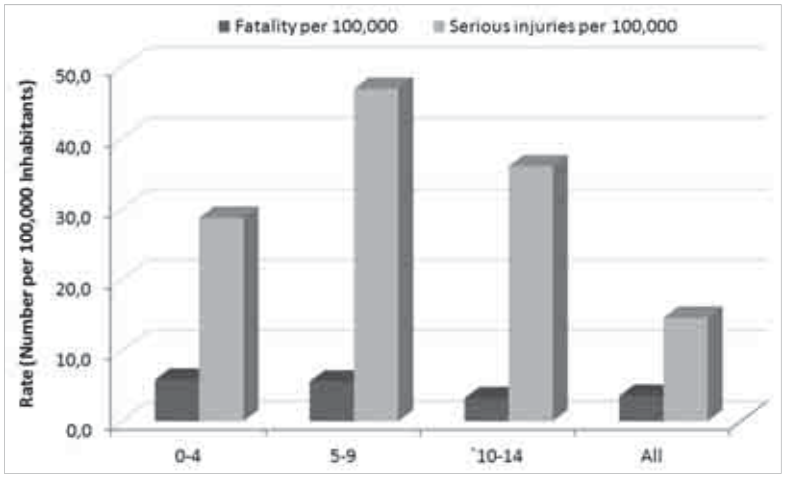


Figure 4. Child pedestrian injury / fatality rate by age group (JTI, 2010).

4.3 SCHOOL ENVIRONMENT ASSESSMENT

The principals were asked to state what kinds of measures were taken to regulate student movements to and from the schools (Figure 5). Around one-third of the principles reported that no measure is taken as there is no safety problem. Traffic warders, who have been trained to regulate traffic in school vicinity, are assigned to help colleague students in only three schools of the studied schools.

The surroundings were assessed by a trained person who was asked to check the routes leading to each school. The training covered all aspects included in the study (speed assessment, conflict detection, etc.) A surrounding area with a radius of 2 km was considered for this purpose. The survey showed that 36% of the

schools' entrances are directly on main roads. Humps have been installed nearby 12 out of the 17 selected schools (70%). Traffic light signals have been installed in the surrounding areas of five schools. Proper signing has been provided at only 8 schools to indicate the presence of a school. Fifty percent of the principals reported that there is a speeding problem in the school vicinity.

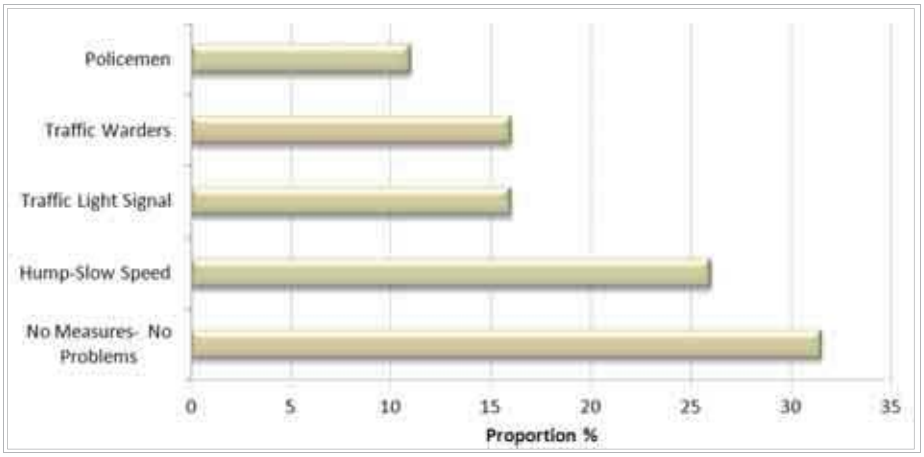


Figure 5. Measures taken to regulate traffic in the vicinity of studied schools.

One-third of the principle indicated that there is a safety problem in the surrounding area of the schools. According to Table 2, high proportions of students are walking to and from schools. One of the selected schools is a private school that provides bus school service and most of its students arrive with buses.

School Name	Ownership	Walking	School Bus	Public Bus	Taxi	Private Automobile
Al-Lttehad Secondary	Private	3	95	2		
Al-Esra' Secondary	Public	70		20		10
Sameer Al-Rrefa'I Basic	Public	30			70	
Princess Iman Basic	Public					
Ibn Tofeel Basic	Public	70	10	10	5	5
Jubile Secondary	Public	90		10		
Nafeesah Bent Al – Hasan	Public	97				3
Shmeisani Basic	Public					
Um Hutheefa Basic	Public	80			16	4
Swelieh Secondary	Public					
Daheeat Prince Hasan Basic	Public	90		10		
Youcoub Hashem Basic	Public	70		30		
Um Kulthoum Basic	Public	90		10		
Aaka Basic Basic	Public	25		50		25
Um Mutta'a Basic	Public	70			10	20
Ali Reda Ar Rekabi	Public	80		15		5
Princess Bassma Basic		70			20	10

Table 2. Mode of transport to and from school by ownership.

For the purpose of assessing the walkability of streets leading to schools, six aspects were considered (Table 3). The evaluation was done in two methods, the first method assuming equally weight (without weight) assigned binary score (0 if conditions contribute negatively to safety, and 1 if the existing conditions contribute positively to safety). The second method (with weight) introduced a safety scale (1 to 5), where one for little impact on safety and 5 for high impact on safety.

Assessment aspect	Assigned points (maximum)
Sidewalk conditions	8
Pedestrian crossing conditions	8
Driver behavior at pedestrian crossing	5
Pedestrian ability to comply with traffic rules	4
The attractiveness of streets for walking	6
The general location of the schools	4
Total	35

Table 3. Maximum points assigned by assessment aspect.

Streets have been appraised according to the above six aspects. The maximum point on the scale summed to 35 points. Sidewalk conditions have been assigned 8 points on this scale. Same points were given to crossing conditions. Six points were allocated to attractiveness and 4 points for school location. Driver behavior at crossing was given 5 points while pedestrian compliance with the rules received 4 points. For each aspect, a set of variables were identified and tested. To cross examine the proposed rating scheme, each aspect was weighted according to the average weight given to each tested variable as viewed by a group of experts in the country (Table 4). The total weights add up to 97.3. The overall rate given to each case was adjusted to be 100.

Aspect	Tested variable	Average Weight	Group	Tested variable	Average Weight
Side walk	Sidewalk Width	2.94	Pedestrian behavior	Pedestrian is visible and cars are visible to him/her	2.53
	Sidewalk maintenance	2.19		Safe to walk on the sidewalk	4.00
	Sidewalk continuity	3.00		If there is no side walk, still it is safe to walk against traffic	3.00
	Sidewalk used for vending machine	2.44		Use Well marked and guided pedestrian crossing	2.31
	Sidewalk is used for parking	2.13	Attractiveness	Lit street	2.80
	Sidewalk is occupied with trees and advertisement pole	2.94		Street with flowers	2.56
	Sidewalk with skid surface	2.25		Benches are available	2.75
	No sidewalk	2.53		Clean sidewalk and streets	3.00
Crossing	Marking for pedestrian crossing	2.50		No gang or bad people	2.20
	Signing for pedestrian crossing	2.70		Attractive shops	3.13
	Street width	4.50	Location	School at high speed street	3.25
	Traffic speed	3.00		School at high speed street but not the entrance	3.00
	Long delay at signals	2.50		Humps are available the school vicinity	2.81
	Parked vehicle obscure the view	2.40		The school is well marked and signed.	2.75
	Tress on crossing	2.90	Scale: 1for little impact on safety 5 for high impact on safety		
	Hump existence	2.80			
Driver behavior	Ignoring pedestrian and maintain speed	2.80			
	Giving way to pedestrian	2.60			
	Reversing without being attention to pedestrian	2.60			
	Speed at pedestrian crossing	2.50			
	Comply with rules	3.00			

Table 4. Weights Given to Each Tested Aspect to Evaluate School Environment Walkability.

The average weight of all tested aspects within each category was calculated. Figure 6 show that experts give more weight to school location and pedestrian behavior and less weight to driver behavior and sidewalk.

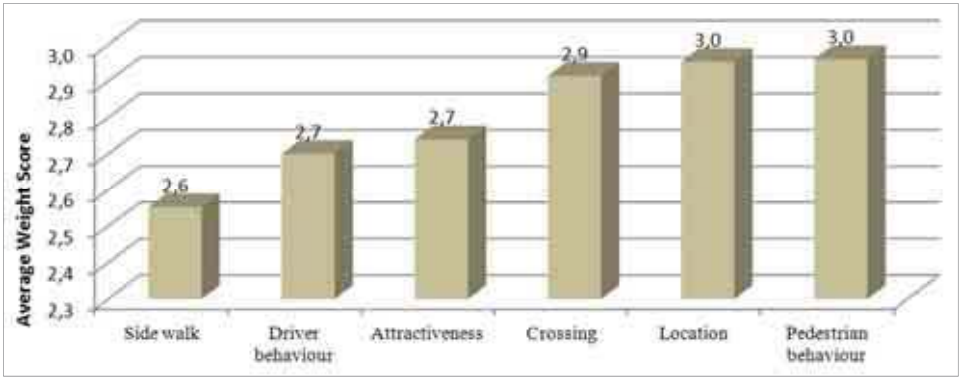


Figure 6. Road expert average weight by investigated aspects used to rate school zone walkability.

Scores of tested aspects were classified into five categories (Table 5) from very poor atmosphere to excellent atmosphere. Considering the two methods of evaluation (with and without weight), Table 5 shows that about 56% of the cases are rated as poor or very poor if weights are not considered, while the ratio is changed to 34% if the weights are considered.

The observations made include collecting data on conflicts that may involve the observed subjects. The total number of conflicts observed is correlated to the overall rating giving for walkability with and without weighting. The results indicated that a negative relation ($r = -0.126$ (with weight) and $r = -0.141$ (without weight)). Although the correlation is low, the level of significant is marginal ($p=0.05$).

Evaluation Method		Excellent atmosphere	Very Good atmosphere	Good atmosphere	Fair atmosphere	Poor atmosphere	Very poor atmosphere
Without weight	Range	30-35	27-29	23-26	19-22	15-18	<15
	Number	1	7	22	72	101	28
	%	0.4	3.0	9.5	31.0	44.0	12.0
With weight	Range	>80	70-80	60-<70	50-<60	40-<50	<40
	Number	4	20	32	97	63	15
	%	2.0	9.0	14.0	42.0	27.0	7.0

Table 5. Rating walkability of school surroundings.

The average rating for each school is calculated to examine the overall walkability. The analysis was completed for with and without weighting. Table 6 shows the without weighing case and illustrate the rank of each school for each assessment aspect.

Table 6 shows that an agreement seems to exist between raking of the site according to how attractive they are or pedestrian ability to comply with traffic rules and the overall rating giving to each school. The correlation analysis yield a significant relation between the overall evaluation with attractiveness ($r = 0.75$, $p=0.001$) and pedestrian ability to comply with traffic rules ($r = 0.65$, $p=0.005$). Table 6 shows that the schools that have not taken any measure to regulate traffic in their vicinity have poor ranking. Table 6 also shows a good agreement ($r = 0.96$, $p=000$) between the overall rating (with weight) and the overall rating (without weight).

School	Sidewalk	Crossing	Driver behavior	Pedestrian Behavior	Attracti-veness	Location	Overall		Regulation Measure
							Without Weight	With Weight	
Al-Lttehad Secondary	17	11	7	1	6	2	1	2	
Al-Esra' Secondary	16	5	15	2	1	4	2	1	No measure
Sameer Al-Rrefa'I Basic	13	6	16	3	5	14	3	3	
Princess Iman Basic	5	16	3	5	7	8	4	4	
Ibn Tofeell Basic	10	7	5	9	2	10	5	5	
Jubile Secondary	7	13	4	14	4	7	6	6	No measure
Nafeesah Bent Al – Hasan	9	17	1	11	8	11	7	7	
Shmeisani Basic	6	15	8	7	12	13	8	9	
Um Hutheefa Basic	12	8	9	13	15	1	9	10	
Swelieh Secondary	3	4	14	12	3	12	10	11	
Daheeat Prince Hasan Basic	4	12	2	8	10	6	11	8	No measure
Youcoub Hashem Basic	1	3	6	4	11	5	12	12	
Um Kulthoum Basic	13	14	13	16	14	15	13	15	No measure
Aaka Basic Basic	2	9	11	6	16	9	14	13	
Um Mutta'a Basic	8	2	12	10	9	17	15	16	
Ali Reda Ar Rekabi	11	10	10	15	13	16	16	17	No measure
Princess Bassma Basic	15	1	17	17	17	3	17	14	

Table 6. Rating of the Suitability of School Environments for Walking Based on the Six Aspects.

4.4 PEDESTRIAN BEHAVIOR

To provide insight into the interaction of pedestrians and the environment, pedestrian behavior on some of routes that lead to the selected school were further examined. Pedestrians were followed from when they left school until they reached home and the time they spent walking on the pavement or the road was recorded. Their crossing behavior was closely observed. On average, children cross two junctions during their trips (Figure 7). There is no significance difference in the number of junctions crossed by students due to gender ($t = 0.55$, $p = 0.58$).

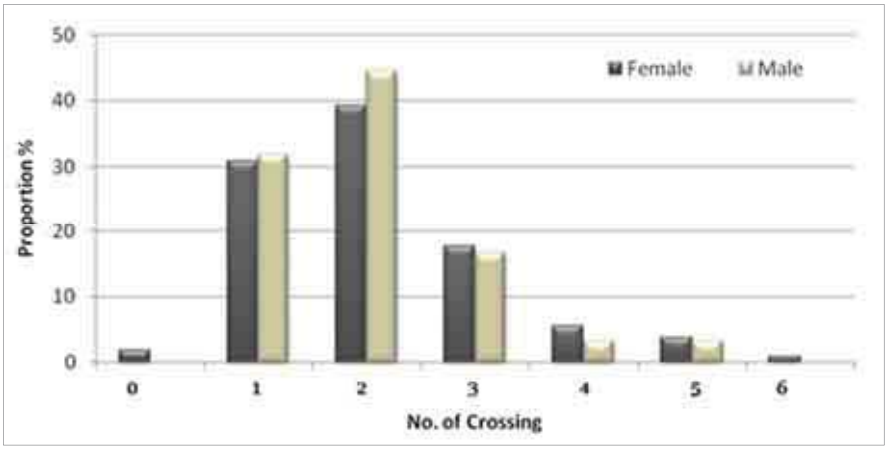


Figure 7. Number of crossing by gender.

Observations made showed that 8% of all crossings tasks were completed with no interaction with vehicles (No vehicle presents on the street at the moment of crossing). The results showed that a slightly above two-thirds of the crossings were made on un-marked crossing (mid-block). Only 2.3% of all crossings were made

near humps, even though humps were installed in the vicinity of 12 of the schools included in the study (Figure 8).

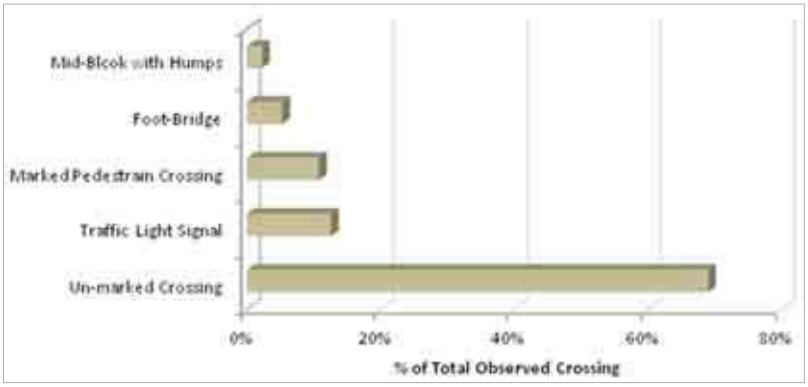


Figure 8. Proportion of crossings by type of traffic control device.

Looking into pedestrian crossing style shows that 26% of males were running compared to 16% of females who were running while crossing (Figure 9). Nevertheless, there is no significant difference in their behavior (χ^2=2.44 p=0.1183).

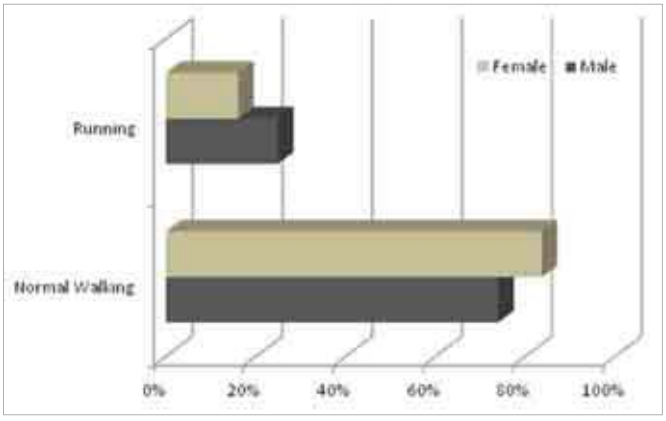


Figure 9. Crossing style by gender: crossing speed.

The visual search when crossing the streets was closely observed. The ratio of number of crossings that was preceded by visual search to number of all crossings made is calculated by gender. The results indicated that male performed visual search more often than female did (Figure 10). However, no significant difference was detected (t = -1.71, p = 0.088). Around one-fourth of all crossings were made without any visual search.

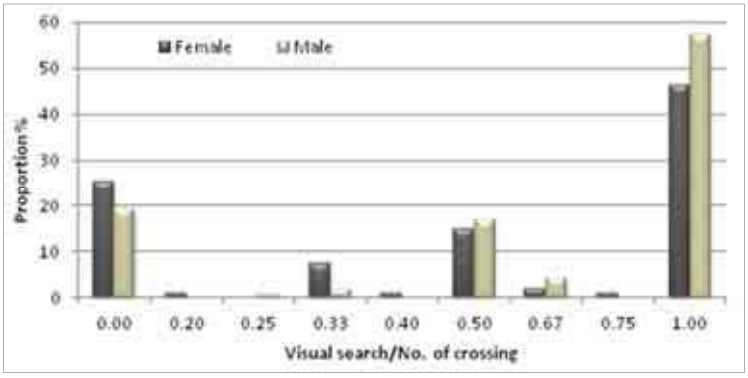


Figure 10. Ratio of number of positive visual search crossings to all observed crossings by gender.

Driver interaction with pedestrian was investigated. Crossing priority was given to pedestrians in 34% of all observed situations. Crossing priority was more frequently given to male children than female children (Figure 11). The study indicated that there is significant difference in driver behavior towards pedestrian gender (χ^2 = 8.85, p = 0.0029).

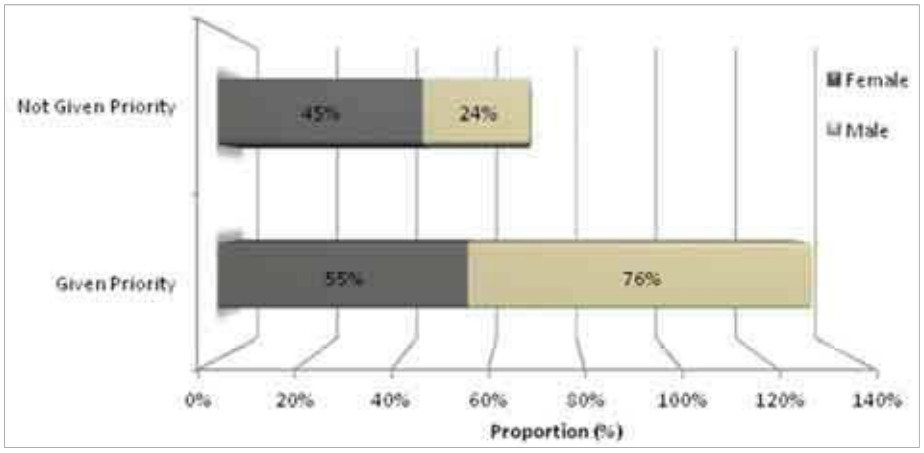


Figure 11. Pedestrian given priority by gender.

Pedestrians were involved in 34 conflicts on their back home trip (15%). Figure 12 shows that females were less involved in conflicts (12%) compared to male (18%). However, there is no significant difference between number of conflicts due to gender (t = 0.54, p = 0.59).

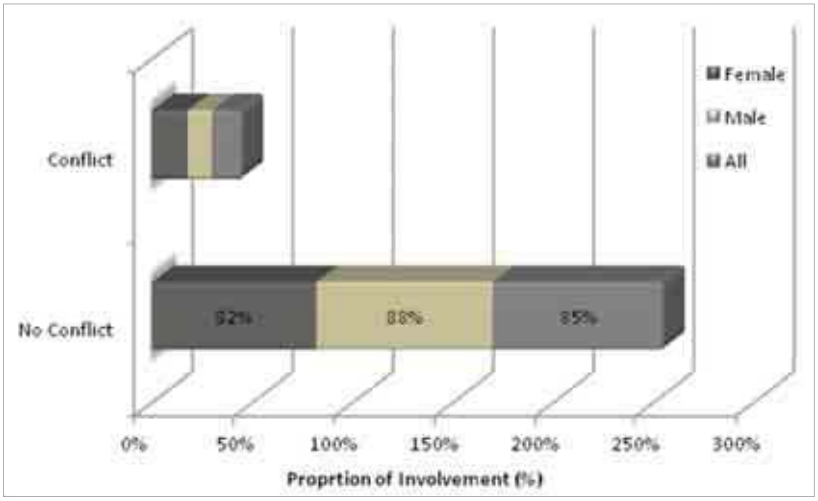


Figure 12. Involvements in conflicts by gender.

The mean time spent by the 232 pedestrians walking was 17.4 (Std = 9.2 minutes). The pedestrians spent 52% of their time walking on the pavement, 32% along the road, and 16% of their time crossing. This clearly shows that they are over exposed to traffic which increases the likelihood of being involved in an accident (Table 7). There was no significant difference between average times of trips, on-street walking time or crossing times due to gender (t-test at 5% level of confidence). Table 7 shows that male children walk along the road longer than female children. In general, male walk longer with an average of 20.1 minutes while female walk for 14.8 minutes.

Indicator	All			Female			Male			t-test
	N	Mean	Std. Deviation	N	Mean	Std. Deviation	N	Mean	Std. Deviation	
Total Walking Trip Time (minutes)	232	17.4	9.2	108	14.8	8.1	119	20.1	9.4	t=-4.61 P=0.001
On Street Walking Time (minutes)	232	5.7	5.0	108	4.5	4.4	119	6.8	5.4	t=-3.43 P=0.01
Street Crossing Time (minutes)	225	2.4	1.6	104	2.1	1.4	119	2.7	1.6	t=-2.88 P=0.04
Proportion of time spent walking on Street Time/ Trip Time (%)	229	0.32	0.2	108	0.30	0.2	119	0.34	0.21	t=-1.32 P=0.19
Street Crossing Time/ Walking Trip Time (%))	224	0.16	0.1	108	0.18	0.1	119	0.15	0.10	t=2.02 P=0.045

Table 7. Walking trip time (minutes) characteristics.

5 DISCUSSION OF RESULTS

The study indicated that pedestrians in Jordan are at a high risk of being involved in a traffic accident when compared to reported risk in a number of industrial countries. Children under the age 15 years [40% of Jordan's population] suffer the most. Children under five years old are subjected to the highest risk of being killed in traffic compared to other age group. Pedestrian environment is a contributory factor that needs to be assessed. Pedestrian facilities are of poor standards and this study looked into the facilities provided in the vicinity of 17 schools indicated that the surrounding environment is poor. The study showed that pedestrian compliance with traffic rules is better in areas that are characterized as attractive for pedestrians to walk through. The correlation analysis yield a significant relation between the overall evaluation and the

pedestrian ability to comply with traffic rules (r = 0.65). As a result, there are more traffic conflicts in the vicinity of schools with poor walkability.

Observing pedestrian behavior indicated that they spend half of their walking trip time either by crossing or walking on the street instead of pavements. On average, children cross two junctions on their way back from or to school. One-fourth of male children tends to run when walk back from school. The proportion of female who walk fast is slightly lowers (16%). Running or jogging combined with crossing more than one junction may increase the risk of subjecting the children to conflicts or crashes. Combing poor environment condition with impropriate behavior makes walking hazardous progression. The results showed female walk less but there was significant difference in their involvement in conflicts. Male involvement in conflict is more than female involvement in conflict, despite the fact that male children were given more priority in traffic compared to female children. On the other hand, the results also indicated a lower proportion of female pedestrian made visual search ahead of their crossing, which may induce them to more hazardous situation because they are not always given the priority.

Internationally, the application of active transportation concept is not widely spreading in Jordan within the given context. Active travel has been positively associated with higher daily levels of physical activities (Rosenberg et. al. 2006 & Cooper et. al. 2006) and higher fitness levels (Andersen *et. al.*, 2009; Voss, Sandercock, 2010). Although, rates of active transportation to schools have declined during the past years (McDonald, 2007), and many initiatives took place as a response to such decline (e.g. Safe Routes to School (SRTS) and the Walk to School (WTS) program).

Active transportation concepts would require providing walkable environment that encourage walking, as safe mode of transport to and from school. The study clearly shows that the surroundings of the selected school are in large not a friendly walking environment. Guidelines ought to be developed to meet pedestrians' needs and safety requirements around schools.

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IMAGES SOURCES

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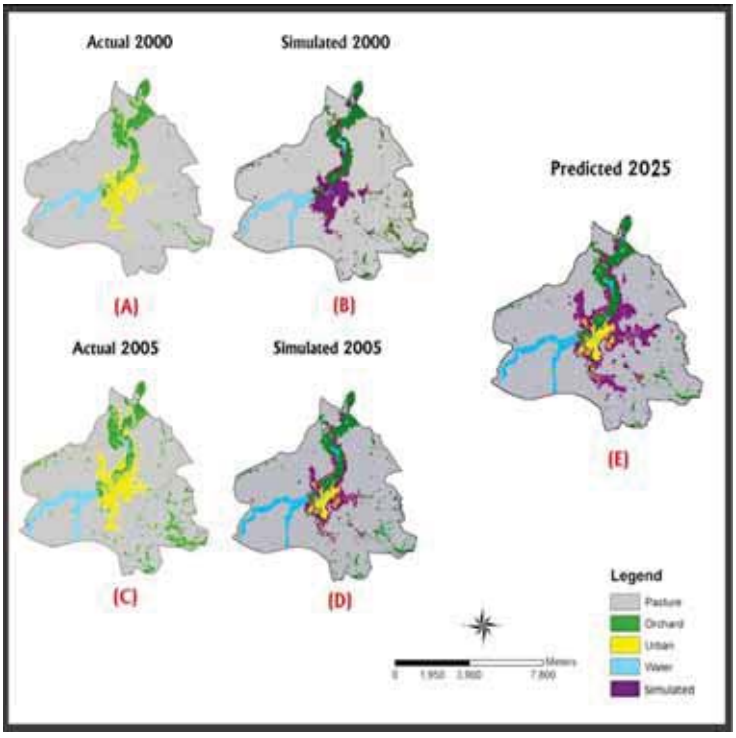

THE SPATIO-TEMPORAL MODELING OF URBAN GROWTH

CASE STUDY: MAHABAD, IRAN

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ABSTRACT

The simulation of urban growth can be considered as a useful way for analyzing the complex process of urban physical evolution. The aim of this study is to model and simulate the complex patterns of land use change by utilizing remote sensing and artificial intelligence techniques in the fast growing city of Mahabad, north-west of Iran which encountered with several environmental subsequences. The key subject is how to allocate optimized weight into effective parameters upon urban growth and subsequently achieving an improved simulation. Artificial Neural Networks (ANN) algorithm was used to allocate the weight via an iteration approach. In this way, weight allocation was carried out by the ANN training accomplishing through time-series satellite images representing urban growth process. Cellular Automata (CA) was used as the principal motor of the model and then ANN applied to find suitable scale of parameters and relations between potential factors affecting urban growth. The general accuracy of the suggested model and obtained Fuzzy Kappa Coefficient confirms achieving better results than classic CA models in simulating nonlinear urban evolution process.

KEYWORDS:
urban growth, simulation, cellular automata, artificial neural networks, Mahabad

1 INTRODUCTION

The irregular expansion of urban land use can be considered as one of the biggest problems for urban managers and policy makers in different fields. Nowadays investigating the trend of converting of noun-urban land use to urban land use and determining the parameters which influence this trend are of great importance in long-term decision making and planning. In this way, exploring the rules and relations which are effective in changing lands into urban area and also the predicting the trend of city development in the future through reliable and efficient methods have received significant attention in urban researches. Land use change models are considered to be among the tools for identifying land use change (Onishi and Braimoh, 2007). Also land use change models are not only considered as approaches for the purpose of improving the quality of change identification and predicting the regimes dominating development patterns (Turner, 1994; Bockstael et al., 1995), but are also of use when it comes to analyzing the factors affecting land use change and choosing the most suitable development strategy (Erfu and Shaohong, 2005). Moreover, spatial models are useful tools for the purpose of a better perception of urban development and are also of use as tools assisting policy making, urban management, and tools providing information for evaluating environmental effects (He et al., 2008).

Urban growth and its management are considered to be a multi-dimensional problem. Cities emerge as complex dynamic systems, with non-linear processes, which are unexpected and self-organizing (Allen, 1997; Portugali et al.1997; Batty, 2007). Additionally, most of the methods which have embarked on model making for cities have traditionally been static, linear, centralized, and based on simple systems theory with a top-down approach. Recent, improvements happened in urban simulation have been because introducing new approaches (techniques) such as CA Multi-agent Systems, Micro Simulation, and Connectionist Models. These all have turned the urban model making into a powerful tool to be used for the purpose of analyzing the complex structures of urban systems. In this paper, efforts have been taken to determine the dynamic land use change in the dimensions of time and space through the use of Non-linear modeling in hope of achieving the closest simulation to reality. Multi temporal images and zoning maps are among the main data of this study. GIS has been used in order to extract the spatial factors and analyze the data. Additionally, ANN algorithm has been used to determine the influential factors and to find suitable values of simulation parameters that can best fit actual development. In other hand Neural network can be used to replace the transition rules used by classical CA models. Therefore CA has been applied as the main simulation engine .

2 CELLULAR AUTOMATION AND URBAN GROWTH MODELING

Cellular automation (CA) has attracted the attention of the researchers significantly in the past two decades (Alkheder, 2006). CA has found a wide range of applications in predicting land use change due to its simple structure in modeling. CA is a discrete dynamic system in which the situation of each cell is determined in the time of t+1, and according to the neighbourhood situations in the time of t, corresponding with already-defined transition rules. CA possessing time-space dynamics is capable of simulating changes in two-dimensional aspects. This method has been used widely for many application areas specifically for urban growth and land use change. In other words, CA is a dynamic modeling technique which produces global patterns from local cells through the use of the four main elements of cells, states, neighbourhood, and transition rules (Batty et al., 1999). In a CA system, space is divided into a regular network of cells with the same form and size and generally in the shape of squares. Each cell possesses a value equal to 0 or 1 or a range of values in a scale from 0.0 to 1.0 and finds certain values in accordance with different uses (AL-Ahmadi et al. 2009). In an urban CA the situations or states can be as: a) binary values (urban, non-urban), b) discrete values which represent different land uses, c) quantitative values which can, represent for instance population density, the level of development (Li and Yeh, 2002), the building cost (Cecchini and Rizzi, 2001), or a vector (Santé et al., 2010) of a number of features. The

state for each cell includes a number of discrete time steps which are controlled by a set of transition rules. These rules are generally defined based on the initial state of the cell and the status of the neighbouring cells.

The competence and attractiveness of this approach can be considered to be because of CA's ability in showing, simulating, and realizing the patterns and behaviors of complex geographical phenomena and self-organizing systems through the use of a number of somewhat simple rules (Torrens and O'Sullivan, 2001; Wu and Webster,1998).

3 ARTIFICIAL NEURAL NETWORKS AND URBAN GROWTH MODELING

One of the applications of Artificial Intelligence (AI), which has been studied in this study, is using AI techniques in optimizing urban growth modeling, specifically CA. Artificial Neural Network (ANN), as one of the components of computational intelligence has a structure including non-linear processing elements known as neurons which model the neural networks of human brain with connected weights. This network is a non-parametric algorithm and has characteristics such as learning, parallel processing, and the ability to generalize without needing an initial knowledge of the statistical distribution of data (unlike conventional statistical methods), which, This property is significant importance in space-time modeling.

Additionally, ANN is capable of recognizing and classifying patterns through training and learning urban growth processes. Therefore, ANN can be used as a simple and effective replacement for the Transition Rules from the classic CA models (Yeh and Li, 2001).

Capability and ability of applying ANN algorithm in urban development researches, is recently attracted some researches and scholars attention to itself. On the other hand, ANN are synthetically applied with other artificial intelligence techniques for urban modeling. Bilanowskia and his colleague assimilated an ANN with GIS to anticipate the earth control changes (Bilanowskia et al, 2002).

In this model, the role of ANN was learning of development patterns in the region and capacity test and the ability of anticipating model. Multi-Layer Perceptron (MLP) which be created by Ramelhart and his colleges (1986), are the most applicable ANN that be used. MLP was formed of three layers, input, hidden and output layers (Fig 1). As these nets are three-layers, there is the possibility of recognition of nonlinear communications existing in nature (Mahini and others, 2010).

