TeMA

Journal of
Land Use, Mobility and Environment

Urban sprawl processes characterize the landscape of the areas surrounding cities. These landscapes show different features according to the geographical area that cities belong to, though some common factors can be identified: land consumption, indifference to the peculiarities of the context, homogeneity of activities and building typologies, mobility needs exasperatedly delegated to private cars.

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THE RESILIENT CITY

Vol.5 n.2 August 2012

print ISSN 1970-9889, e- ISSN 1970-9870
Dipartimento di Pianificazione e Scienza del Territorio
Università degli Studi di Napoli Federico II

TeMA Journal of
Land Use, Mobility and Environment

THE RESILIENT CITY

2 (2012)

Published by

Laboratorio Territorio Mobilità e Ambiente - TeMALab
Dipartimento di Pianificazione e Scienza del Territorio
Università degli Studi di Napoli Federico II

Publised on line with OJS Open Journal System by Centro di Ateneo per le Biblioteche of University of Naples Federico II on the servers of Centro di Ateneo per i Sistemi Informativi of University of Naples Federico II

Direttore responsabile: Rocco Papa
print ISSN 1970-9889
on line ISSN 1970-9870
Registrazione: Cancelleria del Tribunale di Napoli, n° 6, 29/01/2008

Editorials correspondence, including books for review, should be sent to

Laboratorio Territorio Mobilità e Ambiente - TeMALab
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TeMA Journal of
Land Use, Mobility and Environment

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TeMA Journal of Land Use, Mobility and Environment

THE RESILIENT CITY 2 (2012)

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TeMA Journal of Land Use, Mobility and Environment

TeMA

Journal of
Land Use, Mobility and Environment

TeMA 2 (2012) 5-6
print ISSN 1970-9889, e-ISSN 1970-9870

EDITORIALE: RESILIENT CITIES

ROCCO PAPA
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Questo numero della Rivista affronta un tema di crescente interesse nella comunità scientifica internazionale che studia i fenomeni della città e dell'ambiente antropizzato: le capacità adattive dei sistemi urbani di attivare processi di adeguamento a fronte di fattori di perturbazione esterni fortemente squilibranti: le città resilienti. L'attenzione è focalizzata alle strategie e alle azioni messe in campo, sia in ambito europeo che in diversi contesti nazionali ed urbani, per incrementare la resilienza urbana a fronte dei principali fattori perturbativi che ne minacciano lo sviluppo: dai fenomeni di cambiamento climatico, ai rischi naturali ad essi strettamente connessi, alla scarsità delle risorse energetiche.

Il concetto di resilienza è stato oggetto di studi e ricerche fin dalla metà del Novecento in diversi ambiti scientifico-disciplinari, da quello dell'ingegneria a quelli dell'ecologia e delle scienze sociali. Nel corso del tempo, anche grazie ai diversi apporti disciplinari, il concetto ha subìto significative evoluzioni: dall'idea originaria, propria del campo ingegneristico, che individuava nella resilienza la capacità di un elemento o di un sistema di fronteggiare e assorbire gli impatti provocati da un fattore di perturbazione -ripristinando in tempi rapidi la propria condizione di equilibrio- a quella, propria dei sistemi ecologici, che individuava nella resilienza la capacità di un sistema di adattarsi ad eventi perturbativi esterni, riorganizzandosi e innovandosi a fronte delle mutate condizioni di contesto.

Tale interpretazione della resilienza, di gran lunga più rispondente alle caratteristiche dei sistemi complessi, da quelli naturali a quelli sociali e territoriali, è stata oggetto nel corso dell'ultimo decennio di ulteriori approfondimenti, soprattutto grazie alla sua diffusione nel campo di studi relativo ai rischi naturali e antropici. Il termine resilienza viene oggi sempre più diffusamente utilizzato per descrivere un insieme interrelato di capacità adattive in grado di garantire processi di adeguamento a fronte di fattori di perturbazione esterni. È in riferimento a questa idea di resilienza che, soprattutto nel corso dell'ultimo decennio, sta assumendo sempre maggiore rilevanza, anche nell'ambito della disciplina urbanistica, un filone di studi relativo alla Resilienza Urbana.

Le città attualmente sono responsabili dei consumi energetici globali in una misura variabile tra il 60 e l'80% e, almeno in Europa, del 69% delle emissioni di gas climalteranti. Accogliendo oltre il 50% della popolazione mondiale, in esse si concentra inoltre, gran parte della domanda di energia e servizi necessari a soddisfare le diverse e crescenti esigenze (mobilità, illuminazione, confort degli ambienti interni, ecc.). All'opposto, le città

costituiscono sistemi fortemente vulnerabili agli effetti diretti e indiretti del cambiamento climatico: precipitazioni intense e concentrate nel tempo che accentuano la fragilità idrogeologica del territorio e determinano spesso danni significativi proprio alle aree urbane, siccità, isole di calore urbano, problemi di approvvigionamento idrico sono solo alcuni esempi dei numerosi impatti che tali fenomeni hanno sui sistemi urbani e territoriali.

A fronte di tali fenomeni i sistemi territoriali e, soprattutto, le grandi aree urbane, sono oggi chiamati a ripensare le proprie forme di organizzazione in ragione dei fenomeni di cambiamento climatico e della scarsità delle risorse energetiche disponibili e, soprattutto ad accrescere la propria resilienza, caratterizzandosi quali sistemi in grado non soltanto di fronteggiare i fenomeni a breve termine connessi ai cambiamenti climatici ma di costruire risposte che consentano loro di resistere nel lungo periodo alle sollecitazioni poste da tali fenomeni.

All'interno della sezione FOCUS di questo numero della rivista il tema della resilienza è affrontato nei suoi molteplici aspetti. In particolare, l'articolo di Rabino e Cutini pone l'accento sul rapporto tra resilienza urbana e reti di mobilità in ambito urbano, proponendo metodi e tecniche per l'analisi configurazionale, atti a valutare e prevedere le attitudini spaziali dei contesti urbani, e individuando la resilienza come utile concetto per migliorare l'orientamento spaziale in ambito urbano. Il contributo di Gargiulo, Pinto e Zucaro evidenzia la recente transizione dal concetto di sostenibilità a quello di resilienza e propone una rassegna di politiche e buone pratiche europee e nazionali volte ad accrescere l'efficienza energetica degli insediamenti urbani, come punto di partenza per la definizione di un approccio integrato alle politiche di governo del territorio e della mobilità mirato alla riduzione dei consumi energetici. L'articolo di Salat e Bourdic esplora le relazioni tra resilienza e modelli di organizzazione spaziale e funzionale dei sistemi urbani, evidenziando come differenti strutture urbane presentino diverse caratteristiche di efficienza e resilienza. Il contributo di Galderisi e Ferrara, approfondisce l'evoluzione del concetto di resilienza, proponendone un modello interpretativo quale strumento per guidare in chiave di resilienza le attuali strategie e politiche di adattamento dei sistemi urbani ai cambiamenti climatici in atto. Il contributo di Pirlone affronta il tema della Resilienza nella cornice della mitigazione dei rischi naturali, proponendo una metodologia per la messa in sicurezza di elementi strategici in ambito urbano, con particolare riferimento alle attrezzature ospedaliere, al fine di accrescere la resilienza urbana. L'articolo di Angela Colucci propone una rassegna e una comparazione tra differenti approcci al concetto di resilienza e, soprattutto, delle diverse strategie per accrescere la resilienza delle città e dei sistemi territoriali. Il contributo di Saporiti, Echave, Scudo e Rueda approfondisce le caratteristiche di resilienza dei "neoecosistemi", enfatizzando le differenze tra resilienza, sostenibilità e qualità urbana. Il contributo di Verissimo affronta la "spatial resilience in outdoor domestic space in Mozambique". L'articolo di Atun propone un approfondimento del concetto di resilienza in relazione al caso studio della città di Londra, considerata un esempio emblematico di città resiliente, ovvero di città in grado di fronteggiare e riprendersi da un evento naturale. L'articolo di Tezer, Yaman, Altun e Albayrak approfondisce il tema della relazione tra resilienza e servizi indispensabili per un ecosistema urbano, con particolare riferimento ad un distretto urbano della città di Istanbul. Infine, a chiusura della sezione FOCUS, la Rivista ospita un contributo del Presidente del Centro Studi Sistema Protezione Civile - Istituto Italiano di Resilienza.

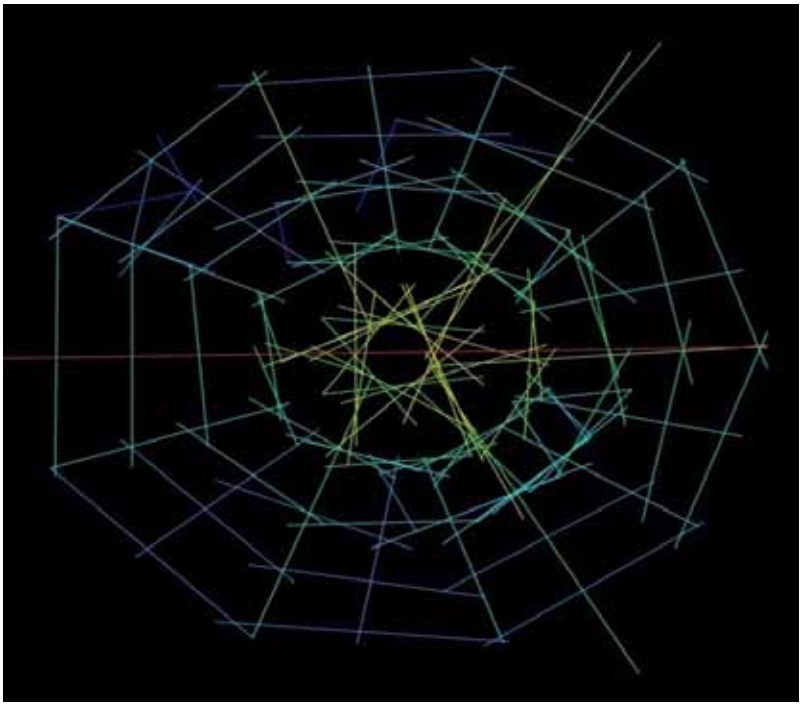
La sezione LUME include un articolo di Xifilidou, Karanikolas e Spatalas che riporta uno studio sugli effetti della localizzazione delle stazioni della metropolitana sui valori immobiliari nelle aree urbane centrali, con particolare riferimento al caso di Tessalonica in Grecia, e ospita il contributo di Macaluso, Guarracino Clemente e Acunzo, dell'Agenzia Napoletana per l'Energia, che propone una rassegna dei finanziamenti Europei per la mobilità e per l'ambiente.