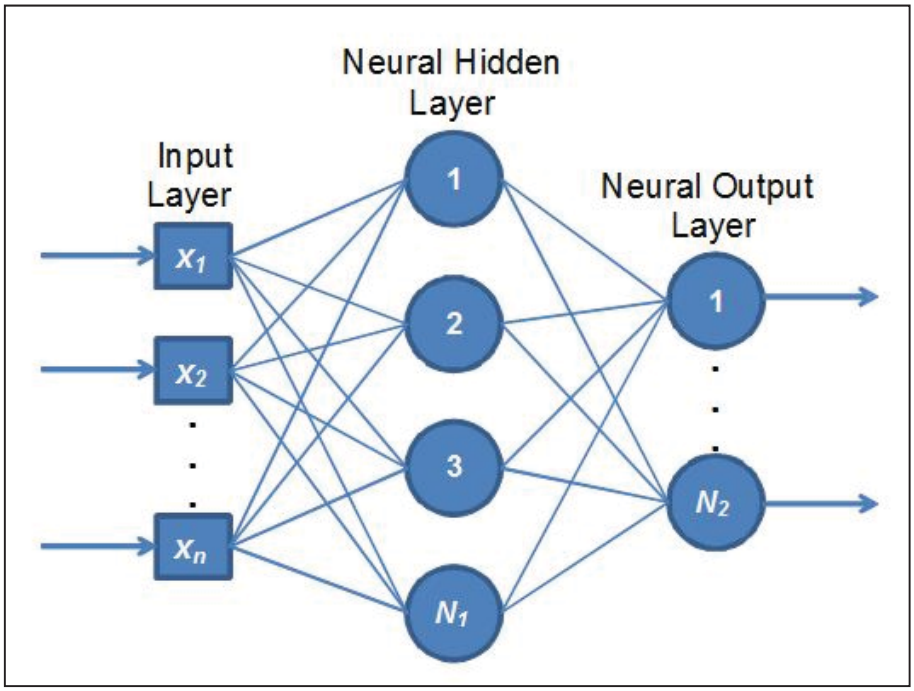

Fig.1 The architecture of 3 layer MLP Network

4 CALIBRATING THE CA MODEL USING ANN

Urban CA models are considered as tools highly capable of developing applied models for producing real urban patterns, hence it is possible to gain better comprehension of urban dynamics and theories. The majority of studies conducted on urban simulation through CA in the past three decades have focused on extracting or defining transition rules. In most of the cases, transition rules have been defined heuristically based on the realm of science and priority of the expert.

Therefore, one of the key points in simulating urban growth is calibrating the model in order to find the proper weights for the simulating parameters. It is obvious that in the process of simulation, calibration calls for finding those weights of the simulating parameters which can have the highest level of conformity with real development. However, after several decades of the application of this method in urban planning and the efforts of researchers in finding a globally applicable model for the purpose of predicting urban complexities, one can still feel some shortcomings in the calibration of the CA model.

In order to point to some studies conducted on the calibration of the CA model, one can mention the efforts of Wu and Webster (1998) in using multi criteria evaluation (MCE), Li (2006) in using the hierarchical analysis (AHP), Wu (2002) in regression logistics, AL-Ahmadi (2009) in fuzzy logic, and Li et al. (2008) in genetic algorithm, and Li and Yeh (2004) in decision making tree where CA produced different results.

The values of the effective parameters in simulation are determined by holding other parameters constant. Calibration and validation of CA models are the key to their successful implementation due to the fact that the quality of the urban CA model depends on the adequacy of the transition rules which usually include a number of parameters to be calibrated (Wu, 2002; Straatman et al., 2004). Moreover ANN has been used to recognize the patterns in different studies such as pictures analysis (Fukushima et al., 1983), weather forecast (Drummond et al., 1998), classification feature of the land (Brown et al., 1998), remote sensing (Atkinson & Tantall, 1997) and earth control changes (Pijanowski et al., 2002).

Based on these points and due to the non-linear and self-organizing nature of urban systems, the use of ANN for the purpose of calibrating the CA model has been examined in this paper.

5 CALIBRATING CA MODEL THROUGH ANN

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Calibrating CA model can be done in two ways (Li & Yeh, 2002).

A method is in base of statistical data such as Logistic Regression operation which is presented by WU (2002) and techniques such as genetic algorithm which is represented by Alkhadar (2008). The other method is calibrating in base of trial and error method such as visual tests (Clarke et al., 1997; Ward et al., 2000) computer simulation comparison (Clarke and Gaydos, 1998). Because of the absence of similar structures and objects, however, in these models, there is no popular method to calibrate CA model (Straatman et al., 2004).

In this paper, we were exploited from ANN algorithm to calibrate CA model. After calibrating, a set of optimized values have been allocated to simulator parameters (Fig 2).

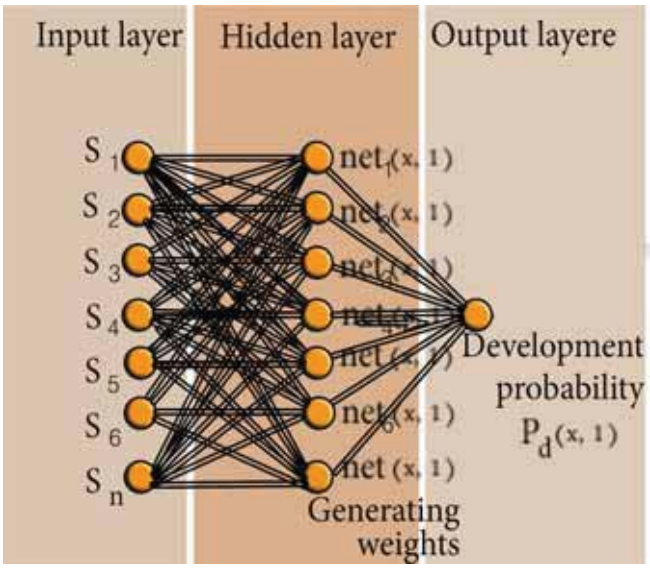

Fig. 2 Generating Weights and Development probability based on ANN

CA simulation is designed in base of ANN algorithm. At each of iteration of CA, ANN will recognize the development, which is subject to the input of site attributes and weights. A cell may be had n characteristic:

$$(s_1, s_2, s_3, s_4, s_5, s_6 \dots, s_n) \quad (1)$$

A neural network can be designed to estimate the probability of development in each period of CA iteration. In the ANN, three layers have been recognized: input layer, hidden layer and output layer.

Input layer has n neurons in base of characteristics of site. Hidden layer may also have n neurons, while in output layer; there is just one neuron which calculates the probability of development.

In each period, iteration of the characteristics of site for each cell is as the first layer input and ANN recognize the probability of development unto that layer.

Most of the basic data before entering in model as the ANN input, are scaled into domain of $[0,1]$. Scaling gives each cell same significance and creates the same numerical value in input data and causes the compatibility of these data with activation function:

$$s_i' = (s_i - min)/(max - min) \quad (2)$$

The algorithm which is incorporated with CA model consists of a simple three-layer net. In ANN, received signal has been calculated by the neuron j hidden layer of the first input layer for each cell as follow:

$$net_j(x,t) = \sum_i w_{i,j}\, s_i'(x,t) \quad (3)$$

Where x is a cell and net_j is received signal by neuron j belonging to x cell in time, and $s_i'(x,t)$ is the characteristics of the slightly site for parameter (neuron) i.

Activation function of the hidden layer is:

$$\frac{1}{1+e^{-net_j(x,t)}} \quad (4)$$

Probability of development (P_d) also defines for each x cell as:

$$P_d(x,t) = \sum_j W_j \frac{1}{1+e^{-net_j(x,t)}} \quad (5)$$

The simulation is loop-based. In each iteration period, probability of development has calculated by the ANN in base of the characteristics of the site attributes. Probable perturbation (error net) is an expression which can be applied for representation of unknown errors during simulation, that it seems necessary to generate patterns coincident to reality, the probability of variation each cell has recognized by the probability of development.
Error net (RA) has been determined by:

$$RA = 1 + (-Ln\gamma)^{\alpha} \quad (6)$$

Where γ is uniform random variable in domain of $\{0,1\}$, and α is a parameter to control the probable deviation scale and also can be used as dispersion factor in this simulation.
In this base, the probability of development function has been modified as:

$$P'_d\ (x,t) = RA \sum_j W_j \frac{1}{1+e^{-net_j(x,t)}} \quad (7)$$

$$= (1 + (-Ln\gamma)^{\alpha}) \times \sum_j W_j \frac{1}{1+e^{-net_j(x,t)}} \quad (8)$$

The probability of urbanizing of each cell is more probable in higher weight than probability of development during simulation process.
A threshold value is also defined by each cell before starting the process in order to accept the alteration. If a cell has higher probability of development than threshold value, the cell will change and expand. The number of expanded cell in defined neighborhood recalculates and the characteristics of site updates at the end of each iteration period. Simulation has maintained as long as the amount of total altered cells equal to amount of consumed land (Yeh And Li, 2002).

6 STUDY AREA AND DATA PREPARATION

The city of Mahabad in Western Azarbayjan province, Iran has been selected as the case study to simulate urban growth process. According to census, its population was 201,104, in 41,000 families. The city's population is predominantly Kurdish, with the city lying south of Lake Uremia in a narrow valley 1,300 meters above sea level in Iranian Kurdistan (fig. 3).

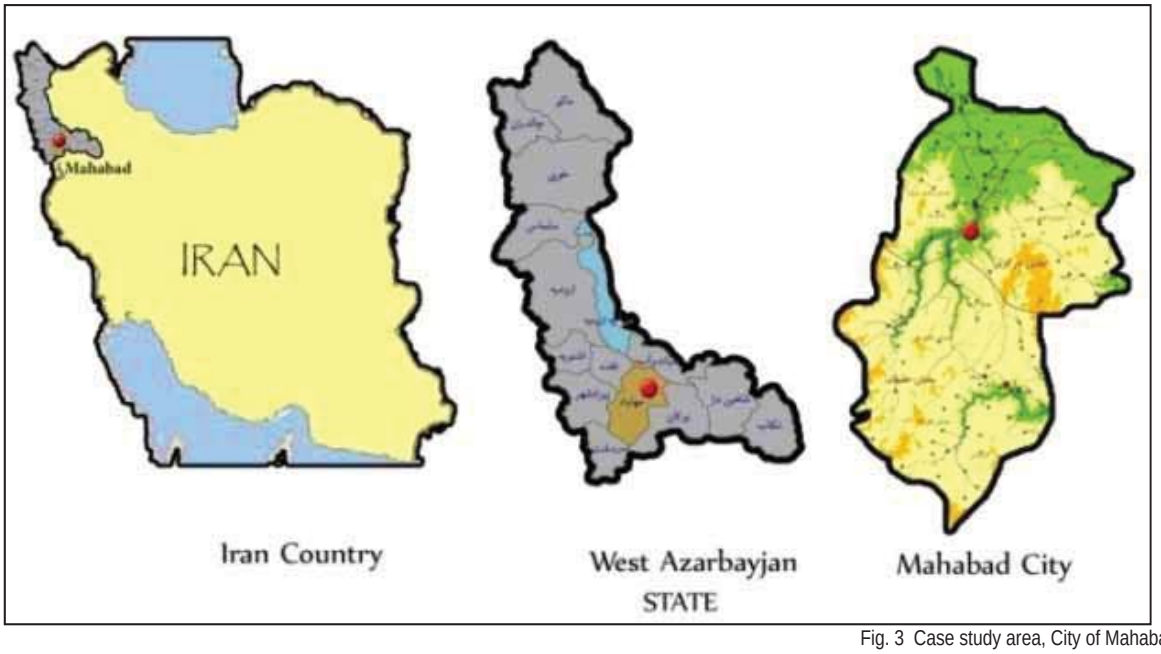

Fig. 3 Case study area, City of Mahabad.

Mahabad with the area of 2‘541 square kilometers is the fifth county of this province.

Historical studies show that Mahabad is not a very old city and it was founded at the beginning of Safavi epoch.

Mahabad which was called Mokri Savojbolaq in the past, started to grow since the beginning of this century and then was developing following the permanently settling the tribes and establishing modern organizations and gradually was added to the new districts.

After the Islamic Revolution (1978), it was faced with rapid unplanned development as the consequence of political and social transformation.

The city’s visage changed completely. At that time, eastern and southern areas of the city were developed irregularly. In 1989, Mahabad had an area of 591 hectares which is three times bigger than its area in 1966.

Between 1989 to 2005, city’s area reached to 1‘434 hectares that is two times of its area in 1989. In fact Mahabad is considered as one of very fast growing urban region of the country (fig. 4).

Over the past two decades, rapid urbanization has threatened the agricultural land and ecologically sensitive landscapes located around Mahabad (fig. 5). The rapid un- planned growth of Mahabad during recent decade makes it a suitable case for model growth.

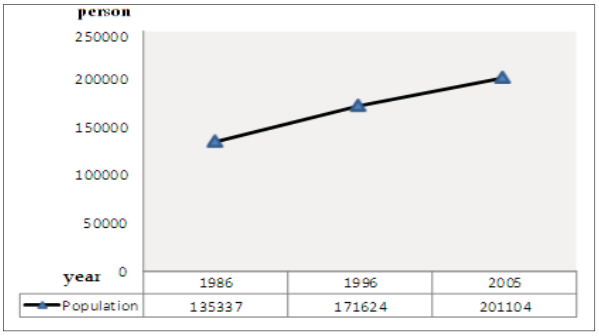

Fig. 4 The population growth of Mahabad 1986-2005.

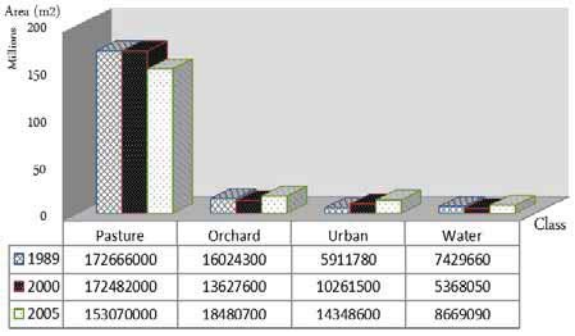

Fig. 5 The land use change statistics of Mahabad.

In this study, remote sensing and GIS techniques were used to provide spatial parameters and land use data, to characterize the relationships exist between site attributes and urban growth. Satellite Images were acquired on 1989 (TM), 2000 (ETM+), and 2005 (ETM+).

The Minimum Distance Supervised Classification (MDSC) approach was employed for land use classification (fig.6).

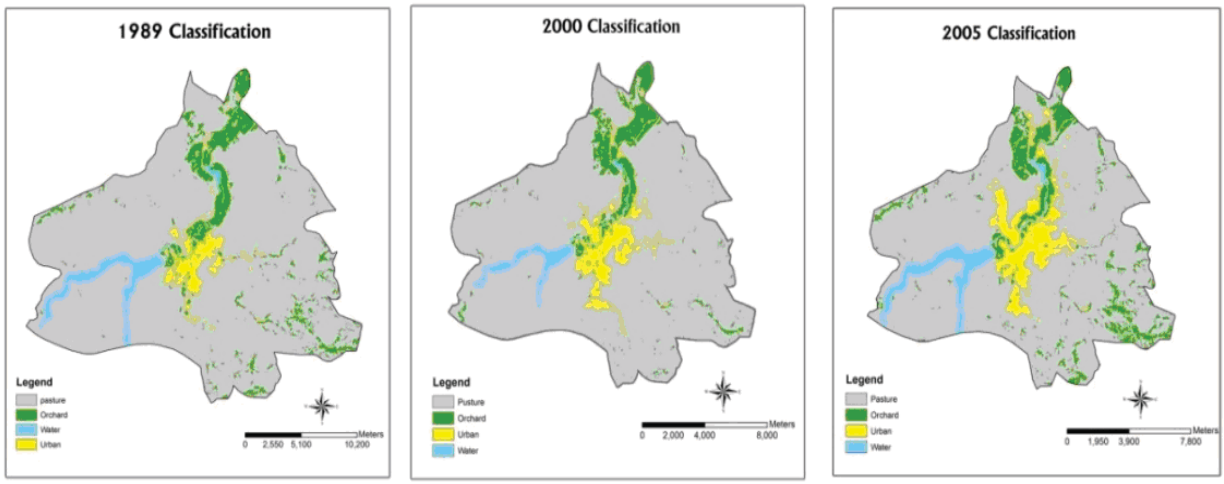

Fig. 6 The classification of satellite images of 1989, 2000, 2005.

To extract the land use layers, fuzzy logic was used for classifying images. For this purpose, fuzzy toolbox of MATLAB package was used.

The Mamdani's Fuzzy Inference method was applied to classify the images. Spatial parameters were calculated by use of Euclidean Function in Spatial Analyst Toolbox of ESRI ArcGIS9.3 (fig. 7).

To get target samples for the ANN training/learning process, the time-series land-use data of Mahabad City in 1989, 2000, and 2005 were used.

The neighborhood level of growth level was measured basing on the number of developed cells in the neighborhood of 10×10 cells adjacent to the central cell. The growth area of initial neighborhood of the model was computed using of binary image of 1989.

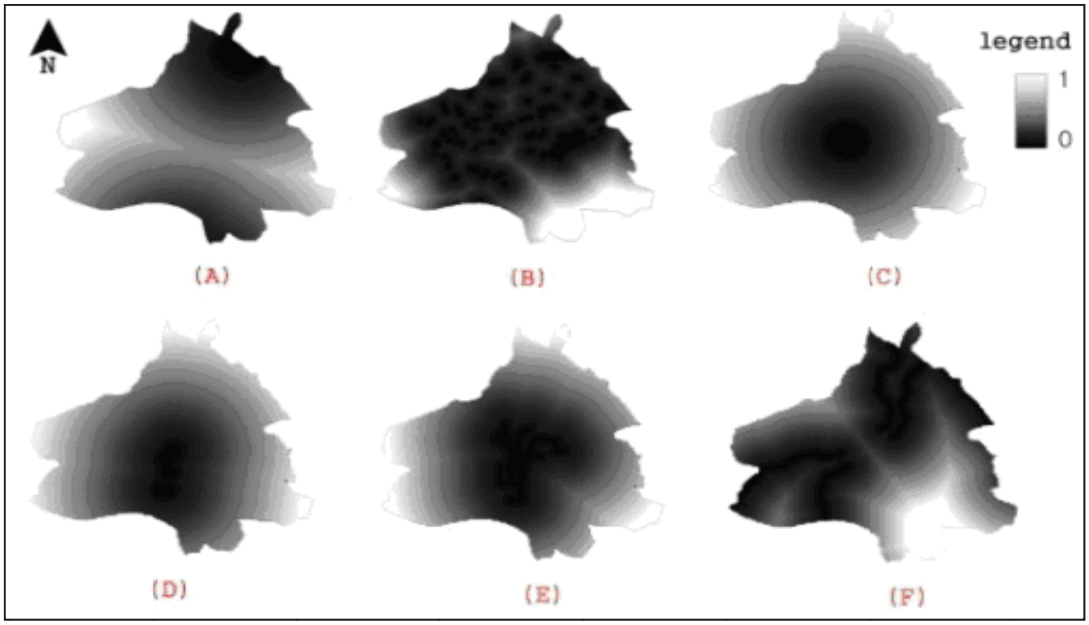

Fig. 7 The spatial parameter of simulation

7 TRANING

In order to use the ANN for prediction purposes, the ANN must be taught the characteristics of the dataset being processed. The training dataset consists of input values and the desired output values corresponding to these input values. The desired output values can be obtained from field, remote sensing data and other secondary sources (Maithani, 2009).

Training data for urban growth in case study area were obtained from satellite images including TM and ETM+ for time between 1989-2005. Although the ANN can be trained using a number of training algorithms, in the present study, the Back Propagation (BP) learning algorithm proposed by Rumelhart et al. (1986) was used for training the ANN due to its simplicity and wide applicability.

The training data can be used to calibrate the network to produce the realistic simulation of the study area. It is inappropriate to use the whole data set for training because the size is too large and the data may have spatial correlation. As mentioned above, a certain number of sample data is needed for the training/learning process of the ANN. So, a random-sampling method was applied to reduce the time and volume of computation.

Some 3'360 training samples were selected from urban growth maps belonged to 1989 to 2005 using ERDAS IMAGINE package.

The selection of samples was similar heuristic method of Kavzoglu and Mather (2003) which is as follow:

$$60N_i(N_i + 1) \quad (9)$$

where Ni is number of input neurons.

In this study, four groups of data relating to physical attribute, accessibility and neighborhood and zoning as well as land use data for the period of 1989-2005 were manipulated (Table 1).

Factor	Parameters
Physical attribute	Slope of the area altitude model
Accessibility and Neighborhood	Accessibility to local road Accessibility to main road Accessibility to CBD Accessibility to local centers Accessibility to business and community centers
Zoning	Planed area Protected area
Data related to land use	Land use classes: Urban, arid, green, water

Table. 1 The explanation of the spatial factors and corresponding driving forces.

8 SIMULATION OF URBAN DEVELOPMENT

The final step of modeling was prediction of urban growth. Based on the parameters and results of model validation, the prediction of future urban growth for 2025 was predicted (fig. 8).

The CA-ANN model using calibrated with the actual urban growth pattern between 1989 and 2005, and then used to predict urban growth in 2025.

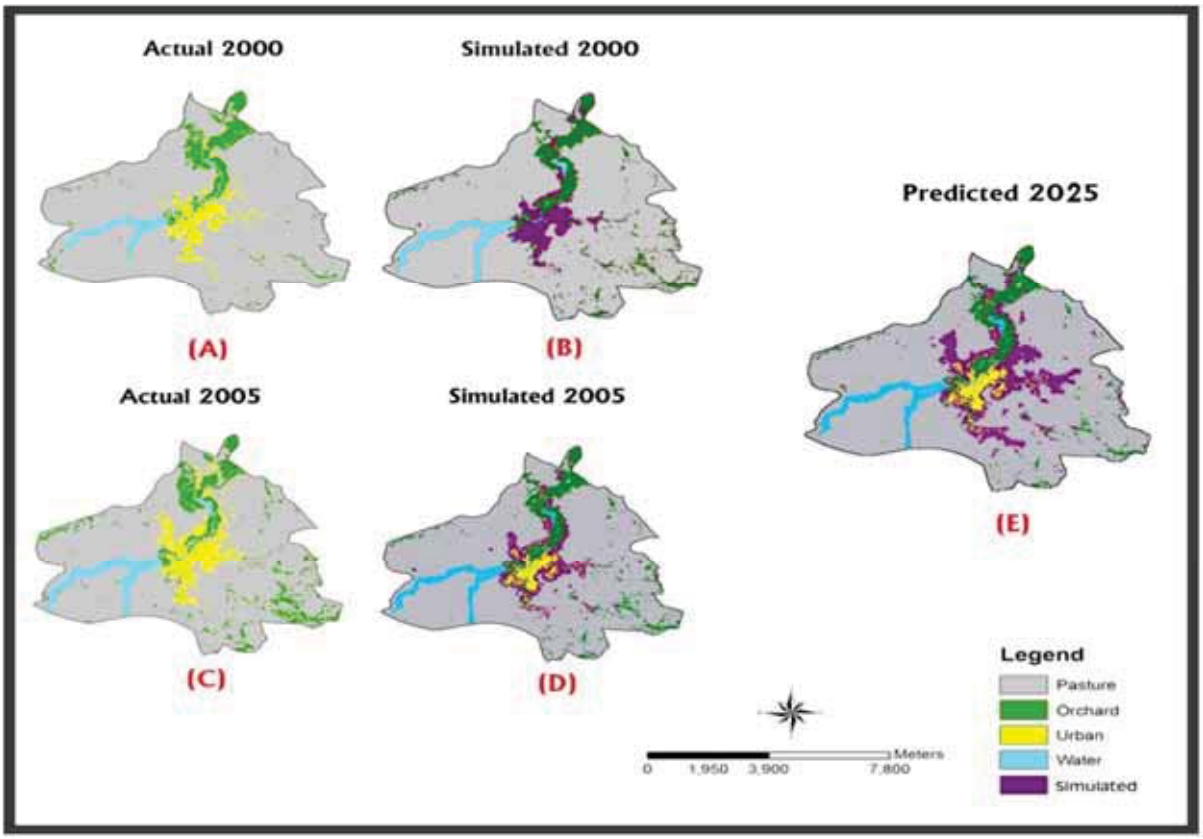

Fig. 8 (A) Actual urban land use in 2000, (B) simulated urban land use, (C) actual urban land use in 2005, (D) simulated urban land use in 2005 and (E) predicted urban land use in 2025.

9 DISCUSSIONS AND CONCLUSION

The result of the study showed that urban growth modeling through CA-ANN is an effective and useful way to analyze complex processes of urban evolutions. While classic CA model is associated with fixed transition rules and complicated calculation, this study was based on the growth of a procedure which calibrated the initial global probability surface from sequential land use data and then modifies the global probability with the local probability that was updated at each of iterations.

The applied approach of this study, integration of CA with ANN offers an easier and more flexible way instead. Because of the flexibility of the model with non-liner systems and uncertainty caused by spatial data, a higher level of confidence is achievable comparing to classic statistical model. In other hand, taking the advantage of ANN's capacity of dealing with nonlinear systems, this ANN-CA model can be calibrated without heavy computing overhead and subjective human interference.

This model can be considered as a helpful tool for policy making and planning. In fact, the results of this study can provide planners and decision-makers with influential information about alternative urban growth under various scenarios. Further, it can be easily combined with environmental models in hope of impact assessment. The model is reputable in other urban contexts using related data and circumstance.

This study can be improved in several ways. Since land use transformation is a multifaceted process, improving transition rules would enhance the classification accuracy and running efficiency.

Furthermore, if the CA simulation is calibrated through the desired pattern of changes, then the desired relationship can be incorporated into future growth evaluation for the purpose of simulating alternative scenarios. Furthermore, unsteadiness of the calibration process basing on ANN may bring superfluous parameters for the simulation model, which also points out the further research direction of this study.

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TOURISM AND CITY

REFLECTIONS ABOUT TOURIST DIMENSION OF SMART CITY

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ABSTRACT

The city of the future seems to be forcibly "intelligent" both in physical and in the functional aspects.

This paper starts from the consideration that the diffusion of new communication technologies (ICTs) are significantly changing the urban supply system of tourist services giving rise to new ways of enjoying the city.

As tourism can be assumed as an urban activity, by a town planning point of view, the study of tourism is meaningful to identify development trajectories of the present cities oriented toward sustainable and smarter models. As a matter of fact, almost all the projects to get a "smart city" are based on the idea of joining the potentialities of ICTs and the needs of urban management through people living or using the city. In such a vision, "tourist dimension" of the city becomes fundamental in promoting urban image as well as in improving efficiency of the city. This efficiency also depends on the capability of each city to share historical and cultural heritage as "common good".

As tourist demand has deeply changed also driven by technological development, this paper tries to investigate how will change the urban supply to meet the rising demand of quality and efficiency. The transition to smart tourist destination currently seems to be strongly connected with the number and the variety of apps to improve the "experiential component". A lack of interest there seems to be in finding strategies and politics oriented to plan the urban supply of services tourist or not.

This consideration, if shared, opens up new perspectives for research and experimentation in which city planning could have a key-role also in proposing an holistic approach to city development towards smart city

KEYWORDS:
Smart city, digital tourism, town planning

1 TOURISM AND CITY

At present, city has become one of the tourist destination par excellence (Page and Hall, 2003).

The presence of cities into the "tourist experience" shows the transformation that has been increasingly affecting the tourist demand.

Indeed contemporary cities have become the object of tourist desire thanks to a renewed recovery of their condition of "being cities". It is no longer the city seen only as a container of precious objects and valuable sites that attracts tourists, but the *city system* (Amendola, 1999). In other words, the "tourist city" product is the privileged place that contains either elements with great artistic, architectural, historical, value, or the peculiar cultural and traditional characteristics, or the opportunities of enjoying and taking part in events and occasions that allow tourists (temporal user of the city) get involved in urban life.

This new demand for city use has activated several strategies of urban promotion also because tourism is one of the leading sector of our economy.

The UNWTO data show an increase in this sector despite the crisis that has been affecting the most important west countries. In the last decade, in fact, the expense of international travels has doubled and it is expected to grow extra 50% in the next ten years (UNWTO, 2012).

Therefore, the competition among cities will be based also on the capacity of attracting big tourist flows, because of the undeniable positive effects on economic development. In Italy, for example, tourism contribution to the gross national product is 130 billion euro (about 9% of national production) and consequently it is defined as the leading sector of investment also in the political strategies of the present government (WTTC, 2013).

At the same time cities will have to be able to arrange adequate devices in order to contrast the negative effects produced by the uncontrolled development of tourism. The contradiction of tourism, indeed, consists in being contextually development factor and element which produces negative effects on urban liveability.

The challenge that tourist cities have to face consists exactly in their ability to find a balance between promotion and safeguard of their (historical, cultural, architectural, territorial, environmental) resources.

From a town planning point of view, this condition requires intervening through actions and policies targeted to the optimization of urban liveability. Moreover, a good quality of urban life is an unavoidable condition for building the future smart cities. At the same time, one of the factors of urban smartness consists exactly in making city attract tourists (investments, enhancement, image promotion, attractions of tourist flows, and so on).

Tourism, then, seems to represent one of the factors that shows the real accomplishment of the possibilities offered by the smart city concept.

Indeed, at a first glance, the attention in building the smart city seems to be paid only to the production of applications capable of improving the tourist experience also by involving the users in the mechanisms of city promotion. What seems to lack is an holistic vision which could allow, on the contrary, to face urban problems in an overall view.

Starting from the above-said assumptions, this paper investigates the aspects regarding the relationship between city and tourism pointing out the need for integrating tourist development and urban management. The several opportunities given by the ITCs tools have greatly affected the communication mechanisms as well as the requirements of particular urban users represented by the tourist demand.

Cities will have to provide with structures and services for meeting this demand efficiently and effectively.

This paper aims to show that in order to pursue this target it is necessary to reorganize the urban supply, which should be able to join the several aspects of the tourist demand (safety, mobility, accommodation, and so on) with the organization and liveability of the urban system.

Therefore, the paper is divided into three parts. The first part describes the elements which define a smart city, through a short review of the recent literature in order to stress that tourism is one of the smart city dimensions. The second part tackles briefly with the aspects regarding the changes of the tourist demand and urban supply in order to point out the present trends underway. The third final part includes some reflections on the possibility that the integration between tourist development targets and the town planning needs could offer in defining the urban smartness.

2 ALL THE CITIES AIM TO BECOME "SMART"

The huge amount of funds made available by the European Union (in 2009 through the European Community Smart City and Communities Initiative) and in Italy by MIUR (in 2012 through the announcement Smart Cities and Communities and Social Innovation) for working out "strongly innovating solutions" for the regions development and the enhancement of the quality of life in the cities, has attracted the attention of business, public research authorities, universities and public administration, who have been asked for integrating their respective competences in order to set up projects for developing "smart cities"

The challenge consists in making cities more efficient as regards better quality of services, reduction of environmental impacts (polluting emissions), control of energy consumption, by means of innovating technologies (ICTs) capable of supporting the management, monitoring and functioning of cities.

Actually, it could seem to be not different from what has been already affirmed by some scientists in the Eighties and Nineties about the crucial change that new information and technological technologies had produced, prefiguring the "death of distance" (Cairncross 1997), the transition from the "city of atoms" to the "city of bits" (Mitchell 1996) or the most futurist "anything-anywhere-anytime dreams" (Graham 2004).

Maybe what they miss was the complementary –more than the substitutive– role of new technologies in developing urban activities on several (economic, social and physical) levels.

On the contrary, this concept represents the essential innovation of the emerging idea of smart city, where citizens and city users play an active role both as "detectors" and "diffusers" of data and information.

Indeed, the interaction between users and decision-makers represents one of the key points on which the idea of smart city is based, even if an univocal and shared definition has not been reached yet in Europe and all over the world.

For example, the report worked out by Cittalia titled Smart cities in the world collects twelve cases of innovative strategies activated by European and American cities, representing a "guide handbook" for technicians and decision-makers.

Whereas, The Top 10 Smartest Cities on the planet is the classification worked out in 2012 by Boyd Cohen, researcher at University of Colorado. It is based on some indicators (economy, environment, government, way of living, mobility, people) that compare the most important cities of the world. Stand in the ranking six European capital cities (Vienna (1°), Paris (3°), London (5°), Berlin (7°), Copenhagen (8°), Barcelona (10°) where investments in innovation are mainly targeted to set up measures for reducing climate changes.

Fig.1 The wheel of smart city elaborated by Boyd Cohen

The recent report elaborated by European House Ambrosetti on *Smart Cities in Italy* shows that the definition of "smart city" can transform as the proponents change (fig. 2).

Sustainability is present in each proponents (institutions, academia, business) while the ICTs component is very significant for companies, which consider "smart cities" as an open lab for the application of innovative services and products. Even more, the attention to the "sensors" capable of making cities smarter seems to prevail, in spite of academics and professionals recommending not to underestimate the "smartness" concept by enhancing the role of technologies.

The "iceberg effect" (Bolici e Mora 2012) is a high risk, mostly encouraged by the ICTs leader companies which encourage the use of technology by standardized "smart" applications, lacking in a definite planning of development and application which should take local peculiarities into account (Townsend 2012).

The trend to encourage the operating implementation of technology is still predominant, also because a theoretical reference has difficulty in coming out (Fistola 2013).

	Mobility	**ICTs**	**Environmental Sustainability (energy buildings ground water)**	**Quality of life**	**Smart society (education, health, governance)**
Istitutions					
EU SET plan			●		
EU SC and Communities Initiatives	●	●	●		
Italian Digital Agenda	●	●	●	●	●
MIUR calls	●	●	●		●
University					
Wien University	●	●	●	●	●
MIT SENSEable City Lab		●	●	●	●
Harvard	●	●	●	●	●
Companies					
ABB	●	●	●	●	
Alcatel	●	●	●	●	
IBM	●	●	●		●
Siemens	●	●	●		
Cisco	●	●	●	●	●
Accenture		●	●		●

Fig. 2 Definition/interpretation of smart city according to the typology of proponents, elaboration by ABB Ambrosetti (2012)

Also the reference to sustainability, incited by the environmental emergencies to be faced everyday (energy crisis, climate changes, and so on could represent a "risk" of trivialization in a way.

Therefore, like the sustainable city also the smart city finds it difficult to define a global view that would not be applied only to single parts (smart building, smart district, smart street, smart infrastructure, etc.).

Nevertheless a point of convergence seems to be found in the idea that a "smart city" should refer inevitably to an holistic concept able to join the positive aspects issuing from technological development with the qualities of the "social capital" (Papa, Gargiulo and Galderisi 2013; Fistola 2013).

Indeed, more and more often the availability of a good level of human capital is considered as a factor of competitiveness and territorial capacity of attraction (Florida 2003).

The basic concept refers to the opinion that in a smart city the investments *in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance* (Caragliu, Del Bo andNijkamp 2011).

On an extreme level, it could be argued that in the definition of smart city there are two interpretative models: the *digital city* and the *eco-sustainable city*, which evolve, get stronger and integrate each others supported by a third element that is the *social capital.*

The active role of the human factor (the anthropic system: the urban actors, residents, city users, tourists) is becoming increasingly important also because it can significantly affect the "destiny" of a city.