TeMA
Journal of
Land Use, Mobility and Environment

TeMA 2 (2012) 7-22
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: 10.6092/1970-9870/889

review paper. received 30 May 2012, accepted 2 July 2012

www.tema.unina.it



SEARCHING FOR ARIADNE'S THREAD

SOME REMARKS ON URBAN RESILIENCE AND ORIENTATION

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ABSTRACT

This paper concerns the methods of analysis of the configuration of the urban grids. More in details, it will focus on the configurational approach to the analysis of urban settlements, briefly presenting the different methods and techniques it has inspired, sketching their features, highlighting their actual utility and their respective advantages and limits. Moreover, it will propose the use of some further configurational parameters, suitable for describing and reproducing interesting features of urban settlements; more in details, it will cast attention onto the richness and the variety of paths within a settlement, what makes it resilient, that is capable of sustaining changes and transformations without radically modifying its inner geography. Such parameters have been tested on the case studies of Pisa and Venice, which can easily be recognised as particularly relevant and significant, in that the results they provide are diametrically different. Those outputs will then be presented and discussed; the findings are suitable for suggesting resilience as a singular clue for urban orientation, so that the configurational techniques can be proposed as a tool for evaluating and predicting this spatial attitude, here finding an Ariadne's thread for urban wayfinding.

KEYWORDS:
Configurational analysis, resilience

1 INTRODUCTION

The configurational approach to the analysis of urban settlements is a wide stream of territorial studies deriving from its primal theorization by Bill Hillier, who founded it in the mid 80s with the denomination of space syntax (Hillier, Hanson 1984; Hillier 1996a). Since then, researchers all over the world have embraced this approach and have gone developing methods and techniques, experimenting them on a wide range of cases and issues. The configurational approach is based on the fundamental role it attributes the grid of their paths, appraised as the primary element in determining the patterns of human behaviour: mainly movement, which is oriented and leaded by the visual perception of the spatial layout, and through movement, also the location of activities, land value and so on. At the root of the configurational approach is the assumption that an urban grid contains, as a consequence of the spatial relations between its elements, a specific (either strong or weak) vocation for attracting movement flows; such a vocation is likely to drive movement-seeking activities towards the most crowded spaces as well as to address the movement-avoiding ones towards the most segregated and deserted. It is then movement, as addressed by the grid perception, the key element of most urban phenomena (Hillier 1996b); and, in that it does not depend on the located activities(on their presence, on their position, on their consistency), but uniquely on the grid configuration, such movement is called 'natural', that is intrinsically derived from its spatial layout. The consequence of such assumption in anything but unessential: the spatial layout (that is the way blocks and buildings are disposed and mutually arranged and lined along the streets), as decisive in the distribution of movement and in the location of activities, has to be assumed as the input variable of the system, while the activities (their position, their consistency) are to be expected as its very outcome. Such logic does hence take the space of an urban settlement in the foreground, making its material shape the fundamental element of the phenomena (both material and immaterial) that occur along its paths. A further conceptual element at the basis of the theory is the fundamental importance of the relations between the spatial elements of the grid, on which depends its configurational state: it is then the relations which drive the distribution of activities and land uses, through the distribution of movement flows, while geometry provides the arrangement of blocks and buildings with its mere morphologic appearance. Summing all up, the two columns of the configurational approach are hence the primary role of the grid configuration, on a one hand, and, in the other hand, the essential dependence of configuration on the spatial relations between the elements of the grid itself.

2 BACKGROUNDS

The conceptual basis of the configurational theory, which was sketched above, is founded on the hypothesis of the existence of the so-called 'natural movement', defined as the portion of movement that is determined by the grid configuration itself, and hence does not depend on the presence, the position and the consistency of the actually located activities. On such basis, an urban grid implicitly contains of the grid to host the activities according to their respective interest and attraction to movement (Hillier et al. 1993).

Several operational techniques have been developed, sharing the conceptual basis so far briefly sketched, and distinguishing each other for the different way they use to reduce the urban grid into a system. The original Hillier's theory proposes the axial analysis, which transforms the grid into the so-called axial map, a set of mutually intersected lines (the fewest and longest ones which, covering the whole grid, roughly correspond to the lines of sight) (Hillier, Hanson 1984). The axial analysis has to be carried on computing the spatial relation between a single line and all the other, so as to obtain a set of numeric values

corresponding to some parameters, called configurational indices. Among them, the most used are the connectivity value, the control value and the integration value.