Therefore, the challenge of the smart city seems to be once again the (intelligent) attempt to make a city more competitive basing on the presence of factors which contribute to its "smartness" (the presence of a creative class; high levels of multimodal accessibility; high quality of transportation network; great diffusion of ICTs; high quality of human capital).

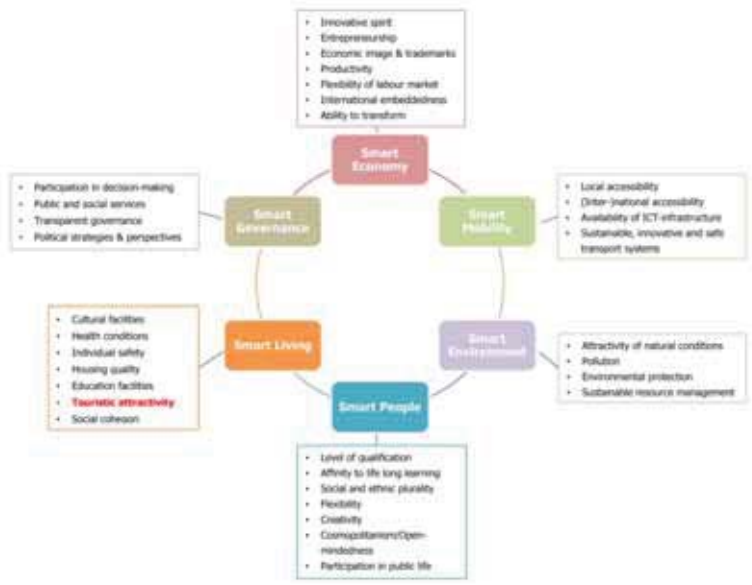

Fig. 3 Factors and indicators of the Smart City Index elaborated by Wien University: touristic attractivity is one of the factors of the "smart living"

The Smart City Index (fig.3), for example, promoted by the Wien University of Technology, University of Ljubljana and Delft University of Technology evaluates a sample of seventy European medium-sized cities characterized by: urban population between 100.000 e 500.000 inhabitants, presence of almost one university seat; catchment area less than 1.500,000 inhabitants (to exclude cities which are dominated by a

bigger city). The ranking is based on the by now well known six dimensions of smart city: smart economy, smart mobility, smart environment, smart people, smart living, smart governance. These six dimensions have been built on the 'smart' combination of endowments and activities of self-decisive, independent and aware citizens.

Tourist attractivity is one of the factors which define the "smart living". In the ranking, this factor characterizes the Austrian cities (Salzburg, Innsbruck, Graz, Linz) and the Belgian ones (Brugge, Gent).

Thus, tourism appears among smart city dimension and it is considered as a factor able to concur to a "smart living". Probably this is because tourism is a real economic resource for many city: it produces income, it generates jobs and skilled labour force, it is often the main element to activate projects of urban requalification, it attracts investments and stimulates local business entrepreneurship, and so on. Briefly there are a lot of positive effects of tourism development from an economic perspective.

At the same time, tourism has also negative impacts on urban life: environmental and noise pollution, over-load capacity, traffic congestion, functional mingling and so on. This dual aspect characterizes the tourist phenomenon and pushes the need to integrate tourism and town planning in order to maximize the positive effects in urban living. At the present, however, there seems to be still a lack of attention especially in town planning sector. In other words only if correctly planned, developed and efficiently managed, tourism can be a catalyst for a vigorous economic development and social progress in city. As shown in the next section, it seems that tourism destinations tend to use "innovation" almost entirely as a vehicle for developing new products or apps even though this is to upgrade the quality of urban services and improve competitiveness between cities. Within this context the concept of "smart city" seems to be reduced. On the contrary, cities have to recognize the changing occurring in tourism demand and set new priority areas for action.

In this sense urban planning research could give a valid contribution in building up tourist smart city where residents needs and tourist demand meet.

3 FROM TOURIST CITY TO "SMART DESTINATIONS"

Cities are going to become more and more the place of crucial challenges that human beings will have to face (Vianello 2013). It is in the cities that the most important challenges are played for hitting global targets such as the mitigation of climate change and the improvement of social inclusion (Testa 2012). It is from cities that the -energy, environmental, economic, cultural- crises have arisen and it is again in the cities that the possible solutions are to be found. Cities are both cause and solution of the crisis: they are the cause because they gather consumption and waste of energy and resources, and they are also the solution because they gather the research and experimentation activities.

Also in contrast with the most catastrophic expectations, according which cities would have been a "worthless heritage of the past" (Gilder 2000), cities still go on increasing their inhabitants and users.

The "city appeal" as place where all the opportunities for "being protagonists" is affecting also the choice of tourist destination: therefore cities have become one of the preferred places of the present tourist demand. As regards the peculiarities of the present tourist demand, in fact, the availability of attractions or amenities is not enough, but it is necessary to create an heterogeneous supply (resources, services, attractors, and so on) in order to meet the ever-increasing demand for quality characterizing the present tourist users (La Rocca 2003).

The "tourist product", in fact, consists in a structured system of interacting elements (goods, services, information, attractions, cultural elements, environmental emergencies and so on) that form the "supply system". The peculiarities and qualities of this system affect the choice of a destination and produce a competition among the different tourist destinations (La Rocca 2010).

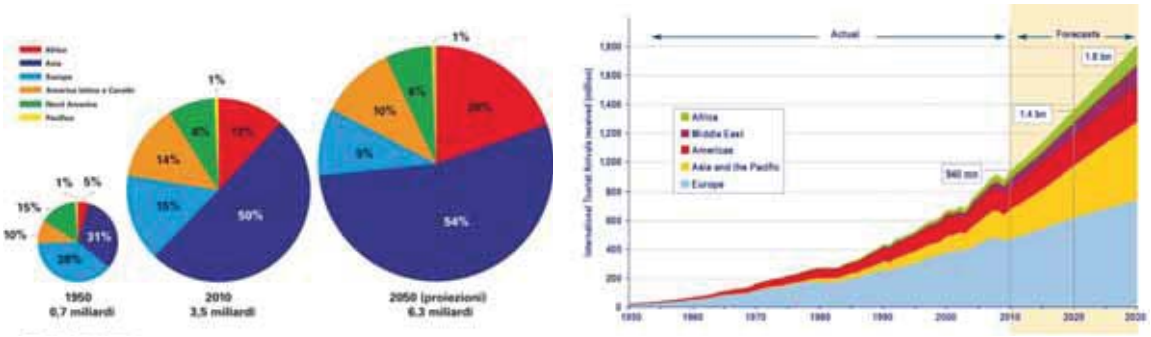

Fig. 4 The increasing urban population trend (left) and the tourism forecast 1950-2030 (right) by UNICEF and UNWTO

The strategies for developing and promoting a region in tourist key are based just on the capability of organizing the supply of goods and services (for tourist support) according to a complex system able to improve the overall "tourist experience".

The reference to the city as experiential tourist product refers also to the systemic-dynamic dimension of tourism, mostly investigated by the European and Anglo-Saxon schools of thought.

According to the above said view, city has become one of the most favourite tourist destinations, thanks to the possibility of using, in the same place, a great variety of elements that increase tourist experience, namely, of meeting the emerging tourist demands (Spirou 2011).

The "experiential component" represents one of the latest evolutions within the disciplines which study tourist phenomenon. This component is represented by elements able to enhance the value and to differentiate the supply system, mainly in relation to those elements capable of "making tourist experience unique". Unlike the global tourist product, the "experience product" is not the sum of attractive factors, but the ability to make the holiday unique by producing emotions.

The challenge involving all the present cities that aim at being international tourist cities consists just in the capability of working out supply systems, which are more original than the traditional supply of goods and services.

In the smart city, this condition is strengthened by the attempt to enhance the supply tourism-supporting services through more and more innovative applications, which transform tourists from simple observers to the leading actors of their visiting experience.

The risk of trivialization and homologation is still lurking. Actually, it is possible that by attempting to make tourist supply spectacular, it could end up by standardizing it and by emphasising only some factors that have almost nothing to do with the enhancement of the city and its resources and culture heritage.

Nevertheless, the transition from the "vacation spot to smart destination" (Sanchez Chillon 2012) has already taken place.

There are infinite possibilities of innovative applications (apps) able to support the tourist in the use and knowledge of the city he wants to visit. Indeed, if the definition of smart city seems to be confused, the one regarding the smart destination is still less defined, where the technological factor seems to prevail on all the others.

At present the urban supply for tourists seems to be addressed almost only to enhance the technological applications to improve tourist experience. Many present cities are trying to put themselves as alternative tourist destination also because of the original supply of urban system use. They pass from the construction of dedicated routes "supported" by QR codes capable of recreating movies scenes (New York, London and Paris) to the applications of Augmented Reality allowing either to "travel across time" and to watch the

original conditions of a monument or an archaeological site (Rome, Athens) or to recreate the atmosphere that have made some places famous (Paris, London), or to be virtually inside an open air museum (London and Barcelona). Street Museum, for example, is the Augmented Reality (AR) app of the Museum of London that lay upon the real image some historical pictures of London streets, allowing the visitor to "live" some decisive moments of the city history, such as the Great Fire of 1666.

As previously said, the applications can be unlimited and they are undoubtedly changing the way of interpreting the supply of tourist-supporting services affecting also the ways in which visitors use cities.

The interest shown by market operators is extremely strong also due to the fact that market analyses allow to set up marketing strategies targeted to catch the user preferences and needs (fig 5).

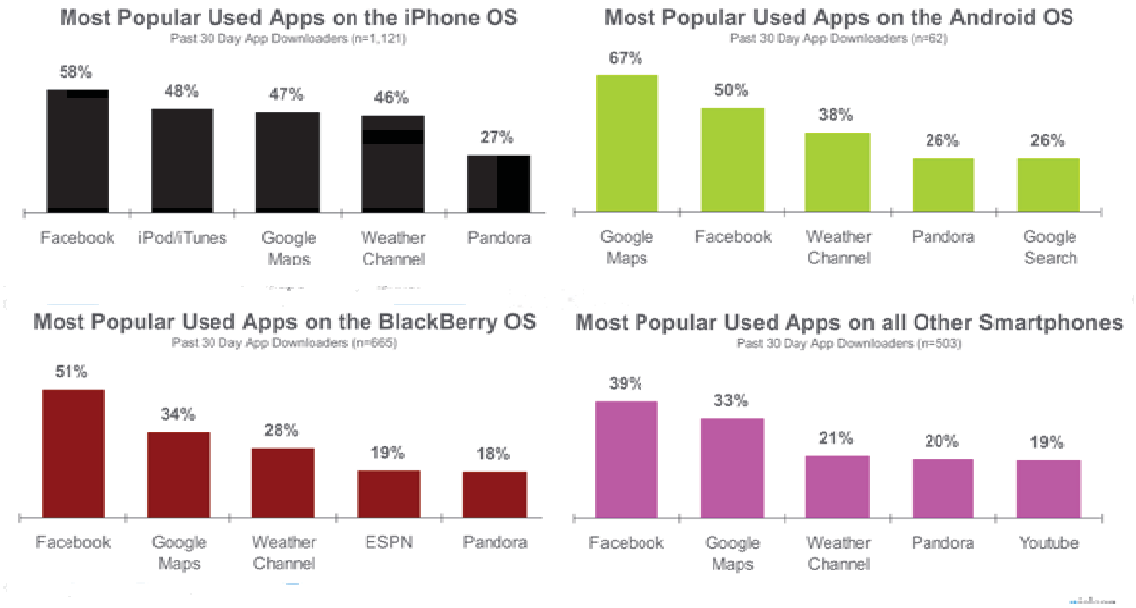

Fig. 5 Utilization rate of the most popular apps for smart phone

On this subject there are many scientific studies that point out the interactions between intelligent systems and tourism (for instance the Laboratory for Intelligent Systems in Tourism – LIST University of Wollongong, Australia). In a recent study (Heather Kennedy-Eden and Ulrike Gretzel 2012), a taxonomy of mobile application in tourism has been proposed referring on one hand to service provided, on the other hand, to the level of user customization.

The study considers apps available prior to July 2011. By using a phonetic approach for building the taxonomy of service provided, seven categories of travel-related apps emerged: Navigation, Social, Mobile Marketing, Security/Emergency, Transactional, Entertainment, and Information. Each category is then subdivided into sub-categories made different according to the service provided by the app (fig. 6). Although being not exhaustive and susceptible to further improvements, this taxonomy allows to look at the way in which the tourist-supporting services are changing and how this element of the supply system strongly affects the visitor's choices.

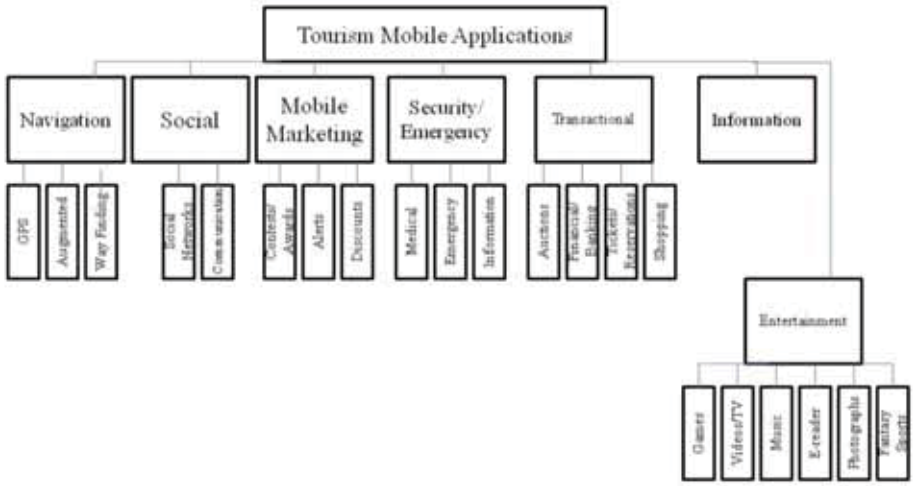

Fig. 6 Taxonomy of tourism mobile application by service provided elaborated by Kennedy-Eden and Ulrike Gretzel

On the other hand the possibility of "making virtual" the tourist phase of travel planning is not new. The use and spreading of the internet, mainly during the Nineties, have greatly changed the development of the pre-travel steps (Maguer 2011). The immediate effect on tourist system has been the drastic change of all the market segment devoted to intermediation. Travel agencies, for example, had to transform their structure and are probably destined to play a marginal role in the future arrangement of tourist sector. At the same time, tourist business had to change their promotion strategies in order to reach the ever-increasing demand segments. The cities aiming to become tourist destinations have been forced to join the network in order to become attractive and offer a charming representation of their resources in view of attracting tourist flows and competing on international level.

The e-tourism[1] phenomenon derives from the possibility of using a "virtual" dimension of a given region or a city before moving to it, which also characterizes the development of tourist activity.

The introduction of mobile technologies has indeed changed this condition too. In effect it is possible to use "virtually" the object of the tourist desire (a destination or a specific site) although being physically present in the desired place. The applications of the augmented reality consist just in the possibility of projecting oneself into a virtual dimension by pointing one's smartphone to the object "to discover" or to get information about what to visit, where to eat or to catch a bus and so on (fig. 7).

Fig. 7 Augmented reality apps allow to interact with the object of the visit

[1] Born in the Ninety, the European project MOSAIC (Museums over States and Virtual Culture) within the programme TEN TELECOM of 1997 was targeted to realize the first network of virtual museums. The basic idea of the project consisted in making available, by using new technologies, also those parts of cultural heritage contained in few European museums not open to public.

The internet connection does not require a physical place, but it can take place everywhere thanks to small devices available in every city (the wi-fi networks for example)

It is the transposition from *e-tourism* to *m-tourism*, a dimension where tourist becomes "mobile user", namely he can be continually connected with any place and/or any community to exchange data and opinions in real time, participating actively in the choice of one destination instead of another.

It is approximately the mechanism of social networks, of tourism 2.0 based on the culture of sharing and participation (web 2.0). This sharing takes place in real time, during the travel experience and has radically changed the role of the tourist: from "consumer" to ""evaluator". According to this view, the tourist's role entails greater responsibility and it is just starting from this condition that the supply system, by the side of private and public operators, is changing its ways of spreading in order to retain more aware, careful and ever-connected customers.

In a short period of time, tourist demand has further increased: e-tourism has become "digital tourism[2]" (SO-LO-MO social local mobile). A typology of tourist that apart from planning holiday with remote assistance (network) shares and communicates them (SOCIAL) through several applications, which strengthen his role of decision-maker-actor (tripadvisor, zoover, hotpot, etc.), allowing him to appreciate the possibilities of using the place he stays in (geo- LOCAL) by means of mobile technology tools (smartphone, tablet, ecc.) which are going to become more and more unavoidable (MOBILE).

4. TOURISM AS PERSPECTIVE FOR FURTHER REFLECTION ON SMART CITY PLANNING REASEARCH

Tourism is one of the fields where the real achievement of the possibilities given by the paradigm of smart cities can compete. The competition among cities has to compare also with the ability of each city to attract tourist flows and investments in order to improve the supply system by exploiting new technologies.

What arises from the present scenario –characterized by radical changes both in the supply system and in the tourist demand one– is a substantial imbalance of the innovative element of the product (the apps) in improving the travel experience element.

On the contrary there is a less clear and scarcely investigation of the factor regarding the possible applications of ITCs in the management and reduction of the impacts inevitably produced by tourist activity in the urban planning field.

The urban tourist dimension seems to be still considered as "other", namely not integrated in the organization of the city. Nevertheless "tourism and culture" are considered as one of the emerging dimensions of the smart city, apart from representing one of the research subjects promoted in Italy by the MIUR (Ministry of Education) to show the projects for Smart City and Communities (smart culture and tourism): "*A smart city promotes its tourist representation as an intelligent presence on the web; makes its cultural heritage and its traditions virtual and put them on the internet as "common goods" for its citizens and visitors; uses advanced techniques to create thematic routes and maps of the city and to make them be*

[2] Digital Tourism is defined as the digital support of the tourist experience before, during and after their tourist activity. http://sachi.cs.st-andrews.ac.uk/research/areas/digital-tourism/

user friendly; promotes a coordinated and intelligent supply of its tourist supply on the Internet; gives tourists an easy access to the networks and online services according to their requirements".

A strategy that is still targeted to enhance services supply for the use of a city, or rather the component of the supply system able to affect the attractive power of a territory, and then still linked to the research of elements and conditions that make a city more competitive, although the reference to the concept of "common good".

In the strategic plan for tourist development "Italy 2020" worked out in January 2013 (fig. 8) among the primary actions there are the indications regarding the improvement of tourist flows distribution with priority to the "top cities" (Rome, Venice, Florence and Milan), in order to reduce the risk of saturation caused by the high tourist concentration in those cities (Action 26).

Guidelines of the strategic plan	***Targets-Actions in the sector***
Governance	Enhancement of the central support and coordination
Relaunch of the tourism national agency	New project and reorganization of the mission
Supply enhancement	Definition of priority poles (30-40)
Improvement of accommodation capacity	Supply requalification and improvement
Transport and Infrastructure	Development and adaptation to the demand requirements
Training and expertise	Improvement of the supply quality carried out by the operators in the field
Investments	Setting up incentives and simplification of the procedures (zero bureaucracy)

Fig. 8 The Tourism Development Strategic Plan in Italy points out seventy actions clustered in seven guidelines targeted to recover the market shares of tourist demand

Nevertheless the interventions are based only on setting up measures for the selective reduction of the incoming flows in specific places (for ex. Entrance ticket) or for the best schedule of the events which mostly attract flows of visitors. While just a hint is given to the possibility of making tourist flows more sustainable for the functioning and organization of the city.

In this direction, the research of possible solutions seems to have still more chances of development, which should not be undervalued, since they allow to investigate aspects considered as marginal up to now in the field of urban disciplines.

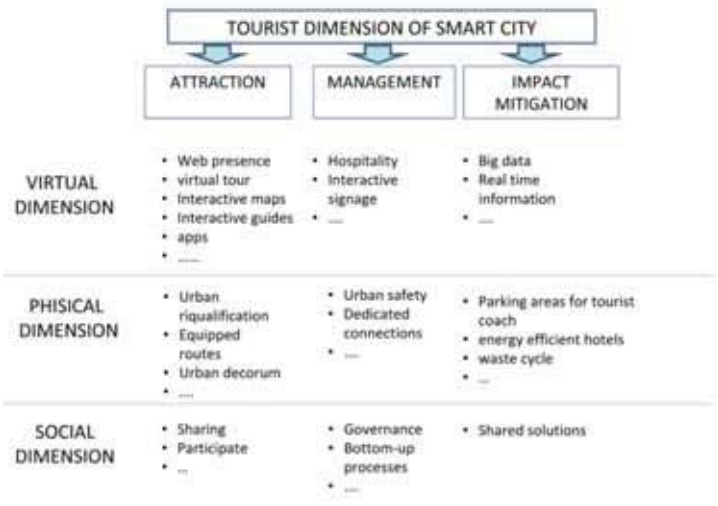

Fig. 9 Relations and impacts of tourist dimension on urban organization

The need for changing urban services supply, according to the emerging requirements expressed by an increasingly expert and qualified tourist demand, will inevitably ask for reconsidering the role of some urban functions modifying also the physical elements and the relationship with the urban context.

Railway stations, airports and ferry terminals, for example, represent the "new gates" to enter the city and are places meant to receive tourist flows and then to allocate them over the territory. Moreover in the urban area it could be possible to find some poles of excellence for delivering services to support tourists, which could be considered as "new poles of tourist reception", an advanced version of the tourist office, which will inevitably modify its role and function.

The enhancement of tourist supply represents the main target of the development policies aimed at improving the image of a city and its competitive relaunch, but it cannot be based only on the realization of a supply of advanced services (virtual tourist guides, augmented reality, and so on). On the contrary, it should be the result of an accurate project of new functionalization and organization of urban supply, which should be capable of integrating the several direxrtrices of tourist needs (security, mobility, accommodation, and so on).

This consideration, if shared, opens up new perspectives for research and experimentation in which city planning could have a key-role also in proposing an holistic approach to city development towards smart city.

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INFORMAZIONI DIRETTE ED INDIRETTE NELL'ORGANIZZAZIONE DELLO SPAZIO URBANO

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ABSTRACT

The relationship between new technologies and urban space has become, especially with the introduction of the concept of smart city, the key in the definition of management options in the city itself.
The opportunities provided by the use of new technologies to manage the complexity of multiple aspects on the relationship between city and people can address strategies and innovation in order to improve the quality of life of the inhabitants. In smart cities different groups of people with different instances can be directly involved in the transformation process and the planners' choices can be supported by information that once would have required costly research. This possibility is granted by the availability of great quantities of data that can be collected and analyzed. Direct information can be gathered by multiple sensors (accelerometer, a geomagnetic sensor, and proximity sensor, etc.) that offer an immediate evaluation of a specific phenomenon. At the same time other aspects can be evaluated by information obtained in social networks: these can contribute to the definition of urban design as the result of a multi criteria analyses. The way to achieve these strategies is a process of interaction between spatial reality and perceived reality made available by passive forms of participation that can help planners in understanding territorial actors' / territorial users' needs and requirements.
Through this approach, the design and decisions about urban space are not to be indifferent to the needs expressed by various categories of population.

KEYWORDS:
Smart City, Pianificazione urbana, Senseable City.

1 TECNOLOGIA E SPAZIO URBANO

Il tema del rapporto tra nuove tecnologie e spazio urbano è oggetto di discussione all'interno della comunità scientifica nazionale ed internazionale fin dagli anni novanta[1].

Il dibattito ha riguardato la configurazione dello spazio urbano così da coglierne le potenzialità nel rapporto tra opportunità digitali e realtà spaziale (da intendersi quale riferimento fisico a dinamiche materiali e non), ha cercato di interpretarne la sua evoluzione attraverso descrizioni ed interpretazioni in grado di cogliere, nella loro virtualità, la multidimensionalità delle dinamiche oltre al legame tra aspetti materiali ed immateriali[2], fino a supporre una smaterializzazione della città, sradicandola da qualsiasi luogo fisico e modellandola sulla capacità di connessione e ampiezza della banda[3].

In un caso il dibattito si è concentrato su aspetti progettuali connessi con la rappresentazione tridimensionale e virtuale dello spazio, creando un legame immediato tra la città progettata e la sua percezione, consentendo di percepirne la consistenza e l'organizzazione e di eliminare l'astrazione delle espressioni tecniche del disegno per coinvolgere direttamente il fruitore finale. L'altro ha focalizzato l'attenzione sull'interpretazione delle dinamiche in atto, cercando degli strumenti di interpretazione della complessità spaziale e del suo continuo divenire, scegliendo di volta in volta punti vista differenti legati alle nuove tecnologie[4]. Tale filone rappresenta ancora oggi una sorta di avanguardia nella ricerca tanto che le innovazioni tecnologiche (come ad esempio la telefonia cellulare, l'utilizzazione dei sistemi GPS – Global Positioning System) vengono utilizzate quale strumento di valutazione delle dinamiche di maggiore attualità[5].

L'ultimo caso è forse quello più utopico perché, in una certa qual maniera, ha spinto a leggere l'innovazione tecnologica, parafrasando il concetto di scienza proposto nella Nuova Atlantide di Bacone, come una sorta di sperimentazione che consente all'uomo di dominare la natura piegandola ai suoi fini. Questo presupponeva una sorta di sgretolamento della città fisica a favore di quella dei bit, immateriale, attraverso la nascita di un nuovo dialogo architettonico e urbanistico fra la dimensione fisica e quella virtuale della città: nascono le agorà digitali che dovrebbero contribuire alla ricostruzione del capitale sociale della città.

Alla base di queste elaborazioni è possibile da un lato ravvisare la necessità di spiegare alcune delle dinamiche in atto attraverso il riconoscimento del legame tra trasformazioni territoriali e dinamiche immateriali, dall'altro è ipotizzabile una relazione tra la necessità di contrapporsi alla spinta prorompente della frammentazione e della disomogeneità, la quale caratterizza sia il mutamento delle strutture sociali e degli stili di vita che la trasformazione dei modelli insediativi e degli spazi urbani.

Oggi il fenomeno delle smart cities, come allora poteva essere quello della città cablata, delle innovazioni nelle telecomunicazioni e nell'informatica, può essere inteso legato solamente all'esigenza di impostare politiche lungimiranti per lo sviluppo sostenibile della città attraverso scelte che si rivolgono all'innovazione tecnologica, al corretto uso delle risorse, al risparmio energetico, alla partecipazione nelle scelte di governance ed all'utilizzazione delle Information Communication Technologies (ICT), riducendone quindi il significato intrinseco ad una dotazione di infrastrutture innovative a supporto della qualificazione dello spazio urbano.

Può sembrare altresì che esso sottenda una vera e propria concezione antropologica volta a favorire un legame di interdipendenza tra l'uomo, lo spazio urbano e la macchina/il software. In questo caso, come osservato da Rem Koolhaas rispetto al fenomeno della sostituzione opportunistica della città in favore della

[1] Tra i primi ad affrontare questa tematica C. Beguinot, U. Cardarelli (a cura di) (1992), Per il XXI secolo una enciclopedia. Città cablata e nuova architettura, Università degli Studi di Napoli "Federico II" (Di.Pi.S.T.), Consiglio Nazionale delle Ricerche (I.Pi.Ge.T.), Napoli.
[2] S. Sassen (2008), Una sociologia della globalizzazione, Einaudi, Torino.
[3] W. J. Mitchell (1997), La città dei bits, Electa, Milano.
[4] Si veda ad esempio AA.VV. (1992), Telecomunicazioni e territorio:l'area centrale veneta, Cleup, Padova, dove si è stato analizzato proprio il legame tra innovazioni tecnologiche e organizzazione territoriale.
[5] Si veda ad esempio Pulselli R.M., Pulselli F.M., Ratti C. & Tiezzi E (2007)., Ecosystemic Approach to City: Exploiting Mobile Technologies for Monitoring Social Dynamics. Proceedings of Eco Summit 2007, Beijing, 22-27 May 2007.

Bigness[6], la forma simbolica e autoconclusa dello spazio multiconnesso virtuale viene quasi a contrapporsi alle potenzialità relazionali dello spazio urbano, serializzando ed esaurendo all'interno del proprio meccanismo la complessità e l'imprevedibilità delle molteplici funzioni da esso un tempo esercitate. Attraverso la smart city si realizza quindi una sorta di introspezione delle dinamiche urbane che pongono l'accento sul particolare, sul singolo oggetto, sull'individuo, in quanto le relazioni (fisiche), i rapporti (interpersonali) e gli spazi comuni assumono una dimensione non più solamente fisica, ma anche virtuale, effimera e dilatata. In tal senso la smart city è il frutto congiunto della tecnologia (hardware e software), della popolazione (in termini di coinvolgimento diretto e facilitato della stessa nelle questioni urbane) e di chi è chiamato a realizzare lo spazio urbano (ovvero le istituzioni che operano nella governance e nelle policies).
Alla luce di quanto esposto, al di là dell'aspetto squisitamente tecnologico che sempre più viene sottolineato in relazione al concetto di smart city, la città intelligente è il luogo dove tutti i processi relativi al vivere sociale possono essere raccolti ed analizzati attraverso l'innovazione tecnologica al fine di poter giungere ad un avanzamento complessivo in termini di capitale sociale. La convinzione dunque è che la tecnologia sia uno strumento per facilitare il raggiungimento della qualità (intesa come prestazionalità, durabilità, coerenza, sostenibilità, ecc.) attraverso meccanismi di mutuo apprendimento, ossia attraverso un percorso che alle tensioni ed istanze spaziali e sociali presentate dal luogo dia vita a innovazioni urbane chiaramente percepibili e funzionali.
Come è possibile perciò coniugare confort urbano e nuove forme di socialità con una maggiore qualità dello spazio urbano così da riuscire a rispondere sia alle esigenze formali della pianificazione che alla funzionalità delle relazioni? Come è possibile utilizzare le tecnologie ed i principi delle smart cities per perseguire una progettualità dello spazio pubblico? Come sfruttare l'integrazione, l'interfaccia, il dialogo, la condivisione di informazioni affinché si mettano in rete sensori, dispositivi, uomo e spazio pubblico?
Sicuramente il vantaggio di una smart city risiede nella possibilità di creare una visione olistica dei processi di uso del territorio, ovvero di spiegare le relazioni funzionali tra gli elementi che lo caratterizzano e quindi di agire attraverso scelte coerenti e complessive. Allo stesso tempo, proprio in funzione della molteplicità delle relazioni offerta dalla smaterializzazione/virtualizzazione dei legami, è necessario comprendere e conservare la centralità del rapporto uomo – città, ovvero tutelare il modo di vivere e muoversi all'interno della città attraverso la comprensione delle visioni di chi ne vive gli spazi, sia esso visitatore occasionale o fruitore abituale.
La smart city attraverso la sua capacità di raccogliere informazioni diventa l'organismo in grado di coniugare le domande funzionali, i requisiti, i bisogni, gli standard prestazionali, i fatti, gli obiettivi ed i vincoli in un sistema ampio di elementi che vanno a costituire l'ecologia stessa del sistema: il benessere umano, l'economia, lo stato della tecnologia, il clima politico, senza porre alcun limite agli elementi utili per descrivere le proprietà di un problema (Alexander)[7].

2 INTERAZIONI

Nella *smart city* è perciò possibile raccogliere informazioni, monitorare i fenomeni che in essa si verificano, si generano, evolvono, si spostano e terminano attraverso un sistema di sensori che la rendono un organismo sensibile (Ratti).
Le informazioni potranno essere raccolte attraverso un monitoraggio diretto, ovvero tramite strumenti in grado di raccogliere e descrivere lo stato del sistema urbano in tempo reale. Si tratta della capacità di

[6] R. Koolhaas, B. Man (1995), S, M, L, XL, Monacelli Press New York.
[7] C. Alexander (1977), A Pattern Language: Towns, Buildings, Construction, Oxford University Press, Oxford.

leggere fenomeni specifici attraverso la raccolta di informazioni su particolari abitudini/consuetudini che possono descrivere implicitamente lo stato di un fenomeno. Un possibile esempio è il caso del monitoraggio della distribuzione della popolazione e delle relative modalità di movimento all'interno dello spazio urbano attraverso la raccolta delle informazioni relative alle chiamate telefoniche mobili (Sevtsuk e Ratti).

Allo stesso tempo risulterà possibile raccogliere informazioni attraverso l'analisi dei contenuti dei commenti postati nei diversi *social network*, elemento pervasivo di partecipazione diretta supportata dell'utilizzazione della rete. Infatti, sempre di più, il *social network* rappresenta un bagaglio di informazioni che viene utilizzato per comprendere il gradimento di specifici fenomeni, prodotti o altro in quanto offre la possibilità di commentare direttamente, attraverso il tasto "mi piace", ogni evenienza quotidiana. Allo stesso tempo i commenti postati all'interno dei *social network*, anche se non direttamente riferiti a fenomeni oggetto di studio, possono diventare la spia del gradimento o la richiesta implicita di intervento relativo a temi specifici. A dimostrazione di ciò ci sono le analisi di gradimento svolte durante le ultime campagne elettorali, dagli Stati Uniti all'Italia, che oltre a basarsi sui commenti postati, hanno valutato parametri impliciti quali la ricorrenza di argomenti specifici, delle vignette satiriche, ecc., raccogliendo queste informazioni proprio nei *social network*.

La *smart city* dunque si configura attraverso un processo di interazione tra realtà spaziale (monitoraggio diretto) e realtà percepita (monitoraggio indiretto), ovvero come il punto di incontro tra due dimensioni, sensibilità tecnologica e sensibilità sociale, che generano il cosiddetto *sensore antropico*[8], frutto dell'incontro tra popolazione e tecnologie gestite personalmente (*smartphone*, *tablet*, ecc.) che, dotate di strumenti di posizionamento e di adeguati *software* (applicazioni), possono monitorare specifici caratteri relativi ai luoghi dove si trovano e condividerli in tempo reale (attraverso il *social network*, una sorta di piazza/luogo di incontro virtuale) con gli appartenenti alla comunità, i quali non necessariamente si trovano nello stesso luogo, ma condividono le stesse esigenze o interessi.

Nello specifico l'informazione acquisita potrebbe anche non fornire dettagli riferiti alla gestione / pianificazione dello spazio urbano, ma contenere dati che, opportunamente raccolti ed analizzati, consentono all'istituzione / al pianificatore o progettista di ottenere delle suggestioni circa possibili modalità di intervento in questioni relative proprio allo spazio urbano.

Si è perciò convinti che, grazie all'individuazione di esigenze specifiche che vengono espresse implicitamente per mezzo degli strumenti tecnologici di condivisione, sia possibile dirigere le valutazioni circa l'uso dello spazio urbano verso quegli elementi che costituiscono un'estrinsecazione ed un potenziamento dei percorsi di pianificazione urbana centrata sulla persona.

3 SPORT APP E GESTIONE DELLO SPAZIO URBANO

Quanto in premessa è stato il punto di partenza per svolgere una semplice valutazione circa le esigenze di chi affronta attività sportive all'interno dello spazio urbano e non in strutture appositamente destinate.

L'idea è partita dal rapporto dell'ISTAT[9] sulle abitudini degli italiani circa l'attività sportiva, da cui emerge che la pratica sportiva agonistica tradizionale (ossia quella legata ai modelli culturali degli sport olimpici) è in una situazione che potremmo definire di stallo, se non di aperta flessione, mentre è sicuramente in aumento la pratica sportiva intesa come *loisir*, come ricerca del benessere fisico, cura del proprio corpo, come rapporto immediato con la natura. Tali dati sono stati ulteriormente specificati in altri studi[10] e hanno mostrato come

[8] Cfr.: Fistola R. (2013), Smart city. Riflessioni sull'intelligenza urbana, TeMA – Journal of Land Use, Mobility and Environment, 1, pp. 47-60.
[9] Istituto Nazionale di Statistica – ISTAT, Lo sport che cambia. I comportamenti emergenti e le nuove tendenze nella pratica sportiva in italia, 2005
[10] Istituto Nazionale di Statistica – ISTAT (2010), I cittadini e il tempo libero.

nel Nord – Est e quindi anche a Padova, esemplificazione di questo contributo, le persone che praticano un'attività sportiva, sia essa saltuaria o continuativa, raggiungono una punta a livello nazionale del 36,5%. Altro dato interessante mostra che il 43,3% di chi svolge attività sportiva lo fa in spazi aperti. In particolare il 17,2% lo svolge in spazi attrezzati, mentre poco meno del 30% lo svolge in aree non attrezzate. Inoltre di questi l'8,9% pratica attività quali corsa, *jogging* e *footing* ed il 7,6% il ciclismo, con un'incidenza complessiva sul totale del 16,5 %.

Si è poi osservata la proliferazione di applicazioni per il cellulare che consentono di monitorare la propria attività sportiva raccogliendo informazioni che riguardano il percorso affrontato, la sua caratterizzazione altimetrica, il tempo impiegato, la velocità mantenuta, la frequenza dell'attività, l'orario di svolgimento dell'attività, oltre a consentire di caricare delle immagini dei luoghi frequentati. Attorno a queste applicazioni sono stati creati dei veri e propri *social network,* dove le informazioni vengono caricate e condivise con gli altri appartenenti alla *community* con la finalità di confrontare le proprie esperienze.

Tramite dunque la raccolta dei dati provenienti da queste *community* ed associandoli alla valutazione delle caratteristiche dei luoghi è possibile svolgere tutta una serie di considerazioni che riguardano la correlazione tra modi d'uso dello spazio urbano da parte dell'uomo e destinazioni/caratteristiche dell'area in chiave progettuale.

La procedura utilizzata ha riguardato la raccolta delle informazioni circa i percorsi di allenamento utilizzati per le sole attività di corsa, *jogging* e *footing*, in quanto, pur essendo evidente in alcuni casi la sovrapposizione con percorsi ciclistici, questi ultimi molto spesso assumono una dimensione di tipo sovra-urbano, che nel caso in oggetto potrebbero addirittura definirsi metropolitani[11].

I dati sono stati mappati associando ad ogni segmento del percorso le sue caratteristiche specifiche in relazione alla fruizione sportiva. Nella fattispecie si sono valutati parametri quali sicurezza e protezione degli utenti (ovvero se il percorso si svolge in sede propria, pista o marciapiede, o in sede promiscua, ossia in commistione con il traffico veicolare), quelli riferiti alle caratteristiche del terreno (asfalto, *macadam*, manto erboso, ecc.) e la presenza di eventuali servizi (fontanelle, stazioni per percorso vita, ecc.). Rispetto ai punti di arrivo e partenza è stato possibile valutare se l'area necessiti o meno di punti di sosta (parcheggi auto o bici) o di servizi (chioschi) in quanto la presenza di queste caratteristiche è elemento di attrazione per lo svolgimento di queste attività.

Altro dato rilevante nello studio è stata l'osservazione della lunghezza del percorso ed il tempo destinato all'attività fisica. Tramite tali informazioni è possibile definire una sorta di profilo medio dell'utente e cercare di comprendere il rapporto esistente tra localizzazione del percorso e tipologia di accessibilità allo stesso (posso raggiungere l'area di allenamento a piedi o in bicicletta o devo utilizzare l'automobile?).

Circa la validità dei dati raccolti essa è garantita dal fatto che sono stati ottenuti tramite tracciamento con strumenti GPS e ad essi è stato associato un rilievo diretto delle caratteristiche sopra riportate, ripetibile ed aggiornabile al fine di ottenere anche una variazione temporale delle caratteristiche del suolo.

Il periodo di rilevamento è stato di tre mesi (maggio – luglio) e coincide con la maggior diffusione delle attività sportive all'aperto, con il maggior numero di allenamenti caricati nella community e con la maggior frequenza di attività sportiva svolta all'interno del mese.

Sono stati quindi individuati 20 profili di atleta con almeno 10 allenamenti (per un totale di 300 percorsi) all'interno del territorio del Comune di Padova e con questi dati è stato costruito un database che raccogliesse le informazioni necessarie per comprendere le dinamiche d'uso dello spazio urbano e gli elementi utili alla qualificazione dei percorsi in relazione alla persona. Il rilevamento sembra essere limitato in termini di profili di utilizzatori (20), ma è stato ritenuto importante selezionare quei profili che indicassero

[11] P. Boschetto, A. Schiavon (2011), L'immagine del territorio metropolitano. La città metropolitana di Padova, Cleup, Padova.

una continuità nella pratica sportiva all'interno del territorio per comprendere al meglio le abitudini e le relazioni tra il percorso scelto e la modalità di accesso allo stesso. Infatti valutare attività non sistematiche avrebbe inserito dei dubbi circa le motivazioni nella scelta di quel percorso, risolvibili solo associando alla raccolta dei dati forniti dallo strumento tecnologico le risposte ad un questionario compilato da parte di ogni atleta. Inoltre si è scelto di utilizzare i dati raccolti da un'unica applicazione per cellulare, che è risultata essere molto diffusa a livello nazionale in quanto disponibile per ciascuno dei sistemi operativi degli *smartphones* in commercio. Non si è infine valutato l'aspetto relativo al sesso in quanto ritenuto ininfluente per la tipologia di valutazioni che si sono sviluppate.

L'analisi dei dati raccolti ha consentito di svolgere le seguenti valutazioni:

- Tipologia del percorso svolto (tavole 1, 1/A ed 8). La distinzione è stata articolata in: percorso circolare, che ha messo in evidenza se il punto di partenza è relativo ad esempio ad un luogo di lavoro/residenza; percorso d'area, che fa riferimento ad un percorso che inizia e finisce in un parcheggio ovvero nei casi in cui ci siano molteplici percorsi che iniziano e finiscono in quel punto.

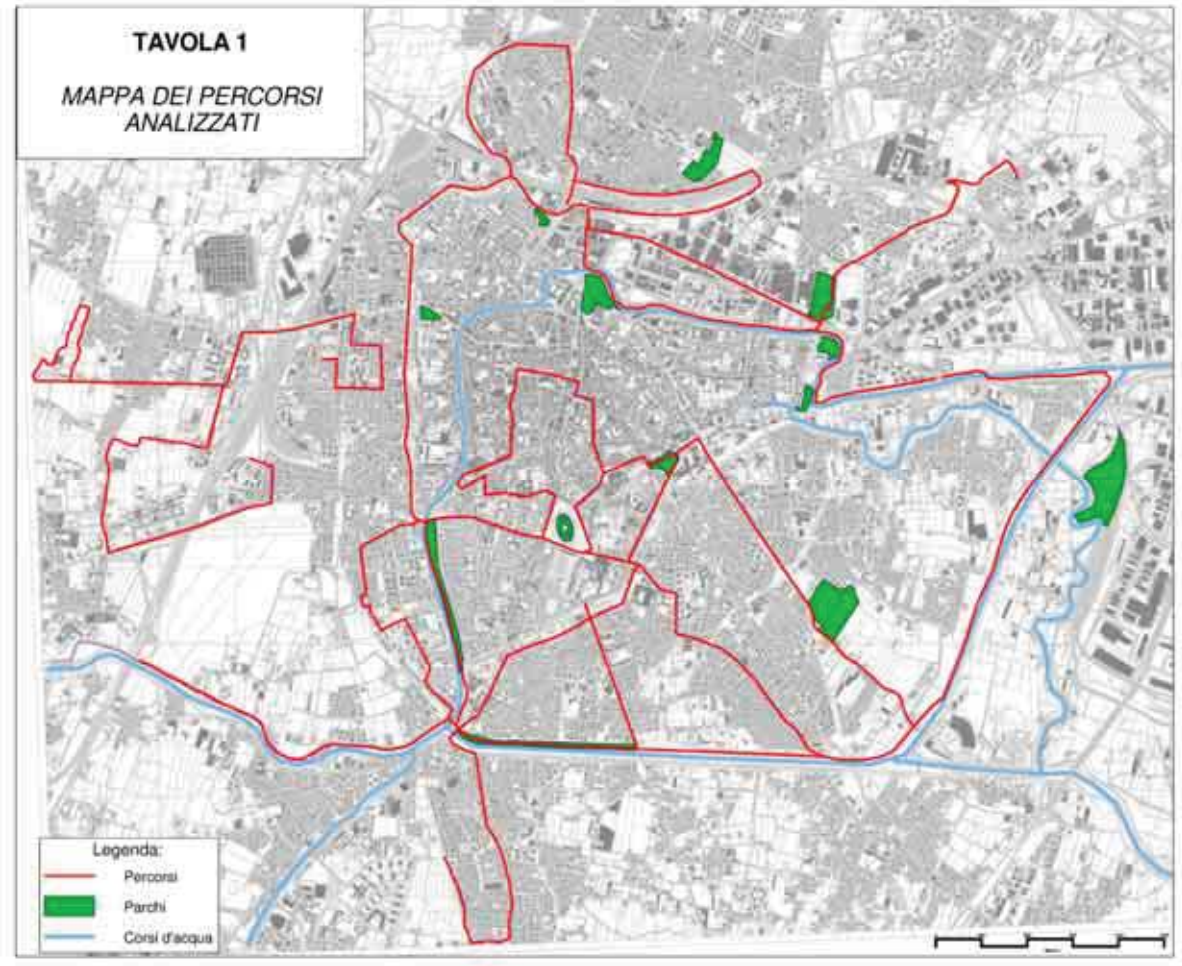

Fig. 1: Tavola 1. Rappresentazione grafica dei percorsi analizzati e delle invarianti.

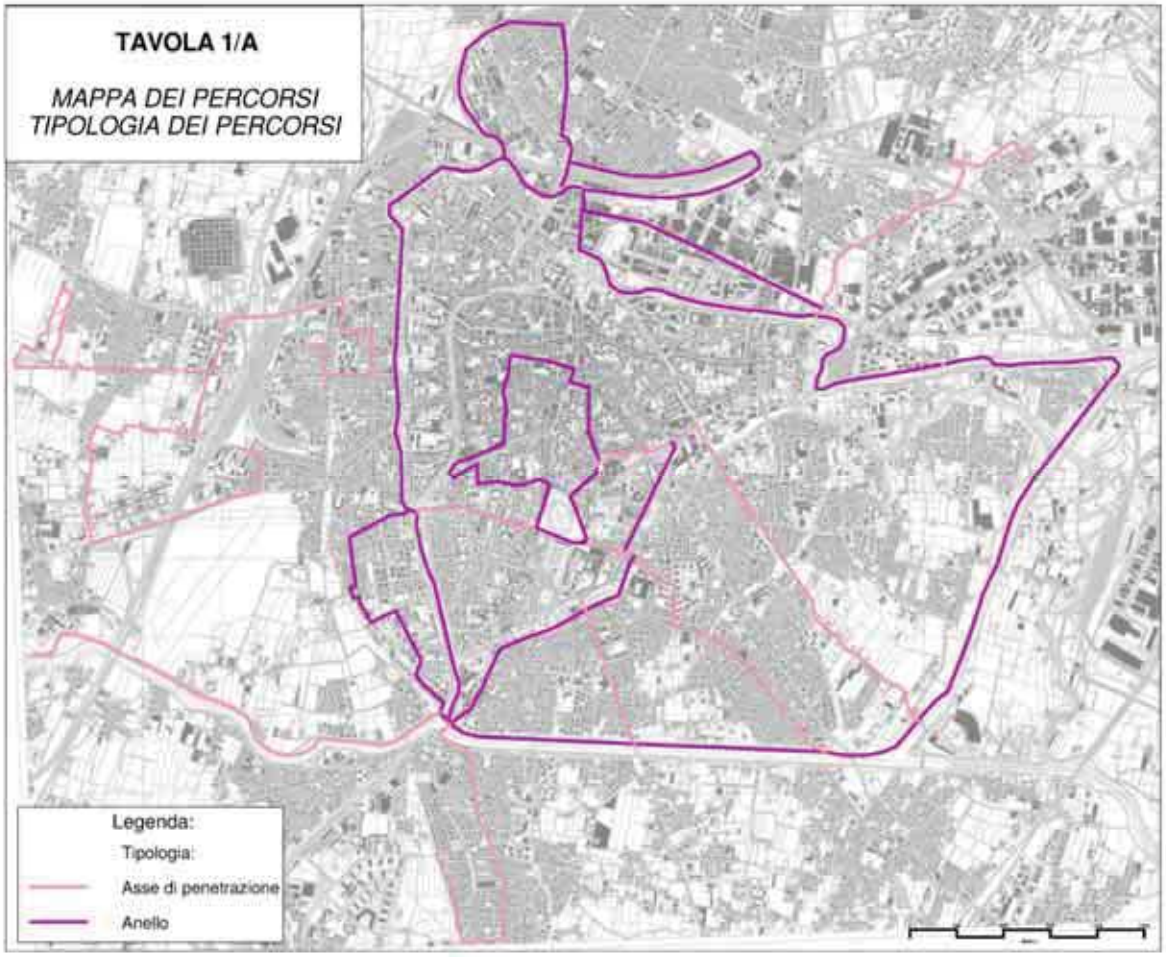

Fig. 2: Tavola 1/A. Rappresentazione grafica delle tipologie dei percorsi analizzati.

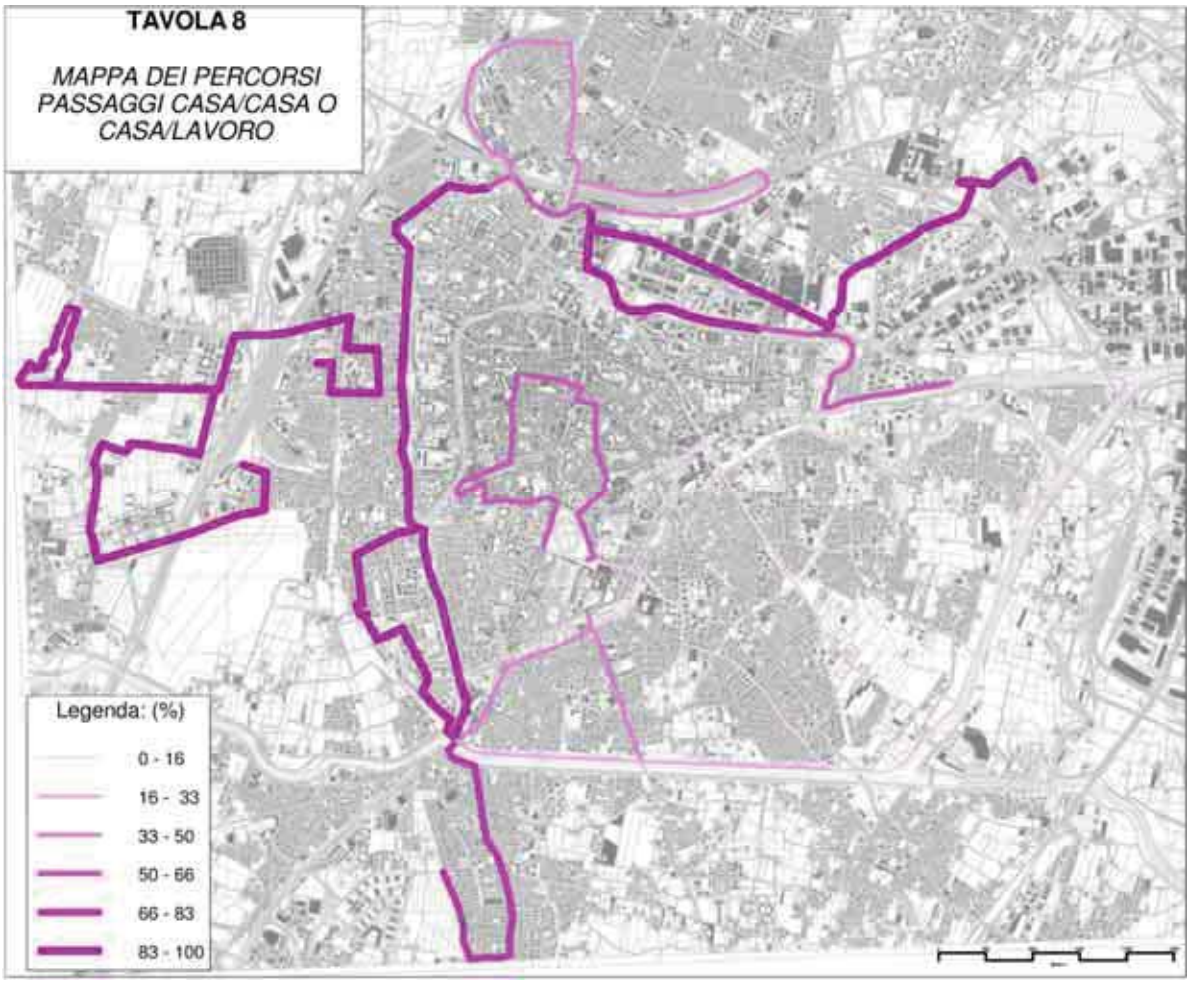

Fig. 3: Tavola 8. Rappresentazione grafica dei passaggi di tipo casa/casa o casa/lavoro. Valori in % sul numero totale di passaggi analizzati per singolo segmento di percorso.

- Densità dei passaggi per singolo percorso (tavola 2). Misura il numero di volte che un determinato tratto di territorio viene percorso da diversi atleti per svolgere l'allenamento. Tale densità aumenta generalmente laddove ci sono aree che mostrano requisiti di sicurezza per il transito pedonale, dotazione di servizi e, molto probabilmente, anche attrazione sociale in quanto l'approccio del *social network* tende proprio ad enfatizzare quelle aree considerate qualitativamente migliori per l'attività specifica. In particolare risulta evidente come i percorsi maggiormente utilizzati sono posizionati lungo le aree verdi che lambiscono le vie d'acqua cittadine attorno alle mura.

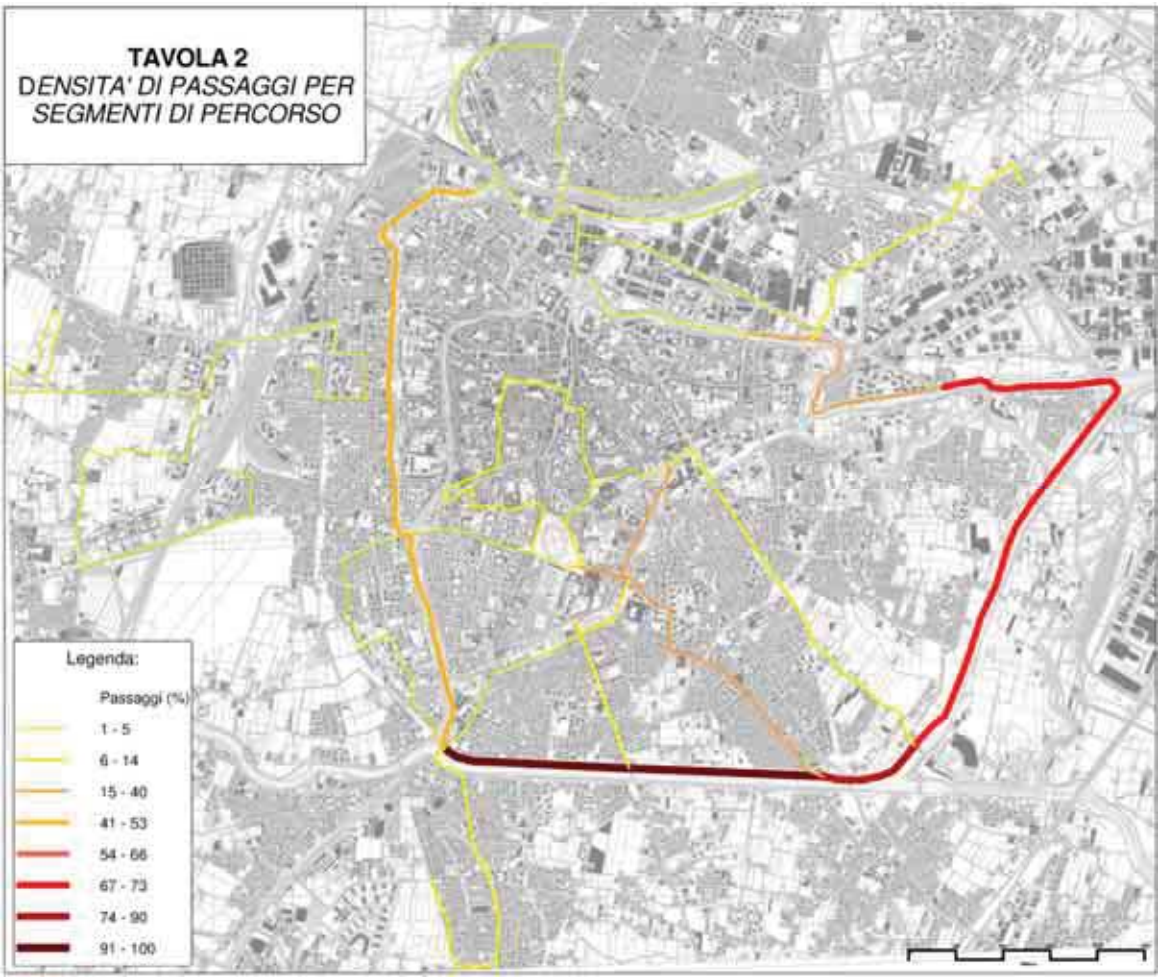

Fig. 4: Tavola 2. Rappresentazione grafica della densità di passaggi per un certo segmento di percorso. Valori in % sul totale dei passaggi analizzati.

- Tipologia del terreno (tavole 3, 4 e 5). Il suolo ideale per l'attività sportiva sicuramente è la terra battuta o lo sterrato, superfici generalmente difficili da trovare in ambito urbano e che quindi necessitano di essere realizzate *ad hoc*. Tali superfici sicuramente garantiscono una minore sollecitazione dei legamenti, che è una condizione ottimale per l'allenamento soprattutto degli amatori. Inoltre, qualora il percorso presenti una pavimentazione di tipo permeabile, essa è generalmente stata realizzata in aree con elevati livelli di naturalità (argini nel caso di studio, ma potrebbero essere anche parchi) che offrono all'atleta una percezione migliore rispetto alla corsa lungo le arterie di comunicazione o in quartieri residenziali marginali. Diversa, molto probabilmente, risulta essere la possibilità di correre all'interno del centro urbano (percorso di Prato della Valle ad esempio), dove la cornice urbana è fonte di emozione.

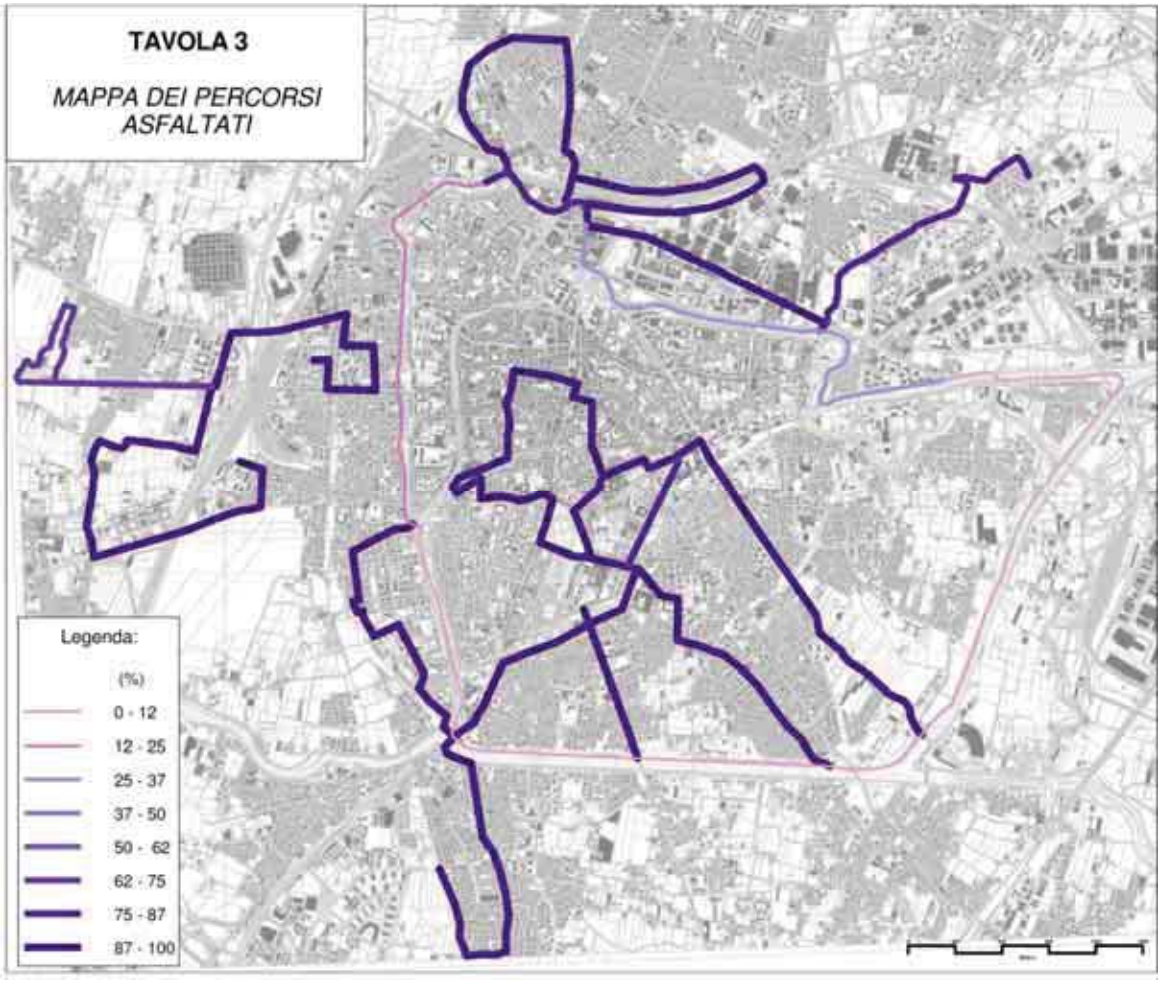

Fig. 5: Tavola 3. Rappresentazione grafica della presenza di zone asfaltate all'interno dei percorsi. Valori in % sul totale della superficie del singolo segmento di percorso.

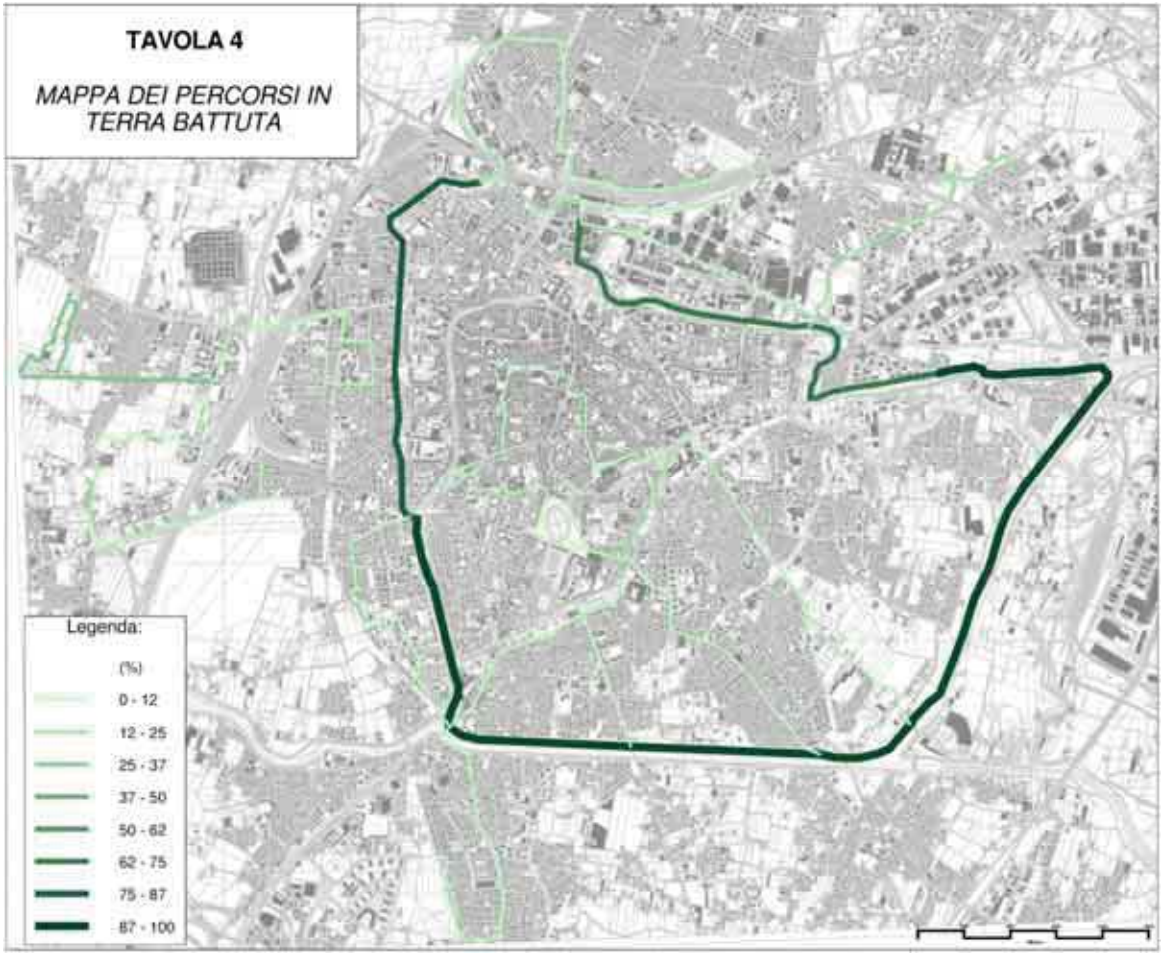

Fig. 6: Tavola 4. Rappresentazione grafica della presenza di zone con terra battuta all'interno dei percorsi. Valori in % sul totale della superficie del singolo segmento di percorso.

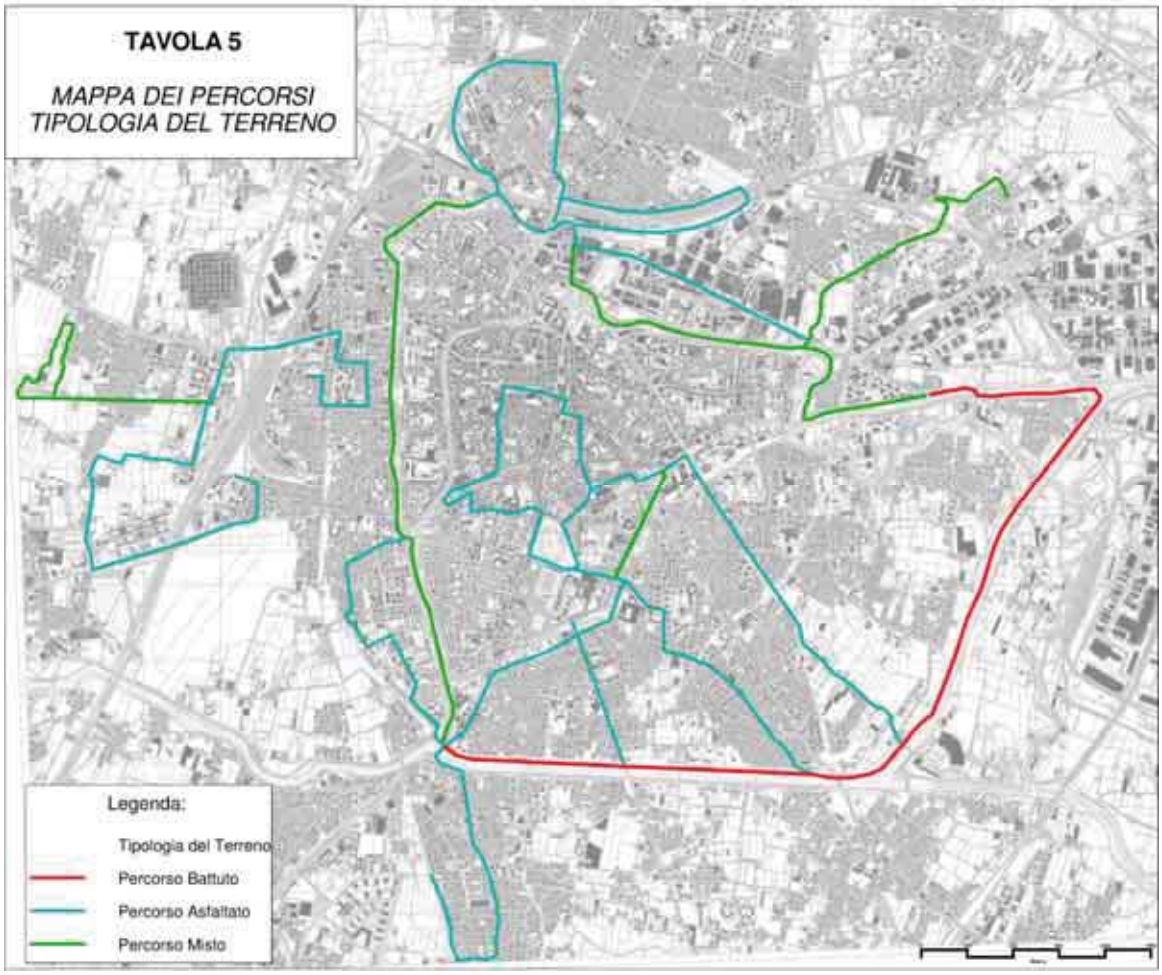

Fig. 7: Tavola 5. Rappresentazione grafica delle tipologie di terreno per ogni segmento di percorso analizzato.