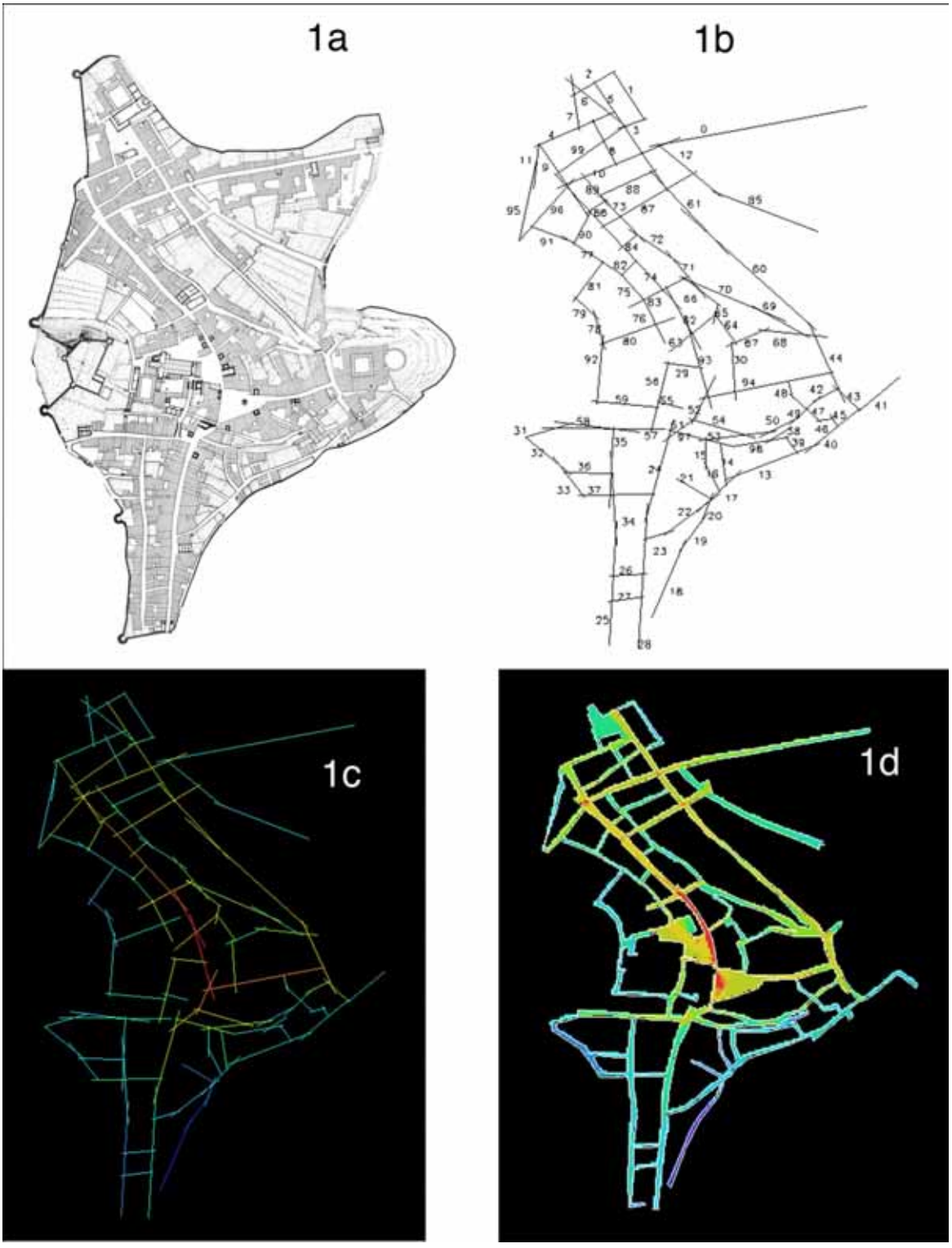

Fig. 1 The reduction of the historic core of San Gimignano (1a) into an axial map (1b). Distribution of axial integration (1c) and VGA integration (1d)

The connectivity value of an axial line is the number of lines which are directly connected, that is intersected; numerically, such value will obviously vary from 1 to n-1, being n the number of lines of the whole axial map. The control value the grade a single line actually controls the path to and from itself; numerically, its value is the sum of the inverse of the connectivity values of the intersected lines. The integration value is by far the most significant configurational parameter, and is defined as the mean depth of a line with respect to all the others, where the depth is the distance a couple of lines, topologically appraised as the number of interposed lines along the shortest path between them. In order to depurate this parameter from the effects of the size of the grid, so as to make possible comparing grids of different dimension, several normalization expressions have been so far introduced, so as to provide different numeric ranges.

The relevant importance of integration derives from some strong evidence of its capability of reproducing the distribution of natural movement; in doing so, it will also result as a reliable indicator of the distribution of the movement-seeking activities, and hence an evocative indicator of urban centrality (Hillier 2000).

Some years after the beginning of space syntax, a different configurational technique, called visibility graph analysis, was proposed, reducing the urban grid into a mesh of vertices, homogeneously distributed along the paths and visually connected (Turner et al. 2001). Such technique share the same conceptual basis of axial analysis, in that it assume a primary role of the grid, reduces it into a system of mutually connected elements, and then provide each of them (each vertex) with a set of numerical values depending on the relation linking it with the others. On such basis, also the configurational indices of axial analysis can be transferred into VGA, and, among them, mainly the integration value. What really changes, on the operational point of view, is the arising of some advantages with respect to axial analysis, as well as the presence of some limits. Among the advantages, we ought to mention a strictly objective construction of the system, which automatically derives from the setting of the density of the mesh, selected in order to fill up the space of the grid and to provide a proper level of detail. Besides, the capability of VGA of taking into account the wide open spaces of the grid, that is the squares, highlighted by the two-dimensional view the method provides. On the other hand, VGA involves the increase of the computing power it actually requires, as well as some difficulties in managing the results, which are scattered in an extremely high number of elements (and hence data). In order to sum up the above sketched techniques, a small example is here presented, showing the urban grid of the historic centre of San Gimignano (fig. 1a), its axial map (fig. 1b), the distribution of axial integration (fig. 1c) and the distribution of VGA integration (fig. 1d). The distribution of integration value is here shown by a chromatic representation, where warm and cold colours respectively stand for integrated and segregated lines/vertices.

A further configurational technique that deserves some mention is the Mark Point Parameter Analysis – Ma.P.P.A. -, which was introduced in 2004 (Cutini et al. 2004) and reduces the grid into a set of singular points (so-called mark points), selected along the paths as particularly significant (middle points of squares, deviation points of road-centre lines, intersection points of road-centre lines, and so on). The main advantages Ma.P.P.A. can provide are an easy construction of the system by its importation from an existing territorial database, a useful possible exportation of the results into the same database and a more capillary and significant definition of the configurational state of the system.

Beside the ones above briefly sketched, many other configurational techniques that here cannot be presented have been introduced in these last few years; among them, it's useful to mention those which reduce the urban grid into the network of its road-centre lines (Crucitti et al. 2006; Porta et al. 2006; Turner 2005). In any case, whatever the system is, the method is applied computing the relations between its elements and determining the values correspondent to the configurational indices; among them, as we

noticed above, the most significant one is the integration value, demonstrated and highlighted in several studies (Bortoli, Cutini 2001; Cutini 2001) as capable of reproducing the distribution of centrality (in terms of attractiveness towards activities). Such a capability makes configurational analysis (whatever technique is actually used) a reliable tool for enhancing the comprehension of the inner geography of urban settlements, and, even more, for supporting and orienting the town planning in managing the arrangement of paths and the distribution of centrality.

3 THE RESEARCH

Most of the researches so far on configurational theory have gone variously discussing the different operational methods, or introducing and testing new techniques, or even criticizing the conceptual bases of the approach (Ratti 2004). Here, assuming a configurational point of view, and taking for granted the actual similarity of the existing configurational methods, we are at investigating around a specific feature of an urban settlement, that configurational analysis is suitable to highlight and, at a certain extent, also to measure. We are referring to the resilience of a settlement, intended as its richness in different paths mutually connecting each other all its parts, so as to offer a various choice of paths from any origin to any destination. At an individual scale, an observer perceives this feature with a wide choice of path towards any destination. Such feature is called 'resilience', in that, at a global scale, it expresses the grade an urban grid can sustain a (large or small) transformation without modifying its relational(and hence configurational) state. A small example is likely to favour a better understanding of the matter; let us consider two different urban grids, whose respective axial map is here sketched in figure 2a and 2b (on the left), and let us suppose (on the right) the interruption of a single line, in both cases located within the inner geometric centre of the system.

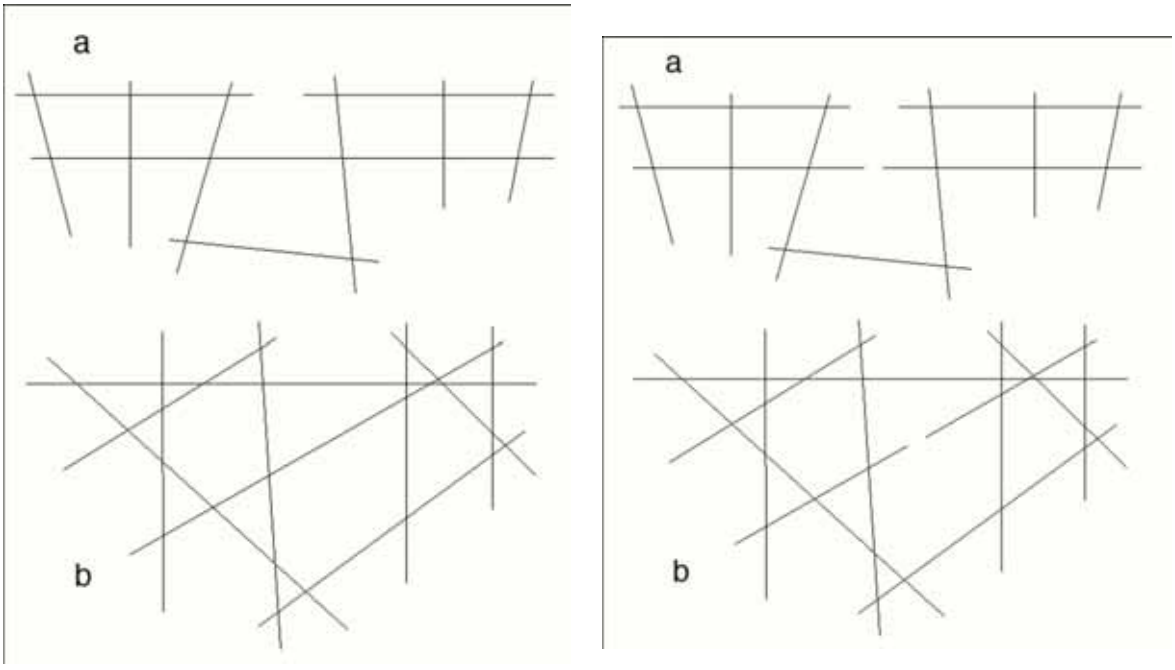

Fig.2 Examples of axial maps (on the left). As they result after a perturbation (on the right)

Such interruption may be either the result of an urban transformation or the temporary effect of an episodic traffic break. In any case, such a variation will determine some effect on the relations mutually linking all the other lines, hence modifying the global configurational state of the system. In the first case, since this variation avoid most of the connection paths between the other lines of the first axial map, the transformation of the configurational state of the system, here represented in figure 3a and 3c by means of the distribution of the integration value, can be said dramatic: the integration core has clearly shifted from the geometric centre of the grid towards its external lines. On the contrary, the effect of a similar variation on the second grid (figure 3b and 3d) is anything but slight, hardly perceptible, so as to leave actually unchanged the position of the integration core. The second grid has therefore adsorbed the variation, which has, on the contrary, radically upset the first one.