- Rapporto con la struttura urbana. Le osservazioni riguardano principalmente la valutazione della qualità del disegno urbano in relazione allo svolgimento dell'attività sportiva e della dotazione di servizi. I servizi considerati potranno essere di tipo diretto, qualora espressamente realizzati per lo svolgimento dell'attività sportiva (le stazioni dei percorsi vita o le fontanelle ad esempio), od indiretti, se utilizzabili anche per attività non connesse con la sola pratica sportiva (ad esempio i parcheggi o la presenza di chioschi e punti di ristoro). Inoltre è stato possibile svolgere alcune osservazioni circa il rapporto tra la localizzazione del percorso e la destinazione d'uso da Piano Regolatore Generale.

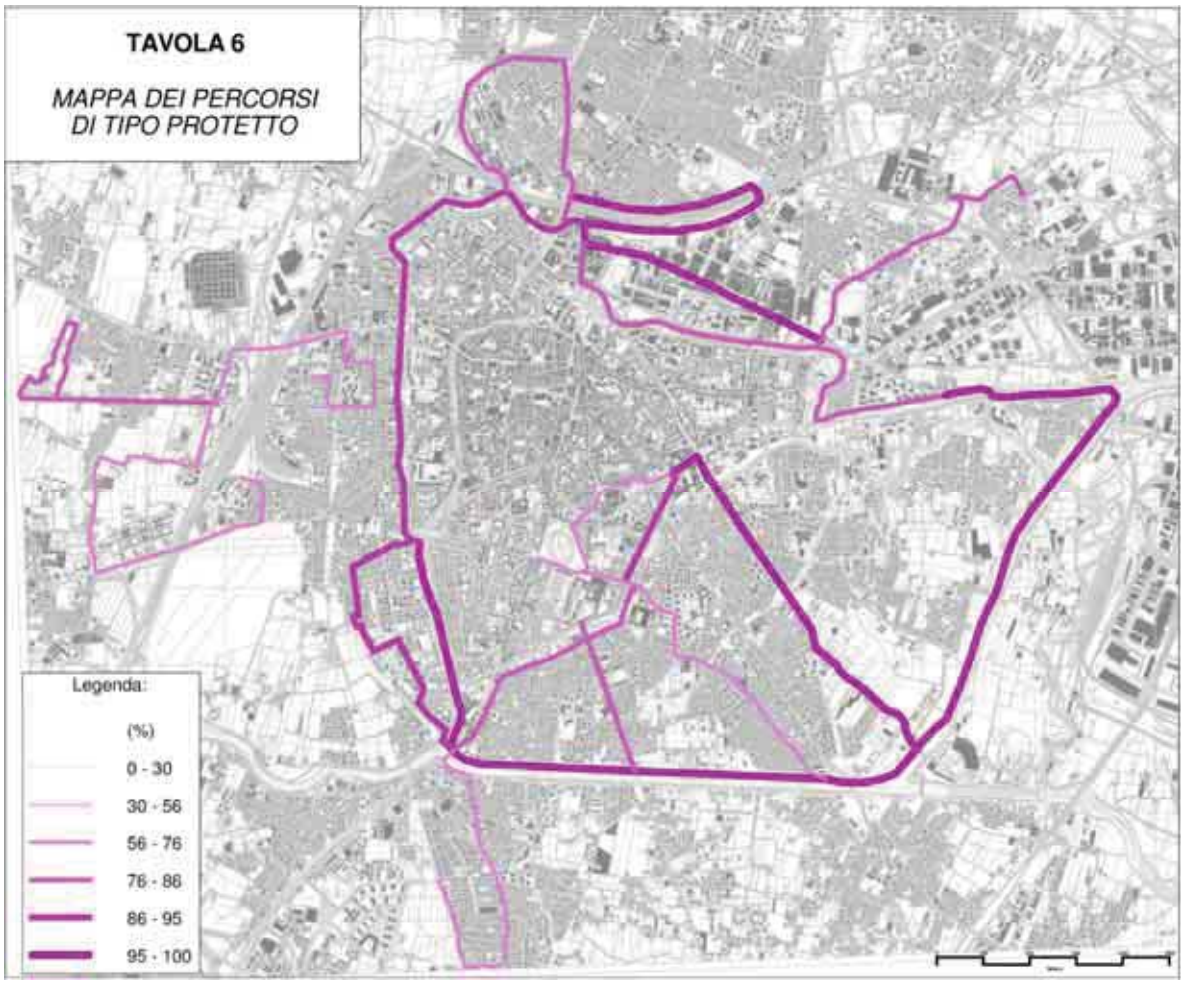

Fig. 8: Tavola 6. Rappresentazione grafica della presenza di zone di tipo *protetto* (percorsi in sede propria). Valori in % sul totale della superficie del singolo segmento di percorso.

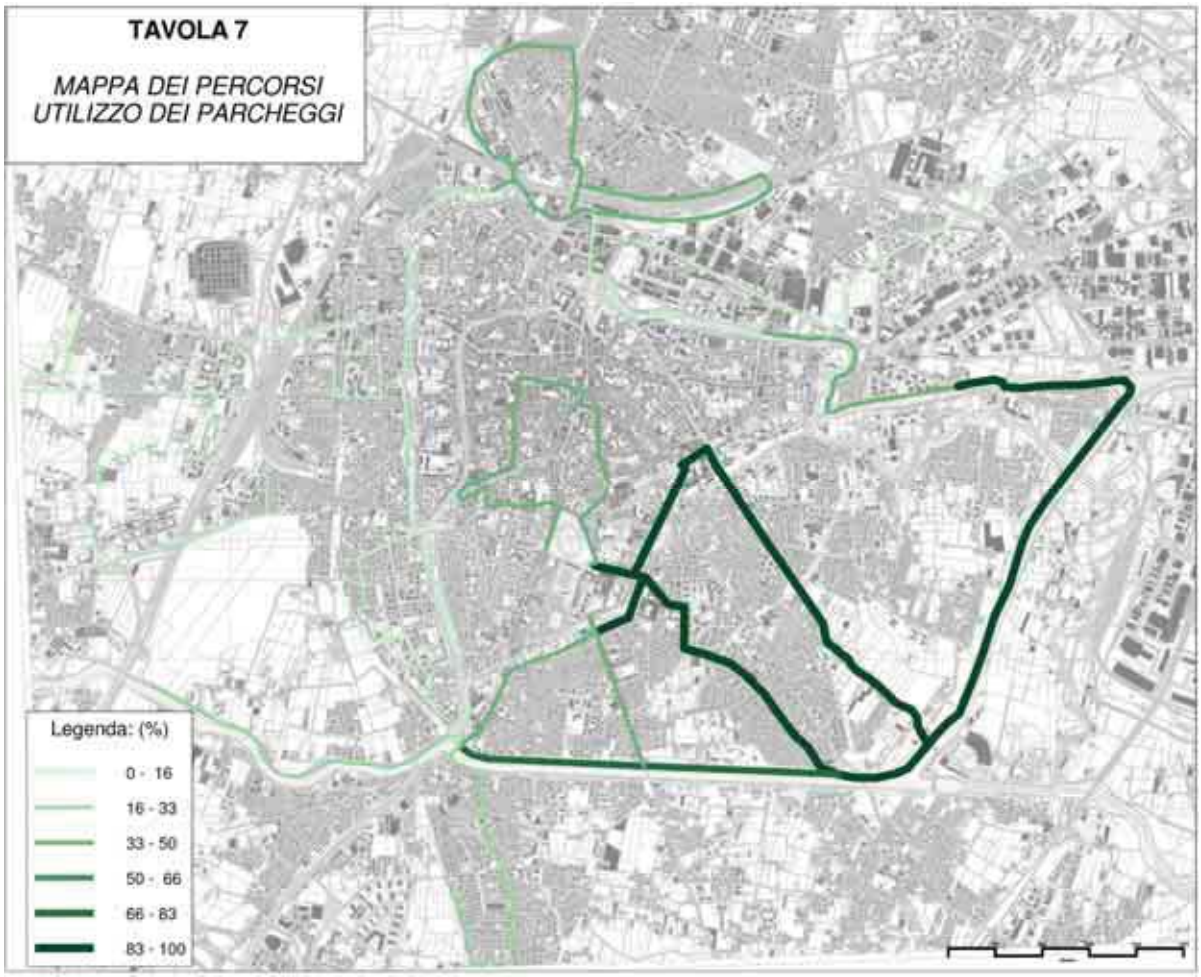

Fig. 9: Tavola 7. Rappresentazione grafica dell'utilizzo di parcheggi di sosta da parte degli utenti. Valori in % sul numero totale di passaggi analizzati per singolo segmento di percorso.

4 LA CITTÀ: I RISULTATI DELLE ANALISI

I risultati ottenuti dall'analisi delle tavole ci mostrano da un lato che la città è riuscita, attraverso degli interventi mirati, a creare delle aree di *attrazione* per l'attività sportiva realizzando dei percorsi protetti, dotati di servizi diretti ed indiretti, in un ambiente che offre un'alta qualità percettiva dal punto di vista ambientale. In quest'area si riscontra la maggior parte dei passaggi anche per chi, eseguendo un percorso circolare, si trova ad inserire questi ambiti nel proprio allenamento solo in parte.

L'area con più passaggi è il lungo argine del Bassanello e di Terranegra, percorso compreso tra le propaggini meridionali della città ed il fiume Piovego. Quest'ultimo funge da margine verso i quartieri residenziali urbani posti a sud del centro. Tale percorso è ben strutturato in quanto offre un'oasi verde/parco lineare all'interno della città, facilmente raggiungibile da aree densamente abitate. Il possibile bacino di utenza, calcolato considerando un *buffer* di 800 metri attorno all'asse del percorso, ci mostra delle aree residenziali ad alta densità e altezza contenuta degli edifici che hanno portato a stimare un bacino potenziale di utenza attorno ai 20.000 abitanti. A questa popolazione insediata, considerato il dato ISTAT[12] sul numero di persone che svolge attività fisica all'aperto all'interno dei centri urbani che è pari all'8,6%, corrisponde quindi un bacino

[12] Op. Cit.

reale di utenza pari a 1720 utenti, oltre alle persone che provengono da zone esterne al buffer di analisi, e che raggiungono i luoghi di attvità tramite mezzi di trasporto (pubblici o privati). Tra i due tratti del percorso arginale quello del Bassanello è più frequentato in quanto compreso tra zone residenziali, mentre il tratto di Terranegra confina da un lato con un quartiere residenziale e dall'altro la zona industriale (tavola 2).

Ad ovest della città sono stati realizzati altri percorsi protetti, ma con frequentazione più limitata. Questi valori sono ampiamente giustificabili dal fatto che la zona non presenta lo stesso grado di servizi di quella precedente: mancano i parcheggi, ad esclusione di quelli a raso dislocati lungo la circonvallazione; sono presenti attraversamenti pedonali critici relativi ad assi viari di penetrazione urbana (SS 11 Vicenza – Padova, SS 250 Colli Euganei – Padova, ecc.); i percorsi sono limitrofi alla circonvallazione interna della città tanto che lo spazio dedicato all'attività sportiva è diviso dalla strada solamente da un filare di alberi; infine l'orientamento non è dei migliori (ovest – nord/ovest rispetto a sud/est del lungo argine Bassanello e Terranegra).

Sempre tra i percorsi attrezzati, ce ne sono alcuni che dal rilevamento virtuale mostrano un'incidenza di utilizzazione notevolmente inferiore perché si spingono verso quartieri (la Zona Industriale Nord di Padova o l'area del Portello, dove però si concentra buona parte delle facoltà scientifiche) non dotati di servizi (innanzitutto posti gratuiti per la sosta delle automobili) e quindi obbligano l'atleta ad allungare il percorso per riuscire a soddisfare l'esigenza di lasciare l'auto in un posto idoneo e sicuro e lo costringono ad attraversare zone di degrado urbano e sociale per giungere al percorso attrezzato.

Altri elementi interessanti risultano essere dei percorsi *a dente,* che penetrano nel tessuto urbano da sud, generano un flusso pari a 1/3 di quello del lungo argine Bassanello e Terranegra. Di fatto sono percorsi in ambiente protetto e in sede propria, che permettono agli utenti una relazione diretta tra centro città ed aree marginali.

Proprio per la conformazione dei percorsi che tendono a penetrare nelle zone con maggiore densità abitativa della prima periferia cittadina e in taluni casi a giungere fino all'interno della città storica, il bacino potenziale di utilizzatori cresce notevolmente e ne consegue anche in questo caso la creazione di percorsi sportivi ad alta densità.

Tutti i percorsi sopra definiti rientrano essenzialmente nella categoria dei percorsi d'area in quanto iniziano e finiscono per lo più in un punto di interscambio modale.

Si tratta di percorsi che risultano essere appetibili per un mix di utenze: i residenti (che raggiungono l'area a piedi o in bicicletta in quanto prossima alla residenza) e gli utenti esterni (i quali ricercano percorsi protetti e inseriti in un contesto naturale oppure la possibilità di incontrare altri utenti, ma che necessitano di parcheggi dove lasciare l'automobile). Tali valori consistenti di utenti non vengono raggiunti in altre zone a causa di una molteplicità di fattori, che spaziano da una minore densità di popolazione residente ad una mancanza di servizi diretti ed indiretti all'attività sportiva fino alla scarsa attrattività dell'area, come, ad esempio, nel caso del quartiere Arcella, dove a fronte di una popolazione attorno ai 40.000 abitanti l'incidenza dei percorsi è molto contenuta.

Tra i percorsi circolari ci sono quelli di Prato della Valle e delle Piazze, in pieno centro urbano, in zone a traffico limitato, ma su fondo meno idoneo per la corsa amatoriale, i quali sono frequentati prevalentemente dai residenti e da utenti esterni che sfruttano i parcheggi di Prato della Valle. Assumono poi rilevanza quelli all'interno del quartiere San Lazzaro (zona residenziale con traffico limitato) e quelli lungo l'arco di Giano, che sfruttano i due nuovi ponti (quello denominato "Ponte Sarpi Dalmazia" ed il "Ponte Verde"), i quali sono attrezzati con spazi protetti ciclo-pedonali. In entrambi i casi, però, si ravvisano una minore qualità percettiva e difficoltà di movimento legata al fatto che i marciapiedi spesso sono parzialmente occupati da auto in sosta, cassonetti, ecc..

Ulteriore spunto di riflessione riguarda il rapporto tra i percorsi rilevati ed i parchi urbani. Infatti questi ultimi non vengono mai toccati dai tracciati scelti dagli atleti molto probabilmente in relazione a diverse motivazioni. Innanzitutto si tratta di aree che vengono chiuse all'imbrunire e quindi offrono una fruibilità limitata visto che la maggior parte delle attività viene svolta ad attività lavorativa conclusa; sono poi posizionati in prossimità dei percorsi, ma non li intersecano mai, costringendo eventualmente ad una deviazione per il loro raggiungimento; infine i parchi non sono dotati di elementi di attrazione (chioschi, fontanelle, attrezzi per lo stretching, ecc.) che potrebbero interessare il podista.

Da quanto descritto emerge che la sicurezza nello svolgimento dell'attività sportiva è elemento di forte attrazione e qualificazione del luogo, oltre che principio chiave secondo il quale vengono scelti i percorsi. Questa conclusione, peraltro prevedibile, mostra però come sia necessario molto spesso dover raggiungere le aree in oggetto utilizzando un mezzo di trasporto, l'auto, per la quale raramente sono previsti idonei spazi di sosta tanto che queste vengono *abbandonate* lungo strade secondarie. La mancanza di una rete sufficientemente capillare di percorsi protetti all'interno dello spazio urbano costringe così il cittadino/atleta ad utilizzare l'automobile anche per svolgere l'attività sportiva, diventando così generatore di traffico e di inquinamento.

Tra gli elementi che è possibile integrare con il sistema dei percorsi ci sono i parchi, che sono una risorsa all'interno della città e potrebbero diventare una sorta di nodo di servizio, restituendoli così alla città attraverso un processo di utilizzazione/salvaguardia.

Attraverso un monitoraggio più lungo che garantisca una casistica più articolata, comprendente sia atleti occasionali che coloro che si trovano in città per turismo o lavoro, ed attraverso un approfondimento sulla lunghezza/tempo di percorrenza, sarà possibile pervenire ad una mappa virtuale per migliorare e definire gli interventi di pianificazione spaziale, dettagliando aspetti quali il rapporto tra localizzazione dei percorsi e densità urbana, destinazioni d'uso, permeabilità dell'insediamento (un reticolo denso di strade disperde il traffico e rende la mobilità dolce più piacevole oltre a facilitare gli attraversamenti, ma, allo stesso tempo, poche strade consentono di avere percorsi protetti più lunghi), continuità dei percorsi, caratterizzazione degli attraversamenti e degli elementi di separazione e protezione, presenza di nodi di servizio.

Emergono, dalle analisi svolte e dalle osservazioni desunte, due differenti scale nella progettazione dello spazio urbano connesso con l'attività sportiva.

La prima, a livello macro ossia di intero sistema urbano, è rivolta alla realizzazione di una rete di percorsi che, racchiudendo il centro della città all'interno di una sorta di anello verde, si diffonde nei quartieri marginali attraverso delle dita verdi che fungono da veri e propri assi di penetrazione rivolti allo svolgimento di attività sportiva o per la mobilità dolce. Nel caso di Padova l'anello attorno alla città dovrebbe coincidere con il sistema delle mura bastionate che, per la loro conformazione, rappresentano un'occasione di valorizzazione del bene culturale attraverso una sua riscoperta ed utilizzazione. Il sistema degli assi che si irradiano verso i quartieri potrebbe poi essere sostenuto attraverso la valorizzazione degli argini della fitta rete di corsi d'acqua che caratterizzano il territorio padovano. Laddove questi non sono presenti, si potrà ricorrere alla progettazione di percorsi pedonali protetti caratterizzati da continuità, intersezione con spazi pubblici con differenti destinazioni d'uso, con attraversamenti delle strade protetti e segnalati dalla presenza di alberature o siepi. In questa maniera sarebbe possibile perseguire sia una maggiore sostenibilità degli spazi urbani che una loro qualificazione percettiva. A questa scala dovranno riferirsi anche le dotazioni di servizi diretti ed indiretti definiti precedentemente. La scala territoriale richiede un approccio sostanzialmente indiretto, ovvero mediato completamente dalla tecnologia sia nella mappatura del territorio che nell'individuazione dei percorsi maggiormente significativi e funzionali alle necessità espresse attraverso l'utilizzazione degli spazi da parte della popolazione.

La seconda, a livello di dettaglio, dovrebbe corrispondere alla caratterizzazione dello spazio urbano attraverso i suoi elementi di qualificazione come l'arredo, la sua disposizione all'interno dello spazio urbano, la dotazione di servizi complementari, la valorizzazione degli elementi identificanti il luogo, la corretta scelta delle tipologie arboree in maniera tale da garantire l'ombreggiamento, una facile manutenzione e il miglior assorbimento della CO_2. Questa seconda scala invece dovrà essere affrontata attraverso un approccio indiretto, rivolto ancora una volta alla mappatura del territorio attraverso la raccolta di parametri misurabili univocamente (numero delle alberature, delle panchine, distanza tra i servizi, ecc.) ed uno diretto, partecipato, ovvero l'espressione da parte dell'utente di un giudizio di qualità per ciascuna tipologia di spazio pubblico e per precise variabili qualitative così da consentire la comparazione tra i giudizi. Lo spazio per la partecipazione potrà essere proprio la *community,* che viene a rappresentare una sorta di piazza virtuale oltre che un luogo di aggregazione e scambio di informazioni e suggestioni.

5 OSSERVAZIONI CONCLUSIVE

A conclusione dell'esperienza effettuata è possibile svolgere alcune riflessioni circa il ruolo della *smart city* all'interno del futuro delle nostre città.

La prima riguarda innanzitutto il ruolo delle informazioni nella gestione e pianificazione dello spazio urbano. La diffusione della tecnologia consente infatti di raccogliere e valutare una moltitudine di informazioni che possono consentire di individuare *just in time* le migliori scelte/strategie volte alla gestione/trasformazione dello spazio urbano. Tali informazioni sono fortemente differenziate e supportano direttamente e/o indirettamente la definizione delle politiche, sottolineando la necessità di un approccio olistico al tema della pianificazione.

Il secondo ci mostra ancora una volta che, pur a fronte di continui processi di innovazione tecnologica, non può esserci città senza la città, ovvero non può esserci innovazione se si perde la centralità dell'uomo e dello spazio nelle valutazioni e nelle scelte strategiche e progettuali. Questo ci porta a considerare che forse la *smart city* non è altro che una proiezione tecnologicamente innovata della città storicamente consolidata. Infatti le considerazioni che emergono dall'esperienza di studio svolta ci mostrano come l'intelligenza della città dipenda più dalla possibilità di raccogliere, verificare e valutare delle informazioni e di creare delle interazioni tra gli individui che dal modo con cui queste vengono svolte. In tal senso Kevin Lynch[13] aveva sottolineato la relazione fondamentale tra conoscenze umane e forma urbana espressa attraverso delle mappe che ciascuno di noi crea nella propria testa. Queste mappe mentali, insieme con i punti di riferimento e con le delimitazioni che permettono l'orientamento nel tessuto urbano, rappresentano ciò che rende la città familiare e comprensibile. Oggi, però, queste mappe sono sostituite da strumenti artificiali per orientarci nel tessuto urbano, per captare ed elaborare la conoscenza di ciò che ci circonda e per portarci dove vogliamo andare e la città è famigliare a tutti.

A fronte perciò della maggiore complessità delle relazioni sottese dalle attuali configurazioni delle reti sociali e dello spazio urbano è necessaria una capacità computazionale più elevata e capace di cogliere e leggere aspetti che prima non erano presenti o che non erano raccoglibili. Infatti ai fini sociali un gruppo di persone, affinché possa interagire, non è necessario che operi a contatto fisico, ma quel che conta è che le interazioni e le azioni che in quel gruppo si producono generino nuove conoscenze e informazioni e producano effetti concreti sulla società e sullo spazio, sia che esse siano dirette che indirette. Inoltre non assumono importanza il modo e il mezzo con cui avvengono.

[13] K. Lynch (1964), L'immagine della città, Venezia, Marsilio.

In ogni momento della storia la città è stata il luogo di incontro di flussi di cose, persone, informazioni in relazione alle attività che in essa venivano svolte, quali il mercato, la produzione, la politica, la costruzione dello spazio pubblico. Tutte queste attività venivano svolte in spazi ben precisi come la piazza, il mercato, l'area industriale, ecc.. Con l'avvento della tecnologia essi non vengono necessariamente sostituiti dalla virtualità e dall'incorporeità in quanto pur nell'aumentata complessità le scelte rimangono riferite alla realtà fisica.

Oggi come oggi si tratta quindi di *"... ridefinire la città come un'ecologia di circostanze, come un ordinamento di incertezze capace di produrre linee di potere e come un'arena politica ricca di potenzialità che possono essere mobilitate per competere e per affrontare i problemi. Stiamo cercando di ridisegnare la mappa della città cercando di mettere nuovi canali per l'acquisizione (o la non acquisizione) di poteri. Questo comporta la rappresentazione di spazialità che oltrepassino i vecchi stereotipi territoriali, in cui una scala si interseca o si impila dentro l'altra."*[14]

A cambiare è il concetto di relazione che diventa multidimensionale. Con ciò si intende che alla gestione/pianificazione dello spazio urbano partecipano porzioni sempre più ampie di popolazione con aspettative fortemente differenziate tanto che le stesse, in mancanza proprio di un approccio olistico, rischiano di favorire interventi slegati creando uno spazio urbano *patchwork* di necessità e rappresentazioni.

La forma dell'aggregazione e la dimensione delle relazioni cambieranno in funzione del tema specifico trattato. Si tratta quindi di saper individuare le categorie analitiche corrette, le quali necessariamente devono essere messe in gioco al fine di giungere e di comprendere quali siano le categorie sociali coinvolte o coinvolgibili nel progetto dello spazio urbano e quale sia la configurazione spaziale che meglio soddisfi la molteplicità delle esigenze.

La *smart city* diventa così la città della gente la quale può esprimere le opinioni sull'organizzazione spaziale secondo sistemi di valori che superano, quelli sì, la scala dei valori locali. Categorie diverse con istanze diverse possono essere coinvolte nel processo e le valutazioni possono godere di informazioni che un tempo avrebbero richiesto onerose ricerche ed oggi sono disponibili facilmente.

Quello che però può venire a mancare è il rapporto tra l'immediatezza dell'informazione e la capacità del luogo di adattarsi alle mutate necessità. I tempi della città sono infatti tempi lunghi, dettati da una struttura complessa di governo urbano e di trasformazioni fisiche che richiedono iter di attuazione lunghi e difficoltosi. Forse proprio l'integrazione della valutazione dei tempi necessari per intervenire nei diversi aspetti funzionali e fisici della città potrebbe diventare un indicatore per la *smart city* del futuro (dove essere *smart* o intelligente sta nella capacità di dare priorità ed attuazione alle richieste di trasformazione), proiettando le informazioni *ex ante* nella dimensione attuativa e del monitoraggio *ex post* delle trasformazioni al fine di mantenerle adeguate al continuo divenire delle esigenze.

[14] Cit: A. Amin, N. Thrift (2005), *Città. Ripensare la dimensione urbana*, il Mulino, Bologna, p. 115.

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IMAGES SOURCES

Fig. 0 in copertina: percorso arginale protetto ciclo pedonale a ridosso della Zona Industriale Nord di Padova (foto Filippo Ghelli).

Fig. 10: Tavola 1. Rappresentazione grafica dei percorsi analizzati e delle invarianti.

Fig. 11: Tavola 1/A. Rappresentazione grafica delle tipologie dei percorsi analizzati.

Fig. 3: Tavola 8. Rappresentazione grafica dei passaggi di tipo casa/casa o casa/lavoro. Valori in % sul numero totale di passaggi analizzati per singolo segmento di percorso.

Fig. 4: Tavola 2. Rappresentazione grafica della densità di passaggi per un certo segmento di percorso. Valori in % sul totale dei passaggi analizzati.

Fig. 5: Tavola 3. Rappresentazione grafica della presenza di zone asfaltate all'interno dei percorsi. Valori in % sul totale della superficie del singolo segmento di percorso.

Fig. 6: Tavola 4. Rappresentazione grafica della presenza di zone con terra battuta all'interno dei percorsi. Valori in % sul totale della superficie del singolo segmento di percorso.

Fig. 7: Tavola 5. Rappresentazione grafica delle tipologie di terreno per ogni segmento di percorso analizzato.

Fig. 8: Tavola 6. Rappresentazione grafica della presenza di zone di tipo *protetto* (percorsi in sede propria). Valori in % sul totale della superficie del singolo segmento di percorso.

Fig. 9: Tavola 7. Rappresentazione grafica dell'utilizzo di parcheggi di sosta da parte degli utenti. Valori in % sul numero totale di passaggi analizzati per singolo segmento di percorso.

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MODELING THE TRAVEL BEHAVIOR IMPACTS OF MICRO-SCALE LAND USE AND SOCIO-ECONOMIC FACTORS

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ABSTRACT

The effects of neighbourhood-level land use characteristics on urban travel behaviour of Iranian cities are under-researched. The present paper examines such influences in a microscopic scale. In this study the role of socio-economic factors is also studies and compared to that of urban form. Two case-study neighbourhoods in west of Tehran are selected and considered, first of which is a centralized and compact neighbourhood and the other is a sprawled and centreless one. A Multinomial Logit Regression model is developed to consider the effects of socio-economic and land use factors on urban travel pattern. In addition, to consider the effective factors, cross-sectional comparison between the influences of local accessibility and attractiveness of the neighbourhoodcentres of the two case-study areas are undertaken. Also the causality relationships are considered according to the findings of the survey. The findings indicate significant effects of age and household income as socio-economic factors on transportation mode choice in neighbourhoods with central structure. One the other hand, no meaningful association between socio-economic or land use variables are resulted by the model for the sprawled case. The most effective land use concept in micro-scale is considered to be satisfaction of entertainment facilities of the neighbourhood. Also the descriptive findings show that the centralized neighbourhood that gives more local accessibility to shops and retail generates less shopping trips. In considering the causal relations, the study shows that providing neighbourhood infrastructures that increase or ease the accessibility to neighbourhood amenities can lead to higher shares of sustainable transportation modes like walking, biking, or public transportation use.
KEYWORDS:
LUTI, sustainable urban form, travel behaviour, Multinomial Logit Model, Iran.

1 INTRODUCTION

In contrast to the sprawled patterns, the sustainable urban forms like compact developments have been claimed to have the capabilities to decrease car dependence and improve sustainable transportation (Cervero, Radisch, 1995; Khattak, Stone, 2003; Khattak, Rodriguez, 2005). To find the relations between the built environment and the travel behaviour, different aspects of the urban form have been examined. Density has been one of the urban form factors that have gained great attention. Large amount of research has been done on the effects of density (Pushkarev, Zupan, 1977; Holtaclaw, 1990, 1994, 2002; Cervero, Kockelman, 1997; Greenwald, Boarnet, 2001), land use mix (Hare, 1993; Ewing et al. 1994; Cervero, Radisch, 1995) and design (Kitamura et al. 1994). Such studies cover a wide range from region and city scale to neighbourhood. A number of researches related to this subject is done in neighbourhood scale (micro) and include a general topic of design. These studies consider the role of neighbourhood attitudes, neighbourhood street structure, sidewalks quality and design, bike routes, walkable distances, etc. on local travels (Ryan, McNally, 1995; Crane, 1996; Plaut, Boarnet, 2003). Although in 1993 Cervero had come to the conclusion that the micro-factors like travel costs and density are more effective than the micro-factors like design, but the number of studies that give better understanding of how and in what scale can design influence travel have increased during the recent years. For example Handy (1993) found the possibilities of neighbourhoods to increase walking trips while the trip lengths to other places in the city would not be affected. Another study of this kind is done by Crane and Crepeau (1998), who showed that fewer car trips are generated by neighbourhoods with special design concepts like high street connectivity. However they emphasize that the role of land use in micro scale is little.

The present paper investigates the above effects of land use and also socio-economic trends in the context of Iranian cities. Most of the existing literature about this subject comes from North America, Australia and Western Europe. The volume of similar studies on the Middle Eastern cities is very small and does not let decision making based on scientifically demonstrated conclusions that show what can make urban transportation more sustainable. The limited research that has been done about the Iranian cities shows that the socio-economic issues are of special importance in defining the travel behaviour. This has been discussed in city and regional level (Arabani, Amani, 2007; Soltani, Zamiri, 2011; Mirmoghtadaee, 2012; Shokoohi et al, 2012) and on zone/district level (Soltani, Esmaeili-Ivaki, 2011; Soltani et al. 2012). However the smallest scale, which is the neighbourhood level, has gained the least attention. It is not exactly known if the Iranian neighbourhood, which has strong roots in the traditional Iranian urbanism has capabilities of promoting sustainable mobility. Developing such studies can connect the Iranian studies to the international research going on about local accessibility and its advantages for sustainable mobility.

During the past decade the Iranian city has experienced inclusive transformations. After 1930s the city form was changed to let cars move freely in the texture of the cities. Therefore the compact cities were cut through to construct streets. The result was that the bazaars, neighbourhoods and their centers lost importance and instead the streets become the destination of urban travels (Masoumi, 2012a). Consideration of the physical form of the traditional neighbourhood shows that it had a distinct center with local public facilities within the walking distance of the houses (Masoumi, 2013a). Nonetheless the urban transformations of after 1970 and 1980 have led to urban sprawl that has made the destinations far away. The automobile-oriented planning has changed the form of the cities, especially in the peri-urban areas (Masoumi, 2012b). The centralized form that is explored in the traditional neighbourhood is not any more seen in the modern quarters. The basic difference is lack of powerful local centers that draw the urban trips to themselves. The most influential qualities of such neighbourhood centers are attractiveness and accessibility. Theoretically, it seems that people must be eager to walk to attractive public spaces and

facilities that are located in the vicinity of their houses. This accessibility is satisfied in the neighbourhood scale, when there is a reasonable level of centrality of facilities like retail, shops, grocery stores, urban parks and green spaces, open spaces, etc.

The present paper attempts to measure the above in District 5 of Tehran. The main questions meant to be answered are 1) Which measures are more important in defining the travel behaviour circumstances? The socio-economic factors or land use and design?; 2) Is there any usable differences in the land use and form of centralized neighbourhoods that have a center to promote sustainable transportation? 3) What causality relationships are there between land use and mode choice of the home-based urban travels?

To answer the mentioned questions, firstly the methodology including case-study areas, survey and sampling, and modelling are described. Then findings comprised of descriptive analysis, mode choice, and causality relationships are explained. Finally the concluding remarks are presented.

2 METHODOLOGY

The study employs empirical research methods to explore the differences in travel habits in the two selected neighbourhood types. The observation also has a comparative nature. Two neighbourhoods are selected; one represents the centralized compact neighbourhoods with a distinct center (Keyhan) and the other neighbourhood is an example of sprawled quarters located on the periphery of many Iranian cities (Bahar). The urban forms of the selected areas are meaningfully different. Cross-sectional analysis is conducted on the travel behaviour, demographic and socio-economic factors and the attitudes of people in the two neighbourhoods.

2.1 CASE-STUDY NEIGHBORHOODS

Both neighbourhoods are located in Region 5 of Tehran in west and north-western part of the city (Fig. 1). The distance between the borders of the neighbourhoods is about 500 meters. In 2006, Region 5 had a total population of 677085 people accommodated in 5287.1 hectares. That makes a gross population density of 128.1 persons/hectare and net population density of 162.1 persons/hectare. The dominant land use of the region is residential use which makes 26.4 per cent of the whole lands. Other large uses are street networks and open spaces with 20.7 per cent, unbuilt lands with 16.5 per cent, gardens with 9.8 per cent and green space with 9.6 per cent. The region includes 7 zones and 27 neighbourhoods (Tehran Master Plan, 2006).

The definition of neighborhood in the master plan is different from the one that is applied in this paper. In this study, the traditional area, size, arrangement of neighborhood units is taken as the standard neighborhood form. The best way to define the neighborhood boundaries is based on the perceptions of people. According to a recent study, the traditional Iranian city consisted of a number of neighborhoods and neighborhood units. The neighborhood units had an area of less than 30 or in larger cases 35 hectares (Masoumi, 2013a). In contrast, the administrative divisions of the Iranian cities are based on regions and zones. Recently neighborhoods are added to this division system, but the areas of such neighborhoods are so large that they are often not human-scaled. They lack a unique center and the distances are not walkable. To make a comparison between the travel behaviors generated by the centrally-structured, compact neighborhoods with the sprawled ones, it is not meaningful to use the administrative boundaries of the neighborhoods, because they are so large that the pedestrian mobility is not significant. Instead two small areas as large as the traditional neighborhood units are selected.

Keyhan presents the traditional form of neighbourhood units. Although it is not old but it has apparently a center with a local urban park including playground for children and a number of local shops including grocery stores, fruit shop, barber, etc. Also the situation of the houses is in a way that the

neighbourhoodhas a compact formation. The form of the selected area is in accordance with the traditional units that are comprised of about 300 buildings in small areas that let the residents access the Neighbourhood Unit Centers' (NUC) facilities easily. The short way to the center of the traditional neighbourhood units provides walkable distances that are mainly less than 670 meters (Masoumi, 2013a). The same is seen in Keyhan. The distance between the farthest houses of Keyhan to the center is 540 meters calculated on a street network basis.

Bahar is a neighbourhood that represents dispersed and sprawled urban patterns that have emerged in Iranian cities during the past four decades. Leapfrog development is seen in the development pattern of Bahar. This urban pattern is a basic characteristic of Iranian urban sprawl along with lack of public open spaces, less compact form, and low density (Masoumi, 2012b). In large and medium-sized Iranian cities, the density of recently built quarters is less than the city centers and the historical cores (Masoumi, 2013b). In other words when the distance of the quarters with the city center increases, the population density drops. Another specification of Bahar that exemplifies the sprawling areas is lack or dispersal of local public facilities like retail. The shops found in Bahar are not located centrally so it does not give the visitor the impression that the neighbourhood has a center.

The two selected areas have similarities that make the comparison meaningful. Firstly, the areas are both about 35 hectares. Secondly the distance between the areas are so short that the socio-economic factors such as household income, car ownership, household size, education, etc. are more or less alike. Thirdly, accessibility to public transportation and other transportation infrastructure like highways and main streets are in the same level. Finally, the distance to the central city of Tehran is the same.

Fig. 1– Tehran and the location of the observation areas within the urban context

Fig. 2 - Location of Keyhanand Bahar in Region 5 of Tehran

Fig. 3 The Bahar and Keyhan areas, with the location of the KeyhanNeighborhood Center. Lack of public spaces and neighborhood amenities is notable inBahar.

Fig. 4 There is an urban park in Keyhan neighborhood (left). A highway with bus lines passes from the north of Bahar(right).

2.2 SURVEY AND SAMPLING

This paper shows the results of an empirical comparison between the travel attitudes of residents of the two mentioned neighbourhoods. A survey was conducted in autumn 2012 by face-to-face interviews with the residents. Based on the interviews the questionnaires were filled out by the interviewers. The sample number was calculated according to Cochran (1963, 75):

$$\mathrm{n}_0 = {z^2 pq}/{e^2} \quad (1)$$

The above is used to define the sample size, where Z^2 is the abscissa of the normal curve, p is the estimated proportion of an attribute, e is the level of precision which is here taken as 10%, and finally q is equal to 1-p. The result is adjusted by the following relation

$$n = {n_0}\Big/{1 + \frac{(n_0 - 1)}{N}} \quad (2)$$

Whereas n is the sample size. Since the data derived from the detailed plan of Tehran is based on the administrative neighbourhoods and this study uses smaller areas, it was not possible to apply the existing neighbourhood populations. Therefore the number of buildings, the average residential units per building, and the household size were applied to calculate the case-study neighborhood population. There is 600 buildings in Keyhan and 400 in Bahar. The household size of Region 5 in the year 2011 has been 3.37 persons. Assuming 9 residential units per building for Keyhan and 7 for Bahar, the neighbourhood population will be 18,000 and 9,500 persons in Keyhan and Bahar respectively (N). For precision of ±10%, the sample size should be 95.53 for Keyhan and 95.09 for Bahar. As a result 96 questionnaires were filled out for each of the neighbourhoods.

2.3 MODELING

As a discrete choice model approach, Multinomial Logit Regression modeling (MNL) is applied to examine the transportation mode choice decisions of the interviewees. This type of modeling is selected because of its capabilities for analysing personal choices that are not in relation with each other. The effects of socio-economies and urban form characteristics on mode choice are investigated. It is also meant to compare these effects in the two selected neighbourhoods. In general 7 explanatory variables are tested. Five socio-economic measures including, age, household income, gender, owning a driving license, and household car ownership are analysed as explanatory variables. Two independent variables representing neighbourhood amenities are evaluation of neighbourhood retail and public space as well as satisfaction of neighbourhood entertainment facilities. All the mentioned independent variables are employed as categorical variables.

Socio-economic characteristics: gender, holding a driving license, and household car ownership are defined as dummy values. Age is a basic social specification that is distributed into 5 categories. Another seemingly influential factor is household income. A 6-point scale is used to show the amounts. The respondents have been asked if the monthly income of their family lies in “no income”, “less than 11,000,000 Rials”, “11,000,000-17,000,000 Rials”, “17,000,000-22,500,000 Rials”, 22,500,000-33,500,000 Rials”, or “more than 33,500,000”.

The land use factors that are discussed here are the ones that are in relation with what the residents perceive about the attractiveness of the neighbourhood retail, shops, entertainment facilities of the neighbourhoods, etc. They were asked about their evaluation of the quality of their neighbourhood shops and public spaces on a 5-point scale including “very weak”, “insufficient”, “average”, “good”, and “very good”. They were also asked about their evaluation of the entertainment facilities of their neighbourhood. They answered the question by selecting among “not satisfied at all”, “not satisfied”, “average”, “satisfied”, and “very satisfied”. The above data were applied to the MNL model to indicate differences in the two case-study neighbourhoods.

3 FINDINGS

3.1 DESCRIPTIVE ANALYSIS

Keyhan and Bahar have been selected in a way that there are large similarities between their socio-economic characteristics. The average age, daily activity pattern, and car ownership rates are largely alike in Keyhan and Bahar. The female interviewees in Keyhan have been more than in Bahar. However the effects of the difference in gender ratios do not have any important effect on the daily activity (p-value= 0.313). As seen in Table 1, although 57 % of the respondents of Keyhan are women (compared to 36 % in Bahar), but difference in the percentage of working individual in the two neighborhoods is only 2 %. Also the household income in Keyhan is slightly more, but the difference is negligible because no significant difference is seen (p-value= 0.509). Table 1 shows the findings of the survey in section 1 of the questionnaires.

PERSONAL AND HOUSEHOLD CHARACTERISTICS	KEYHAN (N = 96)	BAHAR (N = 96)	p-VALUE
Gender			
Female	57 (59.4%)	36 (37.5%)	0.313
Male	39 (40.6%)	60 (62.5%)	
Age			
Mean	34.86	35.80	
Min	18	20	
Max	64	62	
Standard deviation	10.21	9.59	
Daily activity			
Work	71 (74.7%)	73 (76%)	0.509
Education	12 (12.6%)	7 (7.3%)	for “working”
Work at home	12 (12.6%)	16 (16.7%)	
Car ownership			
Own driving license	86 (89.6%)	80 (84.2%)	0.612
Personally own a car	39 (40.6%)	43 (44.8%)	0.846
The family owns a car	74 (77.1%)	66 (68.8%)	0.412
Household income			
No income	0 (0%)	0 (0%)	
< 1,100,000s Rials[1]	28 (29%)	37 (39%)	
11,000,000-17,000,.000 Rials	39 (41%)	41 (44%)	0.288
17,000,000-22,500,000 Rials	16 (17%)	14 (15%)	
22,500,000-33.500,000 Rials	11 (11%)	2 (2%)	
>33,500,000 Rials	2 (2%)	0 (0%)	

Tab.1 - Key socio-economic characteristics in the two neighbourhoods

1 Rial is the official currency of Iran. One US Dollar was unofficially equal to 40.000 Rials on 2 Feb. 2013. In 2012 and 2013, due to political conflicts the conversion rate of Rial to other currencies has fallen rapidly and remained unstable. Therefore the reader probably cannot use the above conversion rate in the time of reading this paper.

Compared to 82.3% in Bahar, 85.3% of residents of Keyhan commute to their work or education place in a daily manner. While the number of people who commute daily as well as the share of public transport modes and slow modes are similar in the two neighborhoods, car use of Keyhan is 10 % more. Most of the people who drive to work place from both areas use cars because of more comfort, safety and security. Among the 192 people who were interviewed, no one commutes by bike. The time duration of commute travels do not show any significant difference. The main reason can be the similar distance to the central parts of Tehran that contains most of the employment centers and jobs.

The centralized local shops of Keyhan and the dispersed ones in Bahar equally attract shoppers. No difference is seen in the mode choice of either neighborhood level non-commute travels or travels to outside. The dominance of personal cars in non-work travels to outside of the neighborhoods is obvious (54.8% for Keyhan and 55.7% for Bahar). The important point is that the public space and neighborhood amenities are more attractive for the residents of Keyhan (64.6%) compared to those of Bahar (51.6%). The satisfaction of the people from the shops and public spaces of their neighborhood is also tested in another way, which shows they are more pleased in Keyhan. 60 % of the respondents of Kayhan evaluate the shops and open spaces of that neighborhood as very good or good, while the same figure is 32.3% for Bahar.

The results of the survey indicate a uniform attitude about public transportation use in the two neighborhoods. The most apparent difference is about the negative effect of poor accessibility on public transportation use. 33.3% of the respondents of Bahar have declared that the main reason for not using public transportation is “Little accessibility to stations, long distance between the stations”, while only 20.4% have given such an answer in Keyhan (Table 2) .

PUBLIC TRANSPORT USE CHARACTERISTICS	KEYHAN	BAHAR	P-VALUE
Number of times of public transport use			
Every day	30 (31.3%)	38 (39.6%)	0.0014
A couple of times per week	12 (12.5%)	12 (12.5%)	
A couple of times per month	17 (17.7%)	17 (17.7%)	
Seldom	31 (32.3%)	28 (29.2%)	
Never	6 (6.2%)	1 (1%)	
The main reason for public transportation use			
It is cheaper	12 (24.5%)	16 (30.8%)	
It is faster	20 (40.8%)	18 (34.6%)	
It is safe and secure	6 (12.2%)	5 (9.6%)	
It is more comfortable	3 (6.1%)	6 (11.5%)	
Because of no access to car	8 (16.4%)	7 (13.5%)	
The main reason for not using public transportation			
It is not comfortable	20 (40.8%)	17 (37.8%)	
It is expensive	4 (8.2%)	4 (8.9%)	
Little accessibility to stations, long distance between the stations	10 (20.4%)	15 (33.3%)	
No access to public transportation at all	8 (16.3%)	8 (17.8%)	
Because of social and cultural problems	7 (14.3%)	1 (2.2%)	
Public transportation system privileged			
Metro	33 (35.5%)	31 (34.8%)	
Bus or Minibus	8 (8.6%)	6 (6.8%)	
Taxi			
Line Taxi	20 (21.5%)	21 (23.6%)	
Passenger Taxi	17 (18.3%)	21 (23.6%)	
Telephone Taxi	15 (16.1%)	10 (11.2%)	

Tab.2 - The characteristics of public transportation use

What connect Bahar to the central parts of the city in the east are urban highways in the north and south of the neighborhood. Only one bus station covers a part of each of the two neighborhoods. That is why the bus/minibus is not a popular option. Apart from accessibility the most important reason for not using public transport is low comfort. This option received 40.8 % of the responses in Keyhan and 37.8 % in Bahar.

While sense of belonging in the two neighborhoods is in the same level, people in Keyhan are more satisfied of their living environment (41.1 % satisfied or very satisfied) than those who live in Bahar (26.6 % satisfied or very satisfied). Apart from neighborhood satisfaction, Table 3 indicates notable difference between the circumstances of residential self selection in Iran with that of Western Europe and North America. What we see here is that most of the people choose their living places based on economic factors rather than mobility-related reasons. The reasons given by the respondents for selecting their living location are 68.7 % related to economy (affordability or rise of the prices in the future) in Keyhan and 69.2 % in Bahar. In contrast, the reasons in connection with transportation, including commute travels or proximity to the relatives make 19.8 % in Keyhan and 15.9 % in Bahar. This meaningful difference shows how the residential self selection functions under the effect of economic factors.

FACTORS RELATED TO PERCEPTIONS AND SELECTIONS	KEYHAN	BAHAR
SENSE OF BELONGING TO THE NEIGHBORHOOD		
Yes	77 (80.2%)	77 (82.8%)
No	19 (19.8%)	16 (17.2%)
SATISFACTION OF THE NEIGHBORHOOD ENTERTAINMENT FACILITIES		
Very satisfied	9 (9.5%)	4 (4.3%)
Satisfied	30 (31.6%)	21 (22.3%)
Indifferent	27 (28.4%)	31 (33%)
Not satisfied	25 (26.3%)	35 (37.2%)
Dissatisfied	4 (4.2%)	3 (3.2%)
THE PLACE PREFERRED FOR ENTERTAINMENT AND SOCIAL ACTIVITIES		
Inside the neighborhood	41 (43.2%)	31 (34.4%)
Out of the neighborhood	54 (56.8%)	59 (65.6%)

Tab.3 - Human perceptions and selections

3.2 MODE CHOICE

To consider the relationships between different factors and transportation mode choice, a Multinomial Logit Regression Model is developed. The general model output such as model fitting information, likelihood ratio tests, pseudo R-square, and Nagelkerke R-square are illustrated in Table 4 and Table 5. The model generally shows good fit. Although some of the variables for Keyhan and all of them in Bahar have high p-values. The result of this model gives the opportunity to study the association of several variables with mode choices. Table 4 indicates the results of the model for the two case-study areas.

Model	KEYHAN				BAHAR			
	Model Fitting Criteria	Likelihood Ratio Tests			Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	317,903				305,598			
Final	61,672	256,231	84	,000	72,004	233,594	76	,000

Table 4. Model fitting information for the two neighbourhoods.

The model is meant to, firstly, show the association of different variables with mode choice in general and, secondly, provide with data usable for making comparison between the two neighborhoods. The output shows significant (p-value< 0.05) association between satisfaction of entertainment facilities, age, and household income with transport mode choice in Keyhan. This result is presented in Table 6 for selection of car, bicycle, motorbike, and pedestrian trips. The significant and insignificant statistical outputs of all the seven 7 independent variables are presented this table to give better insight to the reader. Public transportation including bus/minibus, taxi, and metro are not seen in the model because it only takes into account the intra-neighborhood trips and public transportation is not used in the very small limitation of the neighborhoods. “Car” is taken as reference in the calculations because it is the strongest variable in the model. Therefore higher values of coefficients show higher pedestrian, bike, or motorbike trips. The model results for the pedestrian travels are of absolute importance; in Keyhan satisfaction of entertainment facilities can lead to increase in pedestrian travels (B=4.584, P=0.038).

Age has a positive effect on walking trips (B=26.248, P=0.000). The findings show that older people in Keyhan are more willing to walk to their non-work destinations inside the neighborhood. The influence of income is negative (B=-39.618, P=0.000). In other words, more affluent people walk less and use more cars. In Bahar the null hypothesis is not rejected for any of the explanatory variables, so they are not significant. This shows that the modes are selected randomly and there are no relationships between the variables and the decisions. Three socio-economic traits, namely gender, owning a driving license, and household car ownership, have not produced significant relationships with mode selection in both neighborhoods. Surprisingly, the evaluation of people from local retail is significant neither of the neighborhoods. More studies seem to be needed for examining the role of accessibility to local shops.

Significance of three variables out of seven in Keyhan while none of them are meaningful for Bahar shows that the difference in the urban structure of Keyhan has something to contribute to sustainable transportation and this can be used by urban policy makers. Providing with attractive urban spaces and local facilities can attract people in quarters that have and accessible local center such as a neighborhood center.

Effect	KEYHAN					BAHAR				
	Model Fitting Criteria	Likelihood Ratio Tests				Model Fitting Criteria	Likelihood Ratio Tests			
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.	Nagelkerke	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.	Nagelkerke
Intercept	61,672a	0,000	0		0,928	72,004a	0,000	0		0,901
RETEV	71,069b	9,397	16	,896		80,823b	8,819	16	,921	
SATISENT	72,310b	10,638	20	,955		77,573b	5,569	16	,992	
AGE	166,129b	104,457	16	,000		80,744b	8,740	12	,725	
INCOME	833,501b	771,829	16	,000		80,077b	8,073	16	,947	
FEMALE	67,307b	5,635	4	,228		74,185b	2,181	4	,702	
DRIVINGLIC	68,400b	6,728	4	,151		74,664b	2,660	4	,616	
COHOUSE	225,522c	163,850	4	,000		75,336b	3,332	4	,504	

Table 5. Likelihood ratio tests and Pseudo R-squared results

Mode Choice	Independent Variable	Description	KEYHAN				BAHAR			
			B (COEFFICIENT)	STD. ERROR	WALD	SIG. (P-VALUE)	B (COEFFICIENT)	STD. ERROR	WALD	SIG. (P-VALUE)
	[RETEV=]	Retail evaluation	10,042	221,266	,002	,964	23,049	168,989	,019	,892
	[SATISENT=]	Satisfactionofentertainmentfacilities	24,297	1,391	304,945	,000	9,042	77,879	,013	,908
	[AGE=]	Age	356,382	1,415	63419,821	0,000	20,098	70,403	,081	,775
	[INCOME=]	Household Income	63,325	1,180	2881,815	0,000	5,023	20,403	,061	,806
	[FEMALE=]	Gender	22,530	100,523	,050	,823	22,741	109,812	,043	,836
	[DRIVINGLIC=]	Own a drivinglincense	20,863	56,567	,136	,712	20,914	67,407	,096	,756
	[COHOUSE=]	Householdcarownership	21,012	57,079	,136	,713	23,112	109,362	,045	,833
Bicycle	[RETEV=]	Retail evaluation	,000	386,049	,000	1,000	,000	229,833	,000	1,000
	[SATISENT=]	Satisfactionofentertainmentfacilities	12,186	798,284	,000	,988	11,006	0,000		
	[AGE=]	Age	338,724	7,289	2159,439	0,000	10,056	312,304	,001	,974
	[INCOME=]	Household Income	47,004	5,983	61,728	,000	,000	72,047	,000	1,000
	[FEMALE=]	Gender	10,488	0,000			-,511	0,000		
	[DRIVINGLIC=]	Own a drivinglincense	,000	255,524	,000	1,000	,000	258,103	,000	1,000
	[COHOUSE=]	Householdcarownership	,000	255,524	,000	1,000	-,069	0,000		
Motorbike	[RETEV=]	Satisfactionofentertainmentfacilities	,000	650,775	,000	1,000	11,006	528,455	,000	,983
	[SATISENT=]	Satisfactionofentertainmentfacilities	22,704	5,398	17,694	,000	,000	152,104	,000	1,000
	[AGE=]	Age	353,431	5,221	4583,138	0,000	-,629	85,304	,000	,994
	[INCOME=]	Household Income	60,374	3,548	289,585	,000	,000	39,250	,000	1,000
	[FEMALE=]	Gender	-1,299	303,986	,000	,997	-,511	230,331	,000	,998
	[DRIVINGLIC=]	Own a drivinglincense	0	-	-	-	,000	140,631	,000	1,000
	[COHOUSE=]	Householdcarownership	,000	184,569	,000	1,000	,219	230,331	,000	,999
Pedestrian	[RETEV=]	Retail evaluation	-9,273	185,646	,002	,960	,236	114,308	,000	,998
	[SATISENT=]	Satisfactionofentertainmentfacilities	4,584	2,212	4,294	,038	-8,136	70,026	,013	,908
	[AGE=]	Age	26,248	1,322	394,489	,000	,706	42,832	,000	,987
	[INCOME=]	Household Income	-39,618	1,198	1094,273	,000	-4,113	18,087	,052	,820
	[FEMALE=]	Gender	0	-	-	-	-,009	113,333	,000	1,000
	[DRIVINGLIC=]	Own a drivinglincense	,152	60,979	,000	,998	,204	70,607	,000	,998
	[COHOUSE=]	Householdcarownership	,331	60,979	,000	,996	,412	113,332	,000	,997

Tab. 6 - Multinomial Logit Regression model for transportation mode choice in Keyhan and Bahar

3.3 SHOPPING ACTIVITY

As a continuous variable, the number of times that each individual in Keyhan and Bahar goes shopping in is compared by t-test. The number of shopping per week is asked from every interviewee during the direct questioning. The statistical test (Table 7 and 8) shows that Keyhan (Mean= 2.719) has significantly less number of shopping trips. Bahar (Mean= 2.958) produces higher number of shopping travels including pedestrian or motorized trips. The t-value of 0.000 shows rejection of null hypothesis and a meaningful difference between the means of shopping frequency in the two neighborhoods. Less shopping travel generation of Keyhan can be in relation with high accessibility to retail and shops inside the neighborhood. In fact people feel that the shops are within their reach so less shopping trips are generated.

	N	MEAN	STD. DEVIATION	STD. ERROR MEAN
Shopping per Week in Keyhan	96	2,72	1,351	,138
Shopping per Week in Bahar	96	2,96	,994	,101

Tab. 7: One-sample statistics for shopping per week in the case-study areas

	TEST VALUE = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Shopping per Week in Keyhan	19,717	95	,000	2,719	2,45	2,99
Shopping per Week in Bahar	29,165	95	,000	2,958	2,76	3,16

Tab. 8: One-sample test for shopping per week in the case-study areas

3.4 CAUSALITY ANALYSIS

Studying the causal relations between different issues with travel behavior is another objective of this paper. Because of better attractiveness of the places of Keyhan for entertainment, the residents are willing to stay in their own neighborhood about ten % more than what the respondents of Bahar declare (Table 9). There is the same good evaluation about the better quality of the retail and public spaces of Keyhan, but there is no sign of higher percentages of walking in Keyhan. The reason behind little walking or biking can be sought at the first step in the socio-economic trends. The cultural problems and lack of bicycle infrastructure are the main reasons for little biking (93 % in Keyhan and 88 % in Bahar). Many people like to drive rather than walk to show the affluence or social class. This can be seen in many cultures from developing to developed countries. The situation for improving biking is even more difficult than that of walking. Methods for removing such cultural barriers against biking, especially biking of women, can be a special topic for the Iranian researchers in the future. As a side strategy to encourage people to use more alternative transportation modes, this paper suggests methods to increase local accessibility and attractiveness. The logic can be found in the responses of people in the observation areas. Far-away destinations are declared as the main reason for not walking in both neighborhoods, but the difference between the percentages is considerable. 52 % of people in Keyhan say the destinations are far away, so they cannot walk to them, while this amount is 35 % more in Bahar. The reason can be found in the central structure of Keyhan that gives more accessibility to the neighborhood amenities.

FACTORS RELATED TO PERCEPTIONS AND SELECTIONS	KEYHAN	BAHAR

THE MAIN REASON FOR NOT TO PARTICIPATE IN SOCIAL ACTIVITIES AND SHOPPING INSIDE THE NEIGHBORHOOD		
Lack of suitable facilities, retail, and shops	6 (17.1%)	16 (32%)
Lack of suitable spaces such as streets and allies	8 (22.9%)	9 (18%)
Absence of suitable social environment	7 (20%)	10 (20%)
Expensive services and materials	11 (31.4%)	12 (24%)
Lack of safety and security	0 (0%)	2 (4%)
Personal reasons	3 (8.6%)	1 (2%)
THE MAIN REASON FOR PUBLIC TRANSPORTATION USE		
It is cheaper	12 (24.5%)	16 (30.8%)
It is faster	20 (40.8%)	18 (34.6%)
It is safe and secure	6 (12.2%)	5 (9.6%)
It is more comfortable	3 (6.1%)	6 (11.5%)
Because of no access to car	8 (16.4%)	7 (13.5%)
THE MAIN REASON FOR NOT USING PUBLIC TRANSPORTATION		
It is not comfortable	20 (40.8%)	17 (37.8%)
It is expensive	4 (8.2%)	4 (8.9%)
Little accessibility to stations, long distance between the stations	10 (20.4%)	15 (33.3%)
No access to public transportation at all	8 (16.3%)	8 (17.8%)
Because of social and cultural problems	7 (14.3%)	1 (2.2%)
THE MAIN REASON FOR NOT BIKING INSIDE THE NEIGHBORHOOD		
Cultural problems	51 (59.3%)	31 (41.3%)
Lack of biking routes and infrastructure	29 (33.7%)	35 (46.7%)
High price of bike	6 (7%)	9 (12%)
THE MAIN REASON FOR PREFERRING CAR TRAVEL TO PEDESTRIAN TRAVEL INSIDE THE NEIGHBORHOOD		
The destinations are not near the living place	26 (52%)	20 (87%)
No attractive and beautiful streets and spaces are on the route	7 (14%)	2 (8.7%)
Lack of safety/security in the streets	6 (12%)	1 (4.3%)
Because of social problems	11 (22%)	0 (0%)

Table 9. Causality relationships: reasons for poor sustainable mobility behavior

Although the central urban structure of Keyhan provides better accessibility and attractiveness (for entertainment and shopping), but still significantly higher percentage of walking is not seen in the modal split of the neighborhood compared to that of sprawled Bahar. According to the survey results, people evaluate the neighborhood amenities and entertainment facilities of Keyhan more attractive. However attractiveness and accessibility must work together. According to the survey, a major part of the respondents of Keyhan prefer to stay inside the neighborhood for entertainment activities. This provides an opportunity to localize the travels and as a result increase the share of pedestrian and bicycle trips. Nevertheless this opportunity has not been used because there is not a huge difference between the share of slow modes in Keyhan and Bahar. When the respondents are asked about the reason for not walking, their main reason is “the destinations are not near the living place”. The accessibility-related reasons include 52 % of the responses. While the same option makes 87 % of the responses in Bahar that has less accessibility. 35 % difference between the responses of the two neighborhoods show that people believe the facilities for entertainment, being with friends and passing time in Keyhan is more accessible while other options like lack of safety/security and social problems can also stop people from walking to their destinations. In Keyhan, one third of people have selected these problems as obstacles of walking. Considering the above, the reason for the approximately equal shares of walking in the two neighborhoods is not clear. On the other hand 65.3%in Keyhan has said that they use public transport because it is cheaper

or faster. This amount is 66.4% for Bahar. This shows how it is possible to add to the privilege of public transport over car by enhancing the quality and accessibility of the metro, bus and Taxi systems.

4 CONCLUSIONS

This paper shows that the socio-economic factors like age and household income have strong effects on travels in compact neighborhoods. This finding is consistent with the result of the previous works done by Iranian scholars. In connection to previous studies (such as Handy et al. 2005), here we find that the built environment cannot individually solve the transportation problems without socio-economic factors. The urban design elements can improve the sustainable transportation, but they are not the most effective factors. Nevertheless this study also demonstrates that the phenomena connected to urban form are not completely ineffective in changing travels. Positive association of presence of entertainment facilities within the neighborhood centers with pedestrian trips has been also shown. It has been also shown in this paper that residential self selection is not so important in defining the urban travel patterns in Iranian cities in contrast to the western countries. That is because people usually do not select their living location due to transportation-related reasons.

Despite uniform techniques applied to the two areas and also similar socio-economic qualities in the two studies neighborhoods, the dispersed and centerlessneighbourhood showed weak capacity to change the travel patterns by means of land use characteristics. In contrary, the compact and central neighborhood form indicated signs of capabilities that can affect urban travels positively. Such potentials can be used in urban planning and design in order to localize the non-commute trips including shopping and entertainment travels. The present study emphasizes on planning accessible local centers to present entertainment facilities and attractive retail. This method is in line with promotion of local accessibility.

According to descriptive findings of this article, the attractiveness of the local centers can urge residents to have their non-work trips (entertainment, social behavior, shopping, etc.) inside the neighborhood. However this can only be done when there are enough infrastructures for walking and biking. Providing such infrastructures can complete the attractiveness and accessibility of the local facilities. The causality study done in this research shows that the existence of neighborhood infrastructures and facilities has a strong effect on the travel behavior of people.

Like the previous Iranian literature that pointed out that socio-economic characteristics are important in defining the nature of the urban travels, this study finds some of these factors like age and income important. However there are two main differences; firstly, approximately all of the mentioned studies take medium and large scale, while this article is zoomed on neighborhood. Secondly, the present study finds only age and income effective on mode choice. For finding association between other factors and travels more observations seem to be needed.

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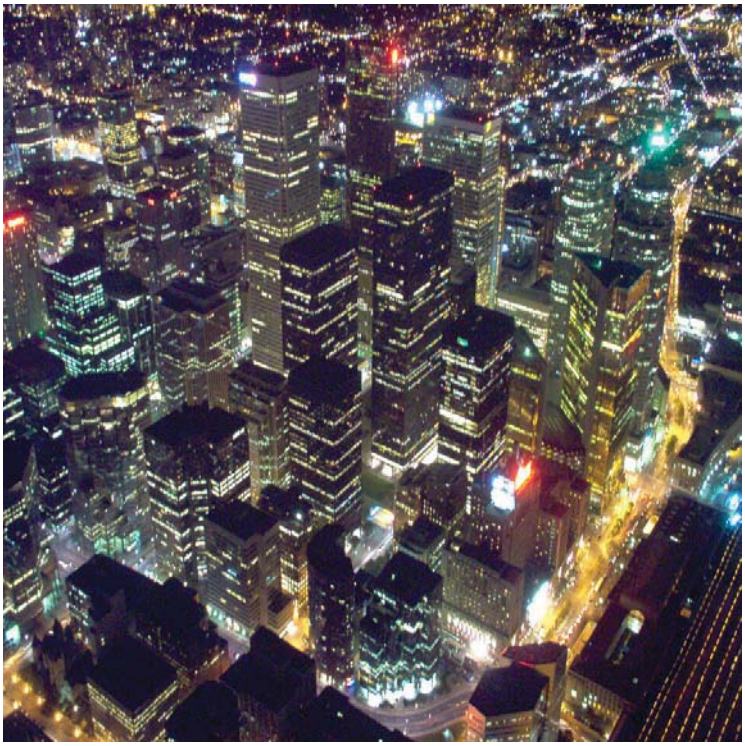

RESILIENCE IN THE TRANSITION TOWNS MOVEMENT

TOWARDS A NEW URBAN GOVERNANCE

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ABSTRACT

Resilience, a concept typical in the natural sciences, has for some years been part of vocabulary of spatial planning but it is as yet relatively unexplored. Its common definition still represents resilience as the capacity of a system to absorb disturbances and to reorganize itself, by returning to the original state. Complexity theory shows that resilience is a bottom-up process, closely related to self-organization of a system, which could change the role of institutions and community in urban governance. Recently, the concept of resilience has been associated with the Transition Towns movement, a bottom-up initiative promoted by civil society. Better known as "urban initiatives for the transition", they are a set of bottom-up practices of urban management, aimed at achieving a self-sufficient and "zero impact" model of urban development.
In this perspective, the research question is: could this new paradigm of development and spatial organization really be a new approach in urban governance?
The paper focuses on the implications of the concept of resilience in spatial planning. The purpose is to understand the extent of innovation in planning practices and urban governance. In particular, the first part of the paper provides a review of the theoretical framework of resilience and the second analyzes the Transition Towns movement, with particular reference to the role of stakeholders.

KEYWORDS:
Resilience; Transition Town movement; Urban governance.

1. RESILIENCE. DEFINITION, ORIGIN AND EVOLUTION

The concept of resilience has been widely studied in many disciplines (Seyfang, Haxeltine, 2009). First formulated in ecology (in the 1960s-1970s), this concept has influenced many other research fields including anthropology, human geography and other social sciences (Folke, 2006). Recently, it has also been discussed in the urban and regional planning sector becoming part of the vocabulary of spatial planning and entering debates in planning theory and practice (Davoudi and Porter, 2012; Papa, 2012).

The first theoretical approach defined it as «*the capacity of a system to absorb disturbance and reorganize while undergoing change, so as to still retain essentially the same function, structure, identity and feedback*» (Walker *et al.,* 2004, p. 5). This definition is used in the spatial metaphor of "resilient city" (Newman *et al.*, 2009; Otto-Zimmermann, 2011; Pickett *et al.*, 2004).

A more thorough inquiry (Folke, 2006) into the adaptive capacity of social-ecological systems underlined the real innovation of the concept of resilience (Papa, 2012). This second approach implies that cities are open adaptive complex systems (Portugali, 1999), that are able to self-regulate and create innovative solutions for urban development. This point of view allows the study of implementation of the concept of resilience in the Transition towns movement (Hopkins, 2008 and 2011). This movement has already spread into several contexts. Despite its phenomenal growth and the wave of positive publicity has received, there has to date been very little empirical research into the development and character of these initiatives, or the impact they have achieved (Seyfang, 2009).

1.1 THE ORIGIN OF THE CONCEPT IN ECOLOGY

According to Pickett et al. (2004), there are two distinct research phases in scientific studies on the concept of resilience: (i) one based on balance and (ii) one based on imbalance. In the first, resilience is the system's ability to return to the starting point by overcoming a period of crisis; in the second – which is more inclusive - it is the system's ability to adapt to external disturbance, not necessarily returning to a steady-state (Gunderson, Holling, 2002; Gunderson et al., 2010).

Early studies in the Sixties and Seventies[1], essentially based on empirical analysis of ecosystem dynamics through mathematical models, focused on resilience as the capacity to absorb shocks and still maintain its functions. This engineering approach, named by Holling (1973), implies the ability of systems to return to equilibrium or steady-state and the return time is the measure of resilience[2]. In this theoretical perspective, the consequent policies relating to natural resource management were "linear approach" types (Folke, 2006).