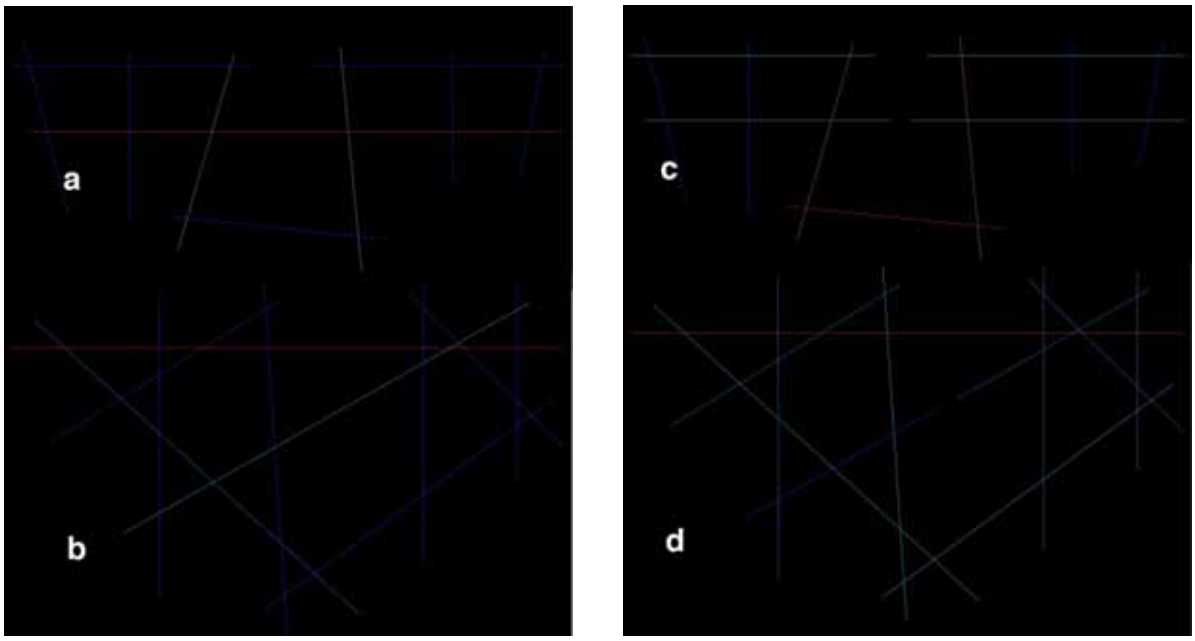

Fig. 3 The distribution of integration value in the maps of fig. 2

The comparison of the analysis of the grid configuration with respect to its previous consistency and to the modified one can therefore indicate the grade the urban system is capable to adsorb any transformation, that is its level of 'resilience': the more different the two configurational states do result, the less resilient can be said the system. Yet, we could ask whether a simple configurational analysis of an urban system, without supposing and introducing a transformation of its layout, can somehow reproduce such a singular capability, so that the grade of 'resilience' of the grid can be appraised and even measured. On such a purpose, two parameters are here proposed, briefly discussed and then, hereinafter, tested on some case studies.

The first one is the mean value of connectivity. If we reduce an urban grid into an axial map, the connectivity value of an axial line is defined (Hillier, Hanson 1984) as the number of lines that are directly connected to it, that is the number of intersected lines. As it can be easily understood, a line which is provided with a high value of connectivity will benefit of a large variety of paths connecting it to any other line of the system; more in concrete terms, a street user moving along the grid will have a wide possibility of

choosing its path. On the contrary, a low connectivity value is expected to stand for the presence of obliged paths to and from the considered axial line.

Of course, connectivity is a local index, in that its value is computed taking into account only the lines that surround (and are actually connected to) the considered one. All the same, the mean value of connectivity, extended to all the lines, all over the grid, can be assumed as a global feature of the whole system, so as to reproduce the density and the variety of paths connecting each line to all the other lines of the axial map. Should a line (and then a path) be interrupted, a high mean value of connectivity would guarantee a dense presence of alternative paths. Therefore, such a parameter can properly reproduce the 'resilience' of the system, intended as its capability to resist and absorb a material transformation of the grid without significantly modifying its relational state (Rabino, 2012); or, in other words, its capability of adapt its movement patter to the different spatial layout. As shown in figure 4, the two extreme paradigms can respectively be recognized as represented by a tenial grid (where each line is chain connected only to the preceding line and to the successive one) and by a star-shaped grid (where each line is connected to all the others).

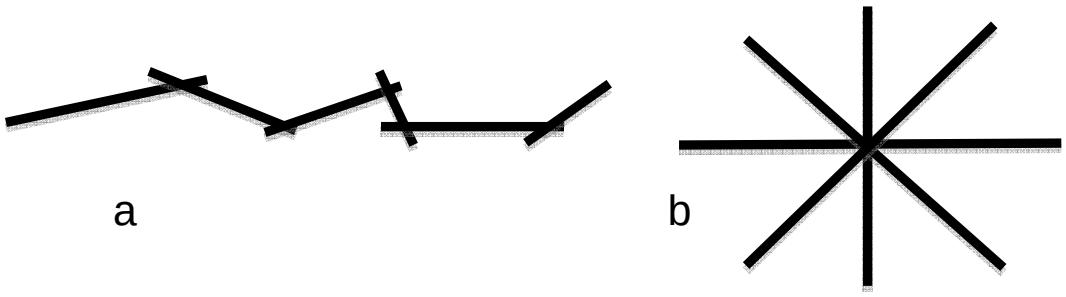

Fig. 4 A tenial axial map (a) and a star-shaped one (b)