Since the Nineties[3], when ecosystems analysis on a large scale included the social sphere (institutions and people), the focus was on the necessity to manage by change rather than simply to react to external shocks. This ecological approach, named by Holling (1973), implies resilience is the ability of systems to overcome external shocks and move to a new equilibrium stage. In other words, it is the capacity to adapt to external shocks. The related policies therefore implied uncertainty and surprise[4], useful to adapt to the external disturbances.

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1 See in particular Holling (1961), Lewontin (1969), Rosenzweig (1971) and May R.M. (1972).

2 Holling (1973, p. 17) states «resilience determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist».

3 Especially after the publication of the volume *Barrier and Bridges to the Renewal of Ecosystems and Institutions* by Gunderson et al. (1995).

4 For a further discussion, see: Carpenter and Gunderson (2001), Berkes, Colding and Folke (2003).

This second view has led to the study of the concept of resilience in socio-ecological systems (Folke, 2006; Gallopin, 2006), which are conceptualization models of linkage between the human and ecological spheres, useful to identify practices of adaptive management. In this socio-ecological approach, resilience shifts from a capacity of system which maintains its original status towards a capacity of system to adapt, innovate and transform, under certain conditions, into new more desirable configurations. Innovation and transformation concern the capacity «for renewal, re-*organization and development.* [...] *In a resilient social-ecological system, disturbance has the potential to create opportunity for doing new things, for innovation and for development*» (Folke, 2006, p. 259).

Following Carpenter *et al.* (2001), Folke (2006) summed up the characteristics of socio-ecological resilience as follows:

- the amount of disturbance a system can absorb while still remaining within the same state or domain of attraction.
- the degree to which the system is able to self-organize (versus lack of organization, or organization forced by external factors).
- the degree to which the system can build and increase its capacity for learning and adaptation.

Absorbing, self-organization and learning/adaptation appear to be the three key elements related to the concept of resilience. Folke (2006, p. 258) adds that resilience «e*mphasizes non-linear dynamics, thresholds,uncertainty and surprise, how periods of gradual change interplay with periods of rapid change and how such dynamics interact across temporal and spatial scales*». Starting from this dynamic perspective, he proposed a modified Panarchy model, a heuristic model of nested adaptive renewal cycles (Gunderson and Holling, 2002) emphasizing cross-scale interplay. The adaptive renewal cycle is divided into four phases of system development driven by discontinuous events and processes: exponential phases of change (the exploitation or r-phase), stasis phases of growing (the conservation or K-phase), readjustments and collapse phases (the release or omega-phase) and re-organization and renewal phases (the alpha-phase) (Folke, 2006). The modified model explicitly takes fast/slow dynamics and cross scale interactions and interdependencies into account. The panarchy is therefore «*both creative and conservative through the dynamic balance between rapid change and memory, and between disturbance and diversity and their cross-scale interplay*» (Folke, 2006, 259).

1.2 THE EVOLUTION OF THE CONCEPT IN SPATIAL

Even today, resilience is defined in planning literature as the ability of a system to absorb external disturbances and reorganize itself on the basis thereof to return to the same function, structure and original identity (Walker et al., 2004). As shown by Funfgeld (2012), this engineering approach is quite often used in the field of climate risk management. In order to conserve the status quo - protect existing assets, people and places from the impacts of climate change - the adaptation measures are designed as thresholds (on the metaphor of "resilient city"[5] see, for example, Musacchio and Wu, 2002; Newman et al., 2009; Otto-Zimmermann, 2011). As Porter and Davoudi (2012) confirm, this perspective adopts a managerial, command-and-control understanding of systems. This view looks at the city as a linear system.

In line with Folke's theory of the Panarchy model, the reaction of systems to external disturbances depends on a certain degree of their self-organization and creativity. This definition adapts to peculiarities of the

[5] It's interesting to note that ecology and spatial planning share both the use of metaphor and the relationship between structure and function (Pickett et al., 2004). In spatial planning, metaphor has traditionally had a particular appeal; the most famous is Howard's Garden City but there are also the first hypotheses of bioregionalism formulated by Geddes and Mumford at the beginning of the Twentieth century. Today, the new metaphor of "resilient city" could be the synthesis between ecology and spatial planning.

complex systems «because it is more dynamic and evolutionary» (Pickett et al. 2004, p. 373). According to Davoudi (2012, p. 303), this socio-ecological approach considers resilience «not as a fixed asset, but as a continually changing process; not as a being but as a becoming». Davoudi (2012) called this approach as "evolutionary resilience" and the authors agree with that designation. It enables the use of the concept of resilience in spatial planning, the complexity theory indeed argues that cities are non-linear systems. Translating the concept of resilience from the field of ecology into spatial planning therefore poses some critical issues[6], the most important being the intentionality of human actions.

Cities, by their nature, are open complex systems and are thereby subjected to constant external disturbances (Portugali, 1999) and characterized by self-organization. Considering the notion of self-organization in the human domain of cities means adding to the list of the main characteristics of open complex systems: human intentionality[7], hermeneutics and memory. As Portugali (1999, 77) asserts, «individuals in the city act and behave intentionally, they need information about the city. This information they subjectively extract from what they see and experience in the city. They extract this information by means of logic, imagination, past experiences, knowledge and other tools commonly assumed to form the content of the individual's memory. This process by which the individual extracts information by means of memory, and by so doing in fact creates and constructs his/her own and other's city, is termed hermeneutics. And to complete the picture and the feedback loop one should add that memory is also the place were intentions are created, represented and stored».

Accordingly, in order to propose a comprehensive definition of the resilience concept in spatial planning, it is useful to study empirical experiences which also take these aspects into account. Examples include the recent experiences of transition towns (Hopkins, 2008 and 2011, Hopkins and Lipman, 2009). Rob Hopkins, founder of the first transition town in the UK, proposed the original use of the concept of resilience as a reaction to the external disturbance of peak oil.

2. RESILIENCE IN THE TRANSITION TOWNS MOVEMENT

The concept of resilience is the main principle of the experiences of the Transition Towns movement. We will understand how it is used in recent international experiences. According to the main definition, we can list four characteristics that allow the use of the concept of resilience for urban systems, as indicated below:

– *Socio-ecological systems*. The first element concerns the linkage between the ecological and social dimensions of systems. Urban systems are based on the close relationship between environmental resources and human capital, they are socio-ecological systems. This is particularly clear in the Transition Towns movement, the new paradigm of urban development that they propose indeed refers to primary resources (eg. energy and food supply).
– *Complex systems.*The second element concerns entirety of the system (Folke*et al.,* 2010). Cities are indeed complex systems wherein several subsystems interact (Portugali, 2000). The transition town model proposes a new paradigm of urban development which is a comprehensive strategic vision of the city and does not just consider a single subsystem (Brangwyn and Hopkins, 2008).
– *Adaptive renewal cycles*. The third element concerns the adaptive renewal cycle theory. It is composed of the sequence of several status phases. Each status phase involves the loss of resilience and the consequent vulnerability of the system. In the transition town model the sequence is clear and closely

6 The critical issues that Davoudi (2012) lists are: intentionality of human actions; outcome or purpose of resilience; system's boundary; resilience for whom?

7 Jane Jacobs yet argues that citizens have spontaneous and self-organised behaviors (Jacobs, 1961).

linked to the widespread use of oil; the peak oil – or at least its shortage - is the external disturbance which involves the loss of resilience and the consequent vulnerability of the system (Hopkins, 2008). Following this approach, the urban system has passed the period of growing - K-phase - and is now going through the readjustment and collapse period – Omega-phase. The transition town model proposes overcoming the current phase of crisis and reaching the last phase of renewal and re-organizing – alpha-phase. Each transition initiative takes into account that «[...] life with dramatically lower energy consumption is inevitable and it's better to plan for it than to be taken by surprise and our settlements and communities presently lack the resilience to enable them to weather the severe energy shocks that will accompany peak oil» (Hopkins 2008, p. 134). The adaptive renewal process also has memory ability. The memory of the urban system is a key feature of the transition town model (eg. key role of the elders knowhow and wisdom, in terms of lifestyle not yet dependent on oil) (Brangwyn and Hopkins, 2008). Self-organizing capacity. The fourth and final element is the self-organizing capacity of complex systems. Folke's theory (2006) proves that complex systems are in a continuous adaptive renewal cycle, which never stops but is able to react creatively to external disturbances. The Transition Towns movement is a practical example. It is a bottom-up movement, it is part - even without knowing it - of the alpha-phase of the cycle and so it is an example of the reaction of the urban system to external disturbances. The movement proposes a new paradigm of urban development and a consequent social organization model.

3. THE IDEA OF TRANSITION

Transitioning is a key assumption of the Transition Towns movement. A relevant topic to discussions on sustainability is the research on transition in socio-technical niches[8], «[...] *protected spaces where new social and technical practices can develop*» (Seyfang and Haxeltine, 2009, p. 3). This concept has been the subject of numerous scientific projects and debates with reference to its innovative solutions and alternatives to the sustainable development topic (Foxon*et al.,* 2008, Smith and Stirling, 2010).

Extending this concept into the social economy, Seyfang and Smith (2007, p. 3) propose a model of grassroots innovations to describe «*community-led, value-driven initiatives for sustainability, which respond to local problems and develop innovative socio-economic arrangements as much as (or in preference to) new technologies*». The benefits of grassroots innovations for sustainable development derive principally from their creation of a space for the development of new ideas and practices, for experimenting with new systems of provision, and for enabling people to express their alternative green and socially progressive values, and from the tangible achievement of environmental and social sustainability improvements, albeit on a small scale (Seyfang and Smith, 2007; Seyfang*et al.,* 2010).

In line with the socio-technical niches theory, the Transition Towns movement proposes a bottom-up paradigm of urban development which comes from the creativity of the urban community. In other words, this movement is a civil society movement which brings together«*diverse parts of a community to act and* produce change and innovation at the whole systems level» (Seyfang and Haxeltine, 2009, p. 21). Creativity means generating new ideas, practices and policies for urban management.

[8] On Strategic Niche Management (SNM) see, for example, researches by Smith A., Stirling A. and Berkhout F. (2005), "The governance of sustainable socio-technical transitions", Research Policy, 34, 1491-1510; Geels F.W. (2005), Technological transitions and system innovations: a co-evolutionary and socio-technical analysis, Elgar, Camberley; Loorbach D. (2007), Transition management: new mode of governance for sustainable development, International Books, Utrecht.

3.1 ORIGINS AND QUALITATIVE CONSISTENCY

The Transition Towns movement was founded in 2005 in Kinsale, Northern Ireland, by Rob Hopkins, a permaculture teacher[9].
The first transition town initiative involved the small town of Totnes (2006), in south-west Britain.

REGION	FORMAL INITIATIVES (JULY 2009)	MULLERS (SEPT 2008)
UK and Ireland	119 (83)	496
Continental Europe	4 (1)	48
North America (of which)	37 (5)	143
USA	33 (5)	113
Canada	4 (–)	30
Latin America	1 (1)	7
Asia	1 (1)	4
Australasia (of which)	24 (15)	100
Australia	17 (9)	54
New Zealand	7 (6)	46
Total	186 (106)	802

Tab.1 Geographical distribution of Transition Towns

Starting from this initial experience, which actively began in 2009, the Transition Towns movement quickly spread, firstly in the UK and then in other European and non-European countries (Seyfang and Haxeltine, 2009).
To date, we could list hundreds of initiatives[10] worldwide. According to recent researches, the transition towns are located in Europe (about 50% in the UK and the remainder in Ireland, Germany, the Netherlands and Italy), but also in Oceania (Australia, New Zealand) and North and South America (the USA, Canada, Brazil and Chile) (Hopkins and Lipman, 2009; Smith, 2011).
As other current grassroots movements, the Transition Towns movement is a socio-technical niche that involves a small part of society. A recent survey on Uk transition initiatives (Smith, 2011), shows that 86% of respondents are well-educated to post-graduate level. It is not possible to determine whether this trend is valid for all initiatives, but we can stress that - at least according to recent researches - the phenomenon is progressively spreading. This trend also depends on the different kinds of initiatives, in terms of location (urban, rural and island) and extent (local transition initiatives, regional transition networks, regional hubs,

[9] Permaculture, another key assumption of the transition initiatives, is not discussed here. For a discussion of this concept, see Holmgren (2002).
[10] It seems difficult to determine a list of the initiatives currently active in the world. The literature shows a lack of data: according to Bailey et al. (2010), on July 2009, the phenomenon involved more than 186 cities, while according to Seyfang and Haxeltine (2010), on January 2010, it involved 156 cities in the UK and 109 in the rest of the world.

national transition support organisations/networks, temporary groupings of local initiatives to carry out particular projects, as well as other manifestations) (Hopkins and Lipman, 2009).

3.2 PURPOSE AND PRINCIPLES

Hopkins and Lipman (2009) define the transition initiatives as «[...] *an emerging and evolving approach to community-level sustainability*» (Hopkins, 2008, p. 134). Bailey *et al.* (2010, p. 601) complete this definition by considering the Transition Towns movement as «*an environmental movement that has both drawn extensively on the perspectives and techniques of its predecessor and peer environmental movements, and adapted these to the specifics of peak oil, climate change and relocalisation*».

The formation process of each transition initiative follows seven principles[11], twelve steps[12] (Connors and McDonald, 2011) and three stages[13]. Although this set of guidelines, listed by the Uk Transition Towns Network, should only provide directions for the process (Hopkins and Lipman, 2009), in some cases it is considered quite binding and prescriptive (Connors and McDonald, 2011).

Following the concept of resilience, the purpose of transition initiatives is «*to support community-led responses to peak oil and climate change, building resilience and happiness*» (Hopkins and Lipman, 2009, p. 7). In line with socio-technical niches theory, these initiatives are virtuous examples of interplay between system supply/use of resources and new models of social institutions and regulation, especially in terms of their influence on sustainable lifestyle (Seyfang and Haxeltine, 2009).

At national level, these collect and monitor all the initiatives (eg. UK and USA)(Hopkins and Lipman 2009). At regional level, the best practices in the transition initiatives are shared in order to support those that are newly active and those in the process of formation and to manage partnership with private or public corporations. At local level, transition initiatives concern crosswise all fields of urban governance, with particular reference to oil-led ones (such as food and energy supply).

For each field there is an organization subgroup that deals with strategic and propositive activities. The final goal is to outline the Energy Descent Action Plan (EDAP). In this view, two other assumptions of the movement are: «*we have to act collectively, and we have to act now and by unleashing the collective genius of those around us to creatively and proactively plan our energy descent*» (Hopkins 2008, p. 134).

The EDAP anticipates three phases of aims (Brangwyn and Hopkins, 2008): a local resources framework, a transition timeline and a set of resilience indicators (such as the percentage of food grown locally, the amount of local currency in circulation, the number of businesses owned locally, the percentage of energy produced locally, the quantity of renewable building materials, and so on).

The Energy Descent Action Plan constitutes a strategic urban plan of a future vision to be carried out through specific practical activities. It differs from traditional strategic planning for a voluntary and shared community-led vision.

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[11] The seven principles are: positive visioning, help people access good information and trust them to make good decisions, inclusion and openness, enable sharing and networking, build resilience, inner and outer transition, subsidiarity (Hopkins and Lipman, 2009).

[12] According to Brangwyn and Hopkins (2008), the 12 steps of transition initiative are: set up a steering group and design its demise from the outset; awareness raising; lay the foundations; organise a great unleashing; form working groups; use open space; develop visible practical manifestations of the project; facilitate the great reskilling; build a bridge to local government; honour the elders; let it go where it wants to go; create an energy descent plan (EDAP).

[13] According to Hopkins and Lipman (2009), each transition initiative should follow a succession of stages: the initial stage (meeting and gathering around the principles of the transition), the mulling stage (contacting and joining the Transition Network Ltd) and the formal transition initiative (declaration of intention).

WORKING GROUP	MAIN ACTIVITIES
Building and housing	Eco-construction Cohousing
Economics and livelihoods	Local currency: the Totnes pound ATMOS: sustainable business park Oil vulnerability audits with local companies
Education	Transition tales with local schools Public future scenario workshops
Energy	Totnes renewable energy supply company Solar water heater challenge Partnership with good energy
Food	Garden share project Sustainable fisheries Seed and plant swaps Allotments association
Health and well-being	Directory of complementary health practitioners Collections of illness-to-wellness stories Discussion group on national health service and sustainability
Heart and soul	Meetings to discuss events and experiences Meditation meetings
Local government	Building of links with town, district and county councils to support and encourage inclusion of climate change and peak oil in decision-making
The arts	Events utilising the arts to explore peak oil, climate change and transition
Transport	Totnes cycling group Totnes rickshaw company

Tab.2 Main activities of Transition Town Totnes

The public sector role, especially of local government, is still central but it has to support - not to drive - transition initiatives, as happened in the Transition Towns Totnes, Lewes, Stroud, Penwith (Brangwyn and Hopkins, 2008).

3.3 COMMON CHARACTERISTICS

The comparison of the main international transition towns enables the common characteristics, both in terms of promoter organizations and initiative typologies[14], to be listed as follows. In regard to the first term, the main characteristics are:

– *voluntarity*[15]. Unlike traditional strategic planning for urban sustainable development, the transition initiatives focus on community-level action, essential to the success of the initiative (Seyfang and

[14] On this topic there are no surveys, the only exception is the work of Seyfang and Haxeltine (2009) about the British case studies.

[15] Seyfang and Haxeltine (2009, p. 6) underline that «[...] *the vast majority (89.0%) are set up by individual citizens (76.7% are set up by several individuals coming together to instigate the group, and another 12.3% are set up by just one person at the outset). At the same time, 19.2% have one or more pre-existing groups involved in setting up the*

Haxeltine, 2009). Common action implies the voluntarity of community members towards a shared goal.

- *common mission*. The common mission is building local self-reliance[16], shared by all community members at the time of agreement.
- *legal form*. The legal form ensures greater legal credit to organizations' actions and facilitates external partnerships. Different contexts affect the legal form of the transition organizations.
- *internal network*. The internal network is made up of working groups and subgroups. There is no leadership, but network organization. Interplay between members is inclusive and participative (Hopkins, 2008).
- *external network*. The Transition Towns movement is not isolated but it interacts with other local and pre-existing social organizations[17] (Seyfang and Haxeltine, 2009). The goal is to focus the actions of civil society on a common aim, without losing the identity and specificity of each initiative. The network organization also avoids the risk of excessive localism. At the same time, there is a network between all the transition initiatives (eg. sharing best practices).

In regard to the second term, the transition initiatives are characterized by:

- *same strategic actions*. The strategic actions concern fields of energy (renewable resources), transport (sustainable mobility), open space (community gardens) and building planning (eco-compatibility), urban economy (food supply, local currency) and community (learning, sense of community, human capital)(Hopkins, 2008; Bailey *et al.,* 2010). Local currencyisnot a necessary criteria.
- *relationship with the public sector*. The relationship with the public sector is usually promoted by transition organizations but it may be the case that local governments are interested in the transition initiatives in terms of forms of cooperation (Bailey *et al.,* 2010).
- *EDAP as final goal*. Although sharing strategic actions fields, each plan concerns a set of initiatives that originated from the local contexts. Therefore, each plan is different because it is flexible within local contexts.

4. CONCLUSIONS. TOWARDS NEW URBAN GOVERNANCE

Folke's theory of the Panarchy (2006) enables the Transition Towns movement as a practical example of the use of the resilience concept in a spatial dimension to be analyzed.

In particular, the concept of resilience in the Transition Towns movement emerges as a *new paradigm of urban growth and development* (Connors and McDonald, 2011) based on oil-free ideas, practices and policies for urban management.

In this movement, resilience is the capacity of urban systems to react to the external disturbance of peak oil. Regarding this disturbance, the transition initiatives propose new ways of using environmental resources that focus on energy conservation and closing energy cycles (eg. food supply based on local production).

However, peak oil is not the only external disturbance (Trapese, 2008). There are indeed several external disturbances that could spark off system shocks (eg. the current economic crisis). Consequently, resilience is not only the capacity of urban systems to react to peak oil disturbance but it is closely linked to the adaptive and progressive capacity to react to all evolving external disturbances (Folke, 2006). It is a progressive, adaptive (also to context) and learning process, that could take a long time and may not involve

group. Only one of the respondent groups (1.4%) had a business involved in setting up the group, and none of them were started by local councils».

16 Data confirm that 55.2% of the respondents share this mission (Seyfang 2009).

17 According to Seyfang and Haxeltine(2009), the 82,4% of the initiatives are linked to other initiatives promoted by pre-existing social organizations (in particular 86,5% are environmentalist ones).

all urban systems in the same way, at the same time. In this sense, the Transition Towns movement is only one model in terms of the use of the resilience concept in spatial planning.

As a first conclusion, we can affirm that resilience has a broad extent. It concerns the rethinking of the traditional idea of urban growth and development that outstrips the traditional paradigm of sustainability and concerns the use of resources in general (Latouche, 2005).

On the other hand, the concept of resilience in the Transition Town movement also emerges as *innate capacity of systems to propose bottom-up ideas, practices and policies for urban management*.

Extending our gaze to the nature of the phenomenon itself, the Transition Towns movement is a grassroot movement - like several others - that provides solutions in order to manage urban complex systems, especially on a local scale. As Jane Jacobs said (1961), the renewal of cities – as complex systems – is innate in the capacity and interest of citizens. The Transition Towns movement was indeed born in and spread through the urban context and it is a practical reaction promoted by the urban community. The movement never refuses the idea of the city. Bottom-up strategic actions aim at new common and shared solutions in terms of urban management.

In this sense, the concept of resilience underlines how some events could be chances to improve the current urban systems status, to trigger social mobilization, to recombine sources of experience and knowledge for learning, and to spark novelty and innovation. It may lead to new kinds of adaptability or possibly to transformational change (Folke*et al.,* 2010).

As a second conclusion, we can affirm that resilience is the innate adaptive capacity and creativity of urban systems to react to various external disturbances and propose new paradigms of growth and development. In other words, system reactions to external disturbances (not only peak oil) are not related to top-down solutions but to solutions innate in the systems, especially in their characteristics and memory.

According to both meanings of resilience in spatial planning – as a *new paradigm of urban growthand development* and *innate capacity of system to propose bottom-up ideas, practices and policies for urban management* – we can stress that it is an approach, a way of thinking, able to propose a *new urban governance perspective* (Folke*et al.,* 2010).

This new urban governance, based on the concept of resilience, concerns urban systems management relating to bottom-up learning capacity and adaptive ability to propose new paradigms and practices. In other words, it means rethinking urban governance through a new rules framework that concerns the three features of *stakeholders*, their *roles* and consequent *tools*, as follows:

- *Stakeholders*. Community-led movements – and those of transition towns – could be stakeholders able to propose new paradigms of urban development and planning practices (Friedmann, 2011).
- *Roles*. Citizens may have a more central role in public choice and, on the other hand, the public sector could innovate itself, learning from bottom-up experiences. In other words, the new urban governance perspective concerns restoring the balance of the stakeholders' role. It means understanding the relevance of inclusive decision-making and (horizontal) subsidiarity (Hirst, 1994; Hirst and Bader, 2001; Brunetta and Moroni, 2012).
- *Tools*. Finally, both features – regarding all stakeholders and their new balanced roles - may have repercussions on urban governance tools (policies and practices). In particular, it means promoting more inclusive policies and practices, which also learn from bottom-up experiences (e.g. EDAP).

To sum up, the concept of resilience and its use in the Transition Towns movement suggests a new urban governance perspective that takes into account evolving social, economic and territorial organization and consequent systems complexity. It may be based on a new balance between institutional and social stakeholders in both decision-making (policies) and subsidiarity (tools achievement).

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TABLE SOURCES

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REVIEWS PAGES

RESEARCHES, PROJECTS AND GOOD PRACTICES FOR BUILDINGS IN THE SMART CITIES

The Reviews Pages keeps the readers up-to-date on developments in five reports: web, books, urban practices, law, news and events. Each report deals with the specific subject proposed in the TeMA issue. These reviews are specialist in nature but contain enough introductory material to make the main points intelligible to a non-specialist. The reader will not only be able to distinguish important developments and trends but will also find a sufficient number of references to the original literature, web and other resources .

01_WEB RESOURCES
The web report offers the readers web pages which are directly connected with the issue theme.

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

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

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

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

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01

SMART CITIES: RESEARCHES, PROJECTS AND GOOD PRACTICES FOR BUILDINGS

REVIEW PAGES: WEB RESOURCES

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In this issue
SMART CITY AT BUILDING SCALE

It is estimated that, at present, the building sector is responsible for 30% of total global greenhouse gas emissions and consumes up to 40% of all energy (Buildings and climate change. United Nations Environment Programme). Because of the progressive growth of construction industry in developing countries and the massive energy waste related to existing buildings, if nothing is done, building-related GHG emissions would grow at alarming rates over the next two decades. Therefore, it is essential to take action to reduce significantly carbon emissions from buildings, helping the dissemination of the most efficient models and strategies to progress towards a low carbon future.

In this context, the European Commission plays a key role, in fact, many of its initiatives support cities and regions in taking ambitious and pioneering measures to progress by 2020 towards a 40% reduction of greenhouse gas emissions; these measures include the promotion of new buildings with net zero energy requirements and net zero carbon emissions (*Net Zero* building).

Today that it's all about the smart city experience, it is necessary to broaden the idea of *Net Zero* buildings and start thinking to *Smart* buildings. While *Net Zero* buildings are constructed using the most advanced technological solutions, *Smart* buildings are designed to run more efficiently and, more important, to communicate with and about their various sensors/systems. Smarter buildings emerge from a holistic point of view that involves collaboration between facilities and IT organizations at new levels (IBM, Smarter buildings). Various components, together, make up what we call a *Smart* Building: heat generation with heat pump, temperature control with blinds, communication with smart grid, energy generation and storage, interpretation of monitored data and forecast for consumption, generation and storage, etc.

Smart buildings represent one of the critical success factors of a smart city because they contribute to optimize energy consumption, integrate renewable energy, reduce costs and CO2, generate and store CO2, support E-mobility charging and more.

In this number, three websites are presented; they are related to the promotion of sustainable building in Europe and U.S.. The first website analyzed is the European web portal for energy efficiency in buildings:

Build Up. It is a platform that promotes the exchange of information between all stakeholders involved in the construction industry.
The second website here proposed is that of Solar Decathlon Europe: an international competition among universities, which promotes research in the development of efficient houses.
In the end, the third and last website indicated is that of the Better Buildings Neighborhood Program, which is a program within the U.S. Department of Energy helping over 40 competitively selected state and local governments develop sustainable programs to upgrade the energy efficiency of more than 100.000 buildings.

BUILD UP – ENERGY SOLUTIONS FOR BETTER BUILDINGS
www.buildup.eu

The goal of Build Up, the European web portal for energy efficiency in buildings, is to provide a platform to exchange knowledge between the different stakeholders involved in the building sector, aiming to reduce the energy consumption of buildings in Europe. Politicians, building professionals and occupants can share information on energy saving for buildings as well as be updated about EU energy policy in the field. The website meets the needs of three different user profiles: building professional, public authority and building owner or tenant, each of which can explore a specific, dedicated, part of the website.
All the information offered by the portal is grouping into eight different sections: *News, Events, Publications, Links, Cases, Tools, Blogs, Communities* and *Frequently Asked Questions.*
In the *News* section, the user can learn more about the latest European news regarding energy efficiency problems and laws, both nationally and internationally.
The *Events* section includes the schedule of the most relevant energy efficiency related events, divided into Top and Upcoming Events. Anyone registered to the site can submit an event to the portal and the list is often updated.
In the *Publications* section, there are reports, set of rules, informative papers, researches and training material related to the issue of reducing energy consumption in buildings. Users can easily submit a document and share their experience with the community.
More than one thousand of links are listed in the *Links* section of the portal; links refer to a wide variety of organizations, institutions and activities across Europe.
The *Cases* section represents an important source of good practices realized in Europe to save energy in buildings. Cases can be projects, energy efficiency campaigns, or reports that can address different topics, such as innovative technologies, legislation, energy performance certification, design for low-energy buildings, monitoring, controls systems and others. The database includes 433 cases.
In the *Tools* section, users can find and submit helpful tools for the improvement of energy efficiency in buildings. Tools can include software applications, excel lists or other programs, which contribute to energy saving; an example can be the *energy performance calculation procedures*.

The Build Up *Blog* gives members of the portal the opportunity to post their opinions, papers, doubts and responses to others' questions; users can interact with each other expanding the debate related to the energy efficiency themes.
The *Communities* section includes over fifty communities, each of which brings together people with same interests and it promotes the exchange of knowledge and experience. Any registered user can start or join a community, but there are specific guidelines to be observed.
The last section of the website is dedicated to the Frequently Asked Questions, ordered by theme and answered by Build Up experts.
Each section of the portal is frequently updated and the website counts almost ten thousand of registered users, providing to be a point of reference for energy efficiency in Europe.

SOLAR DECATHLON EUROPE
http://www.sdeurope.org

Solar Decathlon is an international competition born in 2002 in the U.S.; the challenge occurs every two years and the next one is scheduled this October, at Orange County Great Park. Twenty collegiate teams, applying from all over the world, are call to design and build energy-efficient houses powered by the sun.
The name «decathlon» comes from the number of contests the teams have to overcome: 10 contests for a total of 1.000 points. Each competition allows assessing a specific feature of the houses, such as affordability or livability; there are two different types of contest: *measured contests*, like task completion (cooking, cleaning, etc.) or monitored performance (maintaining certain standard of temperature and humidity, etc.) and *juried contests*, base on jury evaluation.
The aim of the challenge is to encourage the use of renewable technologies in building industry, educating students about the convenience, both in economic and environmental terms, of building a sustainable home: it is possible to have an energy-efficient and solar-powered house which is comfortable, attractive, eco and affordable.
In 2007, with an agreement between the Spanish Ministry of Public Works and the U.S. Government, the Solar Decathlon Europe (SDE) was born. The competition is held biennially, in alternate years respect the American one and while the first two editions took place in Spain, the 2014 edition will occur in Versailles, France. The organization of the SDE challenge is the same as the American, based on 10 contests.
The last edition took place in Madrid in 2012 with eighteen teams representing thirteen countries. It is very interesting to visit the SDE website because it includes the videos of the eighteen houses that participated in the challenge, allowing users to perceive the SDE's atmosphere. An introductory video presents the competition, its organizers and managers, the jury and some team's members, showing an incredible enthusiasm and excitement. Furthermore, other videos complete the virtual tour of the 2012 SDE edition: each of these videos explores one of the challenge house, giving a team's member the opportunity to explain the project, from concept to completion.

More other useful information can be found in the portal, for example, it is possible to learn about the rules and the way a team can apply for the next SDE, or read the profiles of the jurors.
After the incredible success of the European Solar Decathlon, Solar Decathlon China has been added to the international family of Solar Decathlon competitions, in 2011. The first edition will take place in China, next August and it promises to be a triumph.

BETTER BUILDINGS NEIGHBORHOOD PROGRAM
https://www.1.eere.energy.gov/buildings/betterbuildings/neighborhoods

The Better Buildings Neighborhood Program (BBNP) was born in 2010 within the U.S. Department of Energy to develop sustainable energy efficiency upgrade programs using federal funds. The program aims to upgrade existent buildings, both residential and commercial, to reduce energy consumption and allow consumers to save on energy bills as well as produce environmental benefits across the United States.
The BBNP website consists of six parts: *About, BBP Partners, Innovations, Run a program, Tools & Resources* and *News.*
If you want to deepen your understanding of Better Buildings Neighborhood Program, you can find any answer in the *About* section, where an explanatory video shows the advantages produced by the program, communicating straightforward with users.
The *BBNP Partners* section includes more information about partner profiles, case studies and innovative approaches that have already been implemented in many of U.S. states and cities. This section provides many good practices that can be considered as an example by anyone who visits the portal.
A list of the most successful innovations developed to improve energy efficiency in buildings is provided in the *Innovations* section, distinguishing between for types of innovations: *program design, driving demand, financing* and *workforce development.*
The *Run a program* section contains the guidelines for creating and developing a new program; the step-by-step guidance is based on the most positive experiences tested by Better Buildings communities and it can be personalized according to specific needs.
In the *Tools & Resources* section, there is a wide directory including *Documents and Reports*, and *Tools/Calculators* for homes and commercial buildings, downloadable on line to help build new programs.
The latest available program data, namely up to the end of December 2012, reveal that BBNP partners completed more than fifty thousand upgrades by the end of the year, reaching an amazing result and demonstrating the value of the project.

IMAGE SOURCES

The images are from: https://www.asme.org/kb/news---articles/articles/energy/the-net-zero-water-dorm; http://www.alueurope.eu/energy-efficiency-and-build-up/; http://www.univ-angers.fr/en/index.html; http://energy.gov/better-buildings.

02

SMART CITIES: RESEARCHES, PROJECTS AND GOOD PRACTICES FOR BUILDINGS

REVIEW PAGES: BOOKS

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In this issue

NEW AND EXISTING BUILDINGS: WHAT SHOULD WE DO?

The World Business Council for Sustainable Development identified buildings as one of the five main users of energy where megatrends are needed to transform energy efficiency. About 40% of EU final energy demand is due to buildings (it is a larger share than both the transport and the industry sector) and it is estimated that currently available energy-efficiency measures could cost-effectively save around 28% of this. Buildings are also one of the most significant sources of GHG emissions (36% within the EU); for these reasons EU policy has identified increased energy efficiency for buildings as a key objective of energy and climate policy (COM(2006)545). Refurbishing the existing building stock is one of the most attractive and low cost options to save energy and to reduce the emissions of CO_2 at the same time. Therefore, adopting energy efficiency measures in the built environment is important to reach successfully both energy security and ambitious carbon reduction targets. These few considerations allow to understand easy that buildings hold great potential for cost-effective energy savings; the International Energy Agency (IEA) estimates that current trends in energy demand for buildings will stimulate about half of energy supply investments to 2030 and that the energy savings potential in this sector in 2009 will be in the range of 20 EJ per year by 2030, which is the same as the current annual electricity consumption of the United States and Japan combined. Hence the energy optimization of urban structures needs to be part of the sustainability strategy of each European city. Sustainable policies in European cities have to contribute to the paradigm shift from traditional sector oriented approach to a more integrated approach which ensures the consistency between the district energy supply and urban development (BPIE). It should necessary to support and to encourage the construction of buildings with net-zero energy consumption and on the other side, to implement policies improving the energy efficiency of existing buildings. Nevertheless, the regulations regarding the existing real estate reveal little effective because of the complexity of energy problem. The effort that European cities need to take is enlarging the range action both of measures and regulations from the individual building to urban settlements. In these perspective three documents are proposed in order to share energy efficiency good experiences and policies: the holistic strategy for neighborhood energy efficiency of the project Urb.Energy, the steps for a successful implementation of net Zero Energy Building and the energy efficiency policy implementation in the IEA member states.