The first one is the less resilient system one could guess, since every path (from any origin to any destination) is actually strictly obliged, and any local transformation of the grid will therefore determine the radical change of its global consistency; its mean connectivity value is 2(n-1)/n, rapidly approaching 2 as the number of the lines of the axial map grows. A particularly evocative system of this kind is the labyrinth, which essentially is a perfectly tenial and disorienting grid, in that each turn direction differs from the preceding one (Cutini, Rabino 2012). The star-shaped grid, on the contrary, is the most resilient system, in that the paths between the elements, and hence the configurational state of the grid, won't be modified by any transformation; numerically, in this case the mean connectivity value is n-1, indefinitely growing with dimension of the grid. Summing all up, the connectivity mean value is expected to vary from 2 to n, reproducing such value the resilience of the system.

As an easy demonstrative example, if we consider the above sketched axial maps, the system which is represented in figure 2a is actually provided with a connectivity mean value of 2.9, while the axial map of figure 2b has a connectivity mean value of 5.2.

A second configurational parameter suitable for representing this feature derives from the actual strength of the correspondence of the global integration value versus the local one. On such regard, it's worth specifying that two different integration values can be drawn out of the analysis of an axial map: a global integration value, which results extending the compute all over the grid, and a local integration value, with radius k, which is determined taking into account only the lines that lie within a (topologic) circle with radius k around

the considered one; in most cases, the local integration value is selected with radius k=3. A narrow correlation of global and local integration stands for a strong correspondence of the whole urban system with its local sub-systems: each of them does in fact reproduce, at a smaller scale, the geography of the whole settlement, whose main integrators are also strong local integrators. A local perturbation of the grid (again, either an urban transformation or a transitory street interruption) will hence be adsorbed by the whole mechanism of the grid, and its configurational pattern is likely not to carry dramatic changes. The determination coefficient R^2, obviously varying from 0 to 1, is hence proposed as a further indicator of the resilience of the urban system.

Hereinafter, these two parameters are going to be applied and tested in two case studies, in order to verify their capability of reproducing the resilience of the urban grids.

4 CASE STUDIES

As our case studies, we have selected two urban settlements, rather similar for what concerns their dimension (both planimetric and demographic), but clearly different from a structural and morphologic point of view. Pisa and Venice, in fact, present a radically different spatial layout. The Tuscan city derives from the radial development of an ancient (originally Roman, then, and above all, medieval) inner core, and the grid of its paths, highly dense in the centre, gets looser and looser as one proceeds towards its edge areas, which have grown in the last decade sprawling into the surroundings. The urban structure of Venice is the well known result of the dense urbanization of several small islands, connected each other by means of bridges; due to the lacking of space, its actual extension has not grown in the last centuries.

The urban grids of Pisa and Venice have been reduced into systems, by means of the construction of their respective axial map. In the case of Venice, two different axial maps have been constructed, respectively taking into account and disregarding – side by side with the ordinary street paths, also the so-called 'traghetti': these are the crossing paths of the channels by gondola, and their position is so steadily defined as to let them be appraised as actual urban paths.

As a result of the configurational analysis of the axial maps mentioned above, in figure 5, 6 and 7 the distribution of integration value in the different urban grids is shown by a chromatic representation, where warm and cold colours respectively stand for integrated and segregated lines. The map of figure 5 represents the axial map of Pisa, while figure 6 and 7 represent Venice, respectively without and with the presence of the 'traghetti'.

The same grids of Pisa and Venice have then been analyzed with reference to the local configurational indices, in order to obtain the distribution of radius 3 integration value, which is respectively represented in figures 8, 9 and 10.

5 RESULTS

The results of the analysis of the considered urban grids can be here briefly summarized: first with reference to some general indication concerning the inner geography of the settlements of Pisa and Venice; then, and above all, with reference to the feature that was named 'resilience', as it can be drawn out of the outputs of the analysis.

The integration core of Pisa (fig. 5) clearly results located along the central crux formed by the axis southbound-northbound and the orthogonal direction of the 'lungarni', the streets running along the river Arno. Such crux is centred on the Ponte di Mezzo, the bridge that can hence be recognized as the very centre of Pisa.

Fig. 5 The distribution of global integration value in the lines of the axial map of Pisa

Fig. 6 The distribution of global integration value in the lines of the axial map of Venice (without 'traghetti')

Fig. 7 The distribution of global integration value in the lines of the axial map of Venice (with 'traghetti')

Fig. 8 The distribution of local (radius3) integration value in the lines of the axial map of Pisa

Fig. 9 The distribution of local (radius3) integration value in the lines of the axial map of Venice (without 'traghetti')

Fig. 10 The distribution of local (radius3) integration value in the lines of the axial map of Venice (with 'traghetti')