Title: Holistic strategies for energy efficient refurbishment of the housing stock and renewal of the related energy supply system
Author/editor: AA VV
Publisher: German Association for Housing, Urban and Spatial Development
Download: http://www.urbenergy.eu/241.0.html?&L=0%3E.%3F1%3D1
Publication year: 2011
ISBN code: n.d.

Urb.Energy project's main objective is the development and implementation of integrated concepts and strategies for the comprehensive energy efficient renewal of residential area in the Baltic Sea Region. The several partners of the project worked together in order to relate measures of energy efficiency refurbishment of the housing stock to overall development of residential neighborhoods and the renewal of energy supply infrastructure. Therefore the project aimed at including energy and climate issues within the urban development policies and instruments too. Since the project outcomes have showed that the different local urban and socioeconomic conditions have to be taken into account (i.e. age and status of buildings or energy supply structure), this guide presents an overview of various suitable and realistic approaches to implement energy and climate friendly measures to improve energy efficiency and the use of renewable energy sources in the housing sector, embedded in the framework of an integrated energy efficiency concept for residential urban areas. It provides lessons and recommendations aiming at giving advice to practitioners on local level to choose appropriate solutions in the development of energy efficiency concepts, measures and supporting structures. The integration of the energy efficient concept into the urban development process starts realizing small scale energy efficiency projects, related to single buildings or to a small area, to test and learn from experience and then developing the energy concept for the entire city. Solitary energy efficiency pilot projects, not considered into urban planning process, do not address energy and climate issues and have a weaker impact on climate adaptation and energy reduction or efficiency in the city. Five are the main components to build up a proper energy and climate concept:

- analyzing the energy supply and consumption of the city/neighbourhood and its CO_2 emissions;
- evaluating the potential to save energy, according to the results of energy balance;
- establishing energy and climate objectives;
- developing an action plan with priority, in order to reach the above mentioned objectives,
- developing a plan for managing and monitoring the implementation of measures to increase energy efficiency and climate protection.

In regard to energy requirement of neighborhood it is helpful using the plausibility check: it evaluates the influence of settlement structure type and size, building density and typology on the energy balance of a neighborhood. Another recommendation concern the cooperation and participation of stakeholders (apartment owner associations, residents) to recognize their interests and to create a climate of confidence and collaboration. Information campaigns and meetings should focus mainly on benefits and economically feasible energy efficiency measures and financing opportunities; in this way it is possible increasing awareness and motivating local stakeholders.

All the know-how described derives from the experience gained by the project partners: in the last chapter of the guide over twenty good practices are presented and they cover a wide range of energy concepts and measures for different urban areas, in order to demonstrate under which conditions energy efficiency measures can be realized successfully and how detected barriers can be overcome.

Title: Principles For nearly Zero-Energy Buildings
Author/ editor: AA VV
Publisher: Buildings Performance Institute Europe
Download: http://www.bpie.eu/nearly_zero.html
Publication year: 2011
ISBN code: 9789491143021

The Buildings Performance Institute Europe (BPIE) promotes policies and measures for increasing the energy performance buildings, and thereby reduction of CO_2 emission levels both at EU and Member State level, in order to make a significant contribution to the achievement of the 2020 EU targets. Nearly Zero-Energy Buildings (nZEB) will become mandatory for all new constructions from 2020 onwards. To facilitate this process, BPIE analyzed ten methodological challenges and their implications for setting a sustainable and practical nZEB definition, providing an outlook on necessary further steps towards a successful implementation of nZEB. A proper and feasible nZEB definition should be based on three basic principles related to the main aims of energy efficiency building sector: reducing energy demand, the use of renewable energy and reducing associated GHG emissions. These principles and the relative approaches for implementing them have been performed to verify and evaluate them; the main challenge of the simulation was to provide robust insights into the nZEB principles effect by applying them to a set of reference buildings, sufficiently representative of the wide variety of building-types, considering at the same time the influence of three different European climate zones. According to BPIE assessment of the European building stock, the most representative buildings are single-family houses and multi-storey non-residential building, and for both of them geometry, technical systems and usage patterns have been defined. Over these characteristics, the main European climate zones (Copenhagen, cold climate; Stuttgart (Germany), moderate climate; Madrid, warm climate) have been taken into account.
The simulations have shown that a new-built nZEB standard, based on the suggested principles and findings from this study, is achievable with existing technologies. Related to single family home outcomes show that it is possible to achieve a 90% share of renewables only by using a 100% heat supply from biomass fired systems (boiler, Cogeneration Heat Power), while for multi-storey office building only the biomass boiler and biomass fired micro-CHP variants exceed the 50% share of renewable and it should be helpful using 100% green electricity due to the higher relative share of electricity (lighting). For both types of buildings, using off-site green electricity significantly decreases CO_2 emissions. Possible barriers to the availability of systems and resources may be a market that is not able to satisfy the increasing demand for new technologies. Investments in general need to rise in the future to satisfy the additional demand created by new nZEBs. Therefore, the structure of legal requirements needs to be adapted or changed. This especially applies to the close linkage in the nZEB concept between requirements for the building envelope and renewable energy systems. It would be useful to merge regulations for renewables (as far as they already exist) with existing building regulations or to broaden the scope of regulations more towards renewable. The concept of nZEB also links to the EU job creation targets.
The EU strategy for creating growth and jobs in a sustainable manner, known as the Lisbon Strategy, promotes innovation within businesses and investment in people to create a knowledge-based society. Job effects of the energy-related costs can be calculated by multiplying these with the turnover per employee. According to that calculation, the implementation of nZEB as a mandatory requirement in the future would create about 345.000 additional jobs.

Title: Progress Implementing the IEA 25 Energy Efficiency Policy Recommendations
Author/editor: AA.VV.
Publisher: OECD, IEA
Download: http://www.iea.org/publications/insights/name,15211,en.html
Publication year: 2012
ISBN code: n.d.

The 2012 International Energy Agency report investigates progress with implementing energy efficiency policies in IEA member countries from March 2009 to April 2011. In order to help countries to improve their energy efficiency, the IEA has proposed 25 energy efficiency policy recommendations that cover 25 fields of action across seven priority areas: cross-sectoral activity, buildings, appliances, lighting, transport, industry and energy utilities. The IEA estimates that if implemented globally without delay, the proposed actions could save as much as 7,6 (Gt) CO_2/year by 2030, almost 1,5 times the current annual CO_2 emissions of the United States. The rigorous evaluation process is based on several information mainly related to IEA energy efficiency indicators, policies and measures database and to policy reports and questionnaire submitted by IEA member countries. The outcomes of this assessment show that there have been significant energy efficiency policy developments since the last evaluation conducted in 2009: IEA member countries have implemented many of the policies in the transport and lighting sectors that were only planned in 2009. The transport recommendations focus on road transport and include policies to promote ecodriving and to improve tyre energy efficiency and fuel economy standards for light and heavy-duty vehicles, due to heavy-duty vehicles are responsible for 30% of worldwide fuel use. In particular, Japan is the only country in the world to have fuel-efficiency standards in place for heavy-duty vehicles. Despite this, policies for heavy-duty vehicles lag behind light-duty vehicles. In regard to lighting sector the report revealed further efforts to improve lighting energy efficiency. For example, the Energy Performance of Buildings Directive (2010/31/EU) requires lighting to be considered within the overall building energy performance. Others energy efficiency policy developments are related to energy efficiency requirements for buildings that are a key feature of all IEA member country policies. Infact, most IEA member countries reported recent policies to improve energy efficiency in the buildings sector: Austria, Denmark, France, Germany and United Kingdom had planned policies to promote very-low or no-net energy consumption in buildings (passive-energy houses and zero-energy buildings-ZEB). Nevertheless, the biggest challenge facing most IEA member countries is to strengthen the energy performance of existing buildings. To do this, countries should improve minimum energy performance requirements for existing buildings and implement policies to increase the rate of energy performance renovations.

Most Italy energy efficiency policy implementation has been guided by EU directives and regulations, particularly in the transport, appliance, lighting, and buildings sectors. On the other side IEA states that Italy needs to enforce these policy measures and to maximize their effectiveness, implementing energy efficiency policies not covered by EU directives; for example, much is still to be achieved both in the industrial sector and high quality and comprehensive information for the entire building stock (i.e. information on use, building size, construction type and age) should systematically collected, in order to identify target and document barriers to increased energy efficiency in this sector. In summary, all IEA member countries still have significant unexploited energy savings opportunities that could be achieved with additional energy efficiency policy implementation, whose benefits extend beyond energy security and climate change mitigation to job creation and health improvements.

03

SMART CITIES: RESEARCHES, PROJECTS AND GOOD PRACTICES FOR BUILDINGS

REVIEW PAGES: LAWS

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In this issue

TOWARDS NEARLY ZERO-ENERGY BUILDINGS: THE FUTURE OF THE BUILDING SECTOR IN EUROPE

Since 2002, with the first Energy Performance of Buildings Directive (EPBD - 2002/91/EC), the European Union has set out a strong regulatory framework for achieving a substantial reduction of the energy consumption in buildings. On 8th July 2010, the European Parliament adopted the EPBD Recast (Directive 2010/31/UE) in order to strengthen the energy performance requirements and to clarify and streamline some of the provisions from the 2002 Directive it replaces.

The new version of the Directive tightens the implementation assignments for the Member States and sets the 9th of July 2012 as the implementations deadline. With the EPBD Recast the Member State has been severely tested since the Article 9 requires that "by 31 December 2020 all new buildings shall be nearly zero-energy consumption buildings (NZEB); and new buildings occupied and owned by public authorities shall comply with the same criteria by 31 December 2018". The EPBD doesn't set specific target for the renovation of existing building, but Member States shall follow the leading example of the public sector by developing policies and take measures such as the setting of targets in order to stimulate the transformation of buildings that are refurbished into nearly zero-energy buildings.

A definition of NZEB is given in Article 2 of the EPBD recast as "a building that has a very high energy performance" whereby "the nearly zero or very low amount of energy required should to a very significant level be covered by energy from renewable source, including renewable energy produced on-site or nearby". Member States shall furthermore "draw up national plans for increasing the number of nearly zero-energy buildings" by December 2014, which will have to include:

- the Member State's application in practice of the definition of nearly zero-energy buildings;
- the intermediate targets for improving the energy performance of new buildings by 2015;
- information on the policies and financial measures adopted to encourage improving the energy performance of buildings.

Each European country shall also draw up a list of the existing and potential instruments used to promote improvements in the energy performance of buildings that should be updated every three years.

THE TRANSPOSITION OF DIRECTIVE 2010/31/EU IN THE MEMBER STATES

The European countries are at different stages in transposing and implementing the EPBD recast at national level. The Concerted Action EPBD (www.epbd-ca.org) and the European portal for energy efficiency in buildings, BUILD UP(www.buildup.eu), provide updated information on national implementation status.

A comparative analysis of EPBD progress towards implementation in EU 27 Member States has revealed significant diversity and that only some EU-27 Member States have managed to fully implement EPBD: some States have only adopted a national plan but have not transposed yet the directive into national law and *vice versa*.

In September 2012 the Commission started infringement procedures against 24 Member States that had not notified to the Commission the national measures transposing the directive into national law (the deadline for transposition in the Member States was 9th July 2012). In the meantime a number of Member States notified the Commission of their national transposition, although several did not, and reasoned opinions were therefore sent to Italy, Greece, Portugal, and Bulgaria in January 2013, to Spain and Slovenia in April 2013, to Belgium, Finland, France, Latvia, Germany, the Netherlands and Poland in June 2013.

Among them Italy (DL 63/2013) and Spain (Royal Decree 235/2013) have recently notified the Commission of their national transposition while Portugal did not and therefore the Commission has decided to refer Portugal to the European Court of Justice proposing a daily penalty of € 25 273.60 to be paid from the date of the judgment until the transposition is completed.

The Member States that have already drawn up national plans for increasing the number of nearly zero-energy buildings but that have not transposed the directive into national law are: Belgium, Cyprus, Finland, France, Germany, Hungary, Ireland, Lithuania, the Netherlands, Slovak Republic and Sweden.

To encourage the transition towards nearly zero energy building the European countries don't rely only on direct regulation but also on several economic instruments for energy efficiency in buildings, such as: economic incentives, duties, tax reduction and grants, taxes, charges, etc.

Austria, France and the Netherlands have established national grants for demonstration projects for nearly zero-energy buildings; Germany has allocated grants and reduced interest loans not only for demonstration projects but also for realization of passive houses (standard very close to nearly zero-energy buildings) and Belgium has established regional and local incentives for nearly zero-energy buildings, because the implementation of the Energy Performance of Buildings Directive is a regional responsibility.

In North Europe Denmark, Ireland and the United Kingdom have established national grants for demonstration projects. In particular, the Irish Department of the Environment, Heritage and Local Government has financed in 2009 ten nearly zero carbon social housing developments and the United Kingdom has introduced tax reliefs for "zero carbon homes". In East Europe, Latvia has set national grants for demonstration projects, and the Slovak Republic has foreseen easier administrative procedures for nearly zero-energy buildings at national level. Slovenia and Greece has established incentives for passive buildings and technologies related to nearly zero-energy concept (Annunziata *et al.* 2012).

ITALY AND THE STEPS TOWARDS NEARLY ENERGY ZERO BUILDINGS

Italy transposes the EU Directive 2010/31 with the Decree Law n. 63 of 4 June 2013 governing "urgent provisions for the transposition of Directive 2010/31/EU on the energy performance of buildings for the definition of infringement proceedings by the European Commission as well as other provisions on social cohesion". The new Decree Law should be enacted into law within 60 days, a period during which the government will be willing to consider any comments made by the Regions.

The new provision amends and completes the Legislative Decree n.192/2005 and is intended to "promote the improvement of energy performance buildings, taking into account the climatic and local conditions, as well as the provisions relating to indoor climate".

The provision, entered into force on 6th June 2013, introduces the following innovation:

- the transition from “Energy Certificate” to “Energy Performance Certificate” (EPAs) to be drawn up by qualified professionals. The EPAS will be mandatory for all new buildings or for buildings undergoing relevant refurbishment, in case of sale or lease to a new tenant and for all properties occupied by public authorities. In case of new buildings the certificate is produced by the builder; in case of existing buildings, the certificate is produced by the property owner. In this regard, the Decree n.63/2013 establishes the penalties for violating the commitment to provide the Energy Performance Certificate for new buildings, for buildings in sale or subjected to a new lease and in case of violating the commitment to report energy parameters in the announcement of an offer for sale or lease. The certificate is valid for a maximum time of ten years since its release and is updated at each major restructuring that changes the building energy class;
- the implementation of a national calculation methodology for the definition of energy performance buildings, which will have to take into account the characteristics of the building envelope, the air conditioning systems and the production of domestic hot water;
- the development, by 31 December 2014, of the National Action Plan to increase the number of nearly zero energy buildings needed to clear the definition of NZEB, setting intermediate targets for improving the energy performance of new buildings within 2015, defining policies and financial measures for the transformation of the architectural heritage in NZEB;
- the determination of the date by which all public buildings will be transformed into NZEB; the Dl. 63/2013 fixed as the deadline December 31, 2018, by which all the buildings occupied or owned by public authorities, including schools, will have to be "nearly zero energy", extending this provision to all new buildings since 1st January 2021;
- the introduction of deductions of 65% for energy upgrading of buildings for expenses incurred from 1st July 2013 to 31th December 2013 and extending the deduction of 50% for renovations until 31th December 2013.

SOLAR THERMAL ORDINANCES: MAKING A COMMITMENT TO LOCAL SUSTAINABLE ENERGY

Following the adoption of the Renewable Energy Sources (RES) Directive (2009/28/EC), the 27 EU Member States, "in their building regulations and codes or by other means with equivalent effect, shall require the use of minimum levels of energy from renewable sources in new buildings and in existing buildings that are subject to major renovation by 31 December 2014. Member States shall permit those minimum levels to be fulfilled, inter alia, through district heating and cooling produced using a significant proportion of renewable energy sources". In the framework of the RES and the EPBD it is therefore essential that not only the Member States should promote and encourage the use of energy in buildings, but above all the local authority. Local and regional authorities, in fact, play a vital role in setting-up and implementing renewable energy projects, energy efficiency measures and other energy-related activities. For this reason, at local level there have been developed some innovative planning tools, called "Solar Thermal Ordinances" (STOs), in order to encourage local production and use of renewable energy sources as well as enhance energy efficiency. Solar Thermal Ordinances (STOs) are legal provisions requiring owners of buildings to install a solar thermal system for new buildings or for buildings undergoing major renovation. They are in most cases part of national or regional energy laws and often implemented by means of the local building codes at municipal level. A growing number of municipalities, regions and countries (e.g. Spain, Portugal, Italy, the Baden Wuerttemberg region in Germany and some Austrian regions) are already making use of solar thermal obligations. The first European city to have a Solar Ordinance is Barcelona in August 2000 requiring residential and commercial buildings to generate 60% of hot water requirements from solar. This paved the way for the STO to be included in the national technical building code (CTE, Codigo Tecnico de la Edificacion), approved in 2006, which includes an obligation to meet some of the Domestic Hot Water (DHW) demand with solar thermal energy (whose contribution varies between 30 and 70%). A major benefit of solar thermal ordinances is their effectiveness combined with low costs and limited administrative overheads for public authorities. As part of the building permit process, the inspection with regard to the renewable energy requirement is simple and thus does not strain the public budget.

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IMAGE SOURCES

The image are taken from www.gsamasternews.it; www.grifoflex.it; www.buildup.eu

04

SMART CITIES: RESEARCHES, PROJECTS AND GOOD PRACTICES FOR BUILDINGS

REVIEW PAGES: URBAN PRACTICES

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In this issue

INTELLIGENT UNIVERSITY CAMPUS: THREE CASE STUDIES

More efficient and cost-effective use of the built environment is increasingly being driven by economic and environmental pressures requiring reduction of the cost of ownership and operation of commercial and public buildings. The emerging solution to these pressures is the creation of innovative and ICT-based technologies that improve buildings' efficiency in a reliable, cost effective, and sustainable manner.

For this reason, despite the current economic crisis, the demand for smart building technologies is still growing. Indeed, the value proposition for smart technologies has been demonstrated and a growing number of building owners are starting to adopt them with positive results. From early applications to commercial and office buildings, smart buildings technologies are now applied to a wide range of building types such as residential and educational buildings. As the technology continues to evolve, improve, and decrease in cost, efficient and intelligent technologies will start to become an even more pervasive fixture in buildings worldwide.

This paper focus on a particular type of educational building: the university campus. In particular, the paper describes and analyzes the use of smart technologies and innovative building solutions applied in three university's campus projects:

– Campus Luigi Einaudi of the University of Turin (Italy)
– King Abdullah University of Science and Technology's Campus (Saudi Arabia)
– Cloverdale Campus of the Kwantlen Polytechnic University (Canada)

The case studies aim to analyze the design solutions and technological opportunities offered by this new emerging approach to smart and sustainable buildings.

Although the three case studies are diverse in nature and combine different techniques, they share a set of characteristics that set them apart from "conventional" buildings. An intelligent site planning, low impact buildings material, bioclimatic strategies and solar design, the integration of building services and computer-based building management systems represent key features in the analysed projects.

Compared with “conventional” buildings, these buildings improves operational performance, increases occupant comfort and satisfaction and provides the owner with systems, technologies and tools to manage and minimize energy and water consumption.

THE STUDY CASE OF CAMPUS LUIGI EINAUDI OF THE UNIVERSITY OF TURIN – ITALY

Opening with the academic year 2012-13, the new seat of the Faculty of Law and Political Sciences of Turin completes the campus that the University of Turin is building as part of a complex program of reorganization of its offices that, started in late nineties, included the moving of the faculties in new structures on abandoned Italgas areas along the river Dora.
With 45,000 square meters, 14,000 square meters of green, 70 classrooms for 80,000 students and the modern library pole, the campus is an integral part of a broader process of regeneration of the Northern Eastern part of the city, once headquarter of high environmental impact industries, a site in complete state of abandonment since the seventies. The new complex is designed with a great focus on the issues of environmental sustainability and energy conservation, using innovative low impact materials and an integrated and computerized management of the technological systems.
The new campus, designed by the British firm Foster & Partners, is composed by seven blocks (with parking and technical rooms in the basement) distributed around a circular plaza. A suspended roof, designed with the most innovative criteria of bioclimatic strategies and solar design, connects and shields the campus buildings. Its overhanging sides, devised and diversified according to solar gain, provide the right compromise between sunshine and shade on the walls. Hence, the high level of comfort inside the building and the significant reduction of air-conditioning costs in the summer. This strategy has permitted the use of large windows (ensuring the containment of heat) and the provision of work-study positions with a direct view, overlooking the surrounding landscape. Recourse was made to low-consumption and adjustable lighting (depending on the type of employment and use of the environments) and integrated lighting equipment. From the point of view of consumption containment, the integration between natural and artificial lighting ensures an energy saving of about 20%.
The walls, designed and built to acoustically insulate the building, provide noise abatement which reaches values exceeding 48 dB: even in the presence of high external noise (due to traffic for instance) the educational or consulting activities take place in a quiet and comfortable environment.
Particular attention has been taken in the use of building materials that minimized detrimental environmental effects while promoting, for example, wood products that meet rigorous FSC environmental standards. Over 7,200 square meters of outdoor photo catalytic flooring have been used that, thanks to the combined action of sunlight, neutralize the hydrocarbon molecules, or dust pollutants that settle on them.
A centralized, integrated and computerized management of the technological systems allows the regulation of consumption according to actual use of the building, while continuously monitoring and reporting indoor temperature and air quality condition.

The supply of heat and cold from the trigeneration plant of the complex allows approximately 15-20% savings compared to separate production with individual machines, better efficiency, reduced emissions and increased effectiveness of controls.

THE STUDY CASE OF KING ABDULLAH UNIVERSITY OF SCIENCE AND TECHNOLOGY CAMPUS – SAUDI ARABIA

King Abdulla University of Science and Technology (KAUST) is a new graduate-level research university established in Saudi Arabia to drive innovation in science and technology, and to support research in areas such as energy and the environment. The University's focus on sustainable development is well reflected in the site planning and in the building design of the new KAUST's campus, located on the Red Sea at Thuwal and officially opened with the academic year 2009-10.

Designed and built in just 30 months, the campus integrates a series of innovative strategies to create a low-energy, highly sustainable project in the context of an extremely hot and humid climate, limited rainfall and potable water resources. With its 800 postgraduate students and 600,000 square meters of lot size, located on a flat desert coastal, the campus itself can be considered as a living laboratory where smart technologies are tested.

The campus, designed by the international architecture firm HOK, is composed by 27 buildings arranged in a semi-circle, which border a harbour on the Red Sea. These buildings are specifically located and grouped to maximize the benefits of the unique site microclimate and ecosystem. The strategic position of the buildings was designed to reduce outdoor walking distances and to mitigate the detriments of the sun's movement and the harsh Saudi Arabian climate by minimizing the amount of exterior envelope exposed to the sun. Light-colored paving materials were selected to reflect solar heat gain and decrease the overall temperature.

A monumental roof connects and shields the campus buildings from the harsh climate. This roof has been designed to incorporate massive solar thermal arrays to provide domestic hot water to all campus buildings, and solar photovoltaic arrays to generate and distribute power to campus buildings based upon demand. While the roof protects the buildings from excessive solar gain, atria and courtyards have been integrated throughout campus buildings to infuse natural daylight and facilitate natural ventilation into a majority of the interior spaces.

Passive ventilation strategies of the traditional Arabic house also influenced the design of two iconic, solar-powered wind towers that harness energy from the sun and wind to passively create airflow in pedestrian walkways.

Recognising the value of the water in the region, numerous strategies to reduce the amount of non-potable water needed to irrigate the KAUST campus have been implemented. The comprehensive irrigation plan, for instance, allocates water reclamation loads from condensate, storm, gray and black water to satisfy a majority of the irrigation requirements.

Particular attention has been taken in the use of building materials selection: 38% of materials have being manufactured within 500 miles of the site, and 21% containing recycled content. 100% of the wood was FSC certified.

Highly interactive direct digital controls optimize system operation while continuously monitoring and reporting system performance, energy harvested, energy recovered and energy used to ensure long-term energy management.
The project delivers exceptional performance in the areas of water (100% wastewater reuse, 42% water reduction) and energy (27% annual energy cost savings, 7.8% percent on-site renewable energy). Furthermore, KUAST campus is Saudi Arabia's first LEED certified project and is the world's largest LEED Platinum campus.

THE STUDY CASE OF CLOVERDALE CAMPUS OF THE KWANTLEN POLYTECHNIC UNIVERSITY – CANADA

Officially opened in 2007 as new home of Kwantlen's Faculty of Trades and Technology, the Cloverdale Campus is a successful example of integration between architecture, natural systems and smart technologies.
With its 17,000 square meter, 21 shops, a lab for a variety of trades and technologies and 27 classrooms that accommodate up to 900 full-time students, the campus was designed to minimize the environmental footprint through efficient use of energy and water resources, while providing improved indoor environments and healthier building sites.
Designed by the Canadian firm Bunting Coady Architects, the campus use approximately 50% less energy than other universities across North America. Indeed, The Cloverdale campus is the City of Surrey's first certified LEED Gold building.
Particular attention has been taken in the site planning: building orientation and landscaping were developed to optimize energy performance of the building. The placement and positioning of the Centre allows more natural light and natural ventilation supplied by operable windows and the use of the skylight as a central air chimney.
A major characteristic of the building is the intensive use of renewable energy resources. The Institute's greenhouses draw power from a geothermal energy system, while a bio digestion system uses methane recovered from green waste to power the greenhouses' operations. . A large south-facing photovoltaic array generates 5 kilowatts of renewable energy.
Several water conservation strategies, such as the low-flow drains installed on the roof, allow a water use reduction of 45 % over "baseline" conditions.
Great attention has been taken in the use of locally produced materials and from non- or low-VOC (volatile organic compound) emitting products: at least 50% of building materials are manufactured locally while the wood for the roof and the interiors was sourced within a 500-mile radius of the campus.
The Building Automation System was embraced as a core area of focus to enhance facility improvements and achieve their environmental sustainability goals, which contributed significantly to achieving the LEED Gold Certification.
Some of the key technologies installed includes building controllers integrated with lighting occupancy sensors, isolation dampers for rooms with scheduled operating times, digital networked thermostats for

precise control and feedback, occupancy sensors triggered by sound, in addition to movement, control of exhaust systems, and awareness and training programs.

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IMAGE SOURCES

The image are from: http://eandt.theiet.org; http:// torino.ogginotizie.it; http://hok.com; http://exp.com.

05

SMART CITIES: RESEARCHES, PROJECTS AND GOOD PRACTICES FOR BUILDINGS

REVIEW PAGES: NEWS AND EVENTS

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In this issue
SMART BUILDING

The field of smart buildings is one of the most dynamic sectors of smart cities, affected by a major research activities, with many and important innovations in recent years. In the future it's expected greater progress to transform almost all the current concept of building. The goal is to include the development of buildings that turn in real intelligent entities, able to continually adapt to the different needs of different and multiple users.

Of course, the road is still very long, but all over the world there are a lot of experimental projects implemented successfully and that promise to build new buildings and renovate existing buildings in smart buildings. In this context of particular importance for the various operators, investors and industry researchers to organize events that allow to show the benefits of new solutions developed, ready to be applied and the possible developments planned for the future. These events are also an opportunity to promote and initiate an exchange of ideas between the various stakeholders, in fact in almost all the exhibitions are planned sessions for discussion and debate. Most of these events take place in the countries in the developing world, that is in those countries currently interested by a strong economic and social development. In which the greater dynamism and the availability of capital to invest in this sector means that in these countries are numerous initiatives and opportunities to enable the realization projects dedicated to the realization of smart buildings.

Among the many events organized at European and international level expected in the coming months, there is the Green Building Brazil 2013, that is an international conference focused on the theme of sustainable buildings that will take place at the end of august in the Brazilian city of Sao Paulo. This year is now in its fourth edition, which now can be considered the leading industry conference of fields for the whole of Latin America. The Green Building Brazil is organized by the Green Building Council of Brazil, which also seeks with this event to allow for a constructive dialogue on these issues among managers, entrepreneurs and professionals interested in the development of sustainable buildings. In particular, there are many Brazilians and international experts who take turns during the various sessions of the conference to discuss and present new solutions and experiences that have been or are being developed in this area. There are numerous companies that during this conference have the opportunity to show a wide and qualified audience their products and services. Each year the conference is also an opportunity to take stock

of the state of implementation of LEED (Leadership in Energy and Environmental Design) in general in Brazil and in Latin America. And in particular, one of the main topics discussed with is the one on the application of LEED to the next big sporting events that will take place in Brazil in the coming years from the World Cup in 2014 and then finished with the Olympics in Rio in 2016. The goal of the organizers of the World Cup is to organize the first Green World Cup history, then to plan the same objective was also moved by the organizing committee of the Olympic Games in Rio.

From the European point of view one of the main events that will take place in the old continent in the coming months and that will also address the issue related to the development of smart buildings is the Sustainable Conference 2013. This conference will take place in the first half of September in the city of Graz in Austria, and is organized by Graz University of Technology and the Institute for Sustainable Technologies. This conference is one of a series of major international conferences that address the issues of sustainable buildings and that are promoted by the International Council for Research and Innovation in Building and Construction. The program of this conference has a duration of three years. During the first year they prepare regional conference, the second year is devoted to the performance of these, and finally in the third year there is the World Conference, which will take place in Barcelona in 2014. On the website ww.sbconference.org, you can find the list of all the regional conferences that are not carried out and that will take place during 2013, prior to the World Conference. The importance of the organization of these regional conferences borns from the desire to consider all aspects of technical, economic, social and environmental issues related to sustainable building and how these are addressed in the various regions of the world. In order to create a common knowledge in relation to these issues, as well as to promote also the start of fruitful international cooperation. The importance of the creation of such a network of exchange of information arises from the fact that the construction industry is one of those areas that has more room for innovation and has a great impact on the environment.

Another event of particular interest organized in Europe is the Green Building 2013, which is the most important exhibition in the field of sustainable and energy efficient buildings in Denmark and is organized every year in the first part of October in the city of Copenhagen. In the years, this conference with the large participation has become an important point of reference for all the countries of the Baltic region. In this conference there is the participation as exhibitor many Danish companies that have developed practical and effective solutions that generate real benefits for the environment. For them, this conference is an excellent opportunity to show off a national and international level, given the large participation of visitors on the way of politics, the constructions and design. This conference is of even greater prestige as anticipated by a few days one of the most important global conferences related to issues of environmental sustainability and that is the Global Green Growth to be held at Copenhagen October 21 to 22. In Denmark many initiatives undertaken in agreement between the public authorities and the private investors to ensure greater sustainability of buildings, with the intention to arrive in the near future the construction of buildings can reduce energy use and produce more than what they consume. Looking at the success and great participation in these events it can be stated that the achievement of this goal isn't far away.

Another of the countries interested in recent years by a strong development in which cities are expanding is India. In this country there is a big interest on the part of public authorities and private investors in creating new buildings that provide a minimal use of new natural resources and that they are able during their exercise to limit the energy consumption for their operation. This search for new smart solutions is dictated by the absence of new resources and the need to reduce the maintenance costs of the buildings. To respond

to these needs of the various stakeholders is organized Indian Smart Building Summit 2013, which will turn in 3 to 4 October in the city of Mumbai. The topics, during the two days of events, will be numerous and affect all life stages of the building and the various types of use of buildings and also analyzing the way in which the individual buildings interact with each other. So the vision that is provided to participants during the various sessions in which the conference is divided, it is very broad and comprehensive as to highlight the benefits and opportunities deriving from the use of smart solutions related to both the creation from scratch and the renovation of existing buildings.

Another event organized is the Shanghai Intelligent Building Technology now in its 7th edition will take place in 25 to 27 September at the new exhibition center in Shanghai, where will be set up over 10,000 square meters of exhibition space. This event aims to become the reference point for the growing field of smart solutions, which is developing rapidly in China. In fact, with the rapid economic growth of the country and the ambitious goals of urbanization, is growing the demand for new technologies and solutions that deliver increased comfort, convenience, energy efficiency and security of the buildings.

The growing demand for new smart solutions is also due to the strategic choice of the Chinese government to focus concretely to the development of smart cities in China, so this has become one of the main priorities that the Chinese government is working. This choice has led many state and private companies that are investing in these initiatives. For example, the China Development Bank, is committed to pay USD 12.9 billion of euro for various projects on smart cities between 2013 and 2015. This year's edition will focus in particular on three central themes of Building Energy Efficiency, smart cities and smart homes. In addition to the large exhibition areas, with many exhibitors of major global companies are provided a series of forums and seminars as well as to enrich the event for both visitors and for exhibitors.

The planned sessions include discussions and presentations on the following main topics:

– Shanghai International Intelligent Building Development Symposium.
– Building Automation and Energy Management Systems Technical Seminar.
– China Smart Home Industry Alliance Forum.
– Intelligent Building and Wiring Systems Forum.
– Solutions for the city safe and Smart Building: Russian and international experience.
– KNX Technical Seminar.
– Shanghai Intelligent Building Technology - Building Standard forum.

GREENBULDING BRASIL
Where: Sao Paulo – Brazil
When: 27 - 29 August 2013

SUSTAINABLE BULDING CONFERENCE
Where: Graz - Austria
When: 25 -28 September 2013

INTELLIGENT BUILDING TECHNOLOGY
Where: Shangai - China
WHEN: 25 - 27 September 2013

SMART BUILDINGS INDIA SUMMIT
Where: Mumbai - India
When: 3 – 4 October 2013

BUILDING GREEN
Where: Copenaghen - Denmark
When: 9 – 10 October 2013

WEB SITES

http://www.buildinggreen.eu

http://www.expogbcbrasil.org.br/en/

http://www.messefrankfurt.com.hk/fair_homepage.aspx?fair_id=45&exhibition_id=46

http://www.nispana.com/smartbuildings/

http://www.sbconferences.org

http://www.sb13.org

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