A strong gradient can also be noticed as we proceed from the centre toward the edge areas, which are characterized by low values of global integration. The distribution of radius 3 integration (figure 10), on the contrary, shows a poorer gradient, with several strong integrators located in the edge areas of the settlement; all the same, it is possible to observe some correspondence between the distribution of global and local integration, with the strong global integrator that are also characterized by high values of local integration, and, vice versa, strong local integrator that are not relevantly segregated in a global scale. Such configurational finding does actually correspond to the distribution of the levels of centrality in the urban areas of Pisa: the settlement, in fact, is characterized by an outstanding inner core, where most of the prominent activities (in particular, shops and offices) are located, and by an external ring, mainly addressed to residential uses. Yet, a singular aspect appears worth mentioning: the north-western urban area, which is provided (fig. 5) by poor values of global integration, nonetheless is crowded with activities, due to the presence of some relevant monopolistic activities that work as attractors; in particular, here we refer to the monumental area of Piazza dei Miracoli, to the regional hospital of Santa Chiara, to the university of Pisa. Such presence determines some discordance between the configurational state of the grid, as it emerges from the distribution of integration value, and its functional pattern, as it appears from the density of activities in that specific part of the settlement. This local discordance ought to be highlighted in order to point out that the presence of monopolistic activities, as located without taking into account the distribution of attractiveness, are likely to modify the functional pattern that would result from the configurational state of the grid.

The analysis of the grid of Venice (either with the 'traghetti' or without them) provides results that more than slightly differ from those sketched above. First, we can observe a far poorer gradient centre-periphery of integration, both global and local: the integration core appears spreading all over the grid, even if the configurational centre results as corresponding to the Ponte di Rialto, which stands as the very heart of the settlement; what clearly confirms any intuitive expectation, since the Ponte di Rialto is by far the most crowded space of the grid of Venice, crossroads of most of its internal paths. Second, we may also notice a wide discordance between the global integration pattern and the local integration one: in few cases, in fact the main local integrators are also strong global integrator; while, on the contrary, several lines with high levels of global integration results provided with low values of radius 3 integration. Such feature, so clearly different from the pattern of Pisa, seems to suggest that the urban settlement of Venice may be used a suitable case study for testing the parameters we have above presented to reproduce the 'resilience' of the grid. On such a purpose, let us compare the mean values C_M of connectivity in the cases of Pisa and Venice, here represented in the table that follows:

	PISA	VENICE (w/o "traghetti")	VENICE (with "traghetti")
Mean Connectivity	6.638	2.707	2.707

Table 1 Mean values of connectivity in the axial maps of Pisa and Venice

It is easy to notice a sharp difference in the mean values of connectivity between Pisa and Venice, so as to confirm the first impression concerning the different 'resilience' of such centres. In other words, and more in concrete, it appears as though the inner structure of the grid of Venice is somehow labyrinthine, as composed of a large number of tenial sequence of lines. On a one hand, such feature seems to correspond to the intuitive experience of every street user, commonly being disoriented (and frequently getting lost)

while walking within the *calli* of Venice; what actually seldom happens in Pisa, where wayfinding is generally much easier. On the other hand, the same feature is likely to make Venice's grid much less resilient, in that each slight and local change is likely to cause some significant transformation of the global pattern of urban relations.

If the first point appears to deal with intuition and with 'common' experience, which can hardly be objectively demonstrated, on the contrary the issue concerning the resilience of Pisa and Venice can be discussed on the basis of the above proposed configurational parameters.

We have hence seen how different are in the selected cases of Pisa and Venice the two proposed parameters, that is the mean value of connectivity and the R^2 coefficient of the correlation global integration versus local one: in the case of Pisa we find an R^2 value of 0.641, which can be regarded as very high, and even impressive if compared to the values of 0.053 and 0.046 of the grids of Venice.

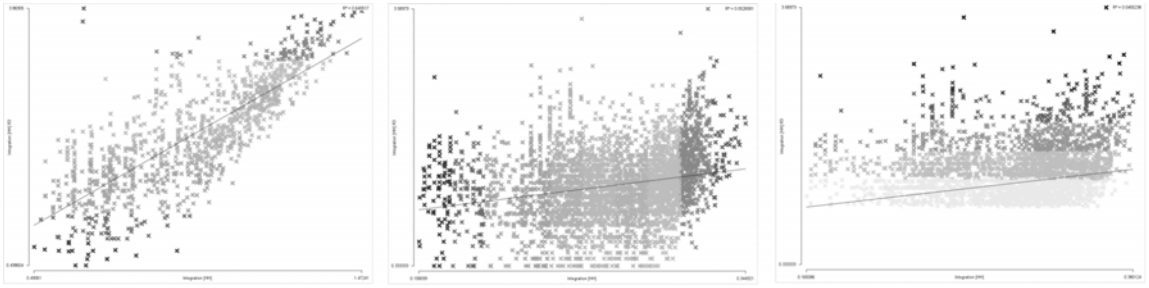

Fig.11 The correlation between global integration and radius 3 integration in the grids of Pisa (left), Venice without 'traghetti (centre) and Venice with 'traghetti" (right)

Fig. 12 The distribution of global integration value in the transformed axial map of Pisa

In order to verify that such differences actually stand for some relevant difference in the respective resilience of the grids, we then introduce in both cases a local perturbation of the grid, that is the insertion of a bridge. Either in Pisa and in Venice, in fact, the settlements are strongly characterized by the presence of the bridges: at present four bridges cross the river Arno in Pisa and three bridges cross the Canal Grande in Venice. In the following figures 12 and 13 the distribution of global integration in their transformed grids is shown, so as to clearly highlight the differences with the respective distribution of figures 8, 9 and 10.
Comparing such results, it is easy to notice how similar (nearly unchanged) are the distributions of integration in Pisa, and, on the contrary, how different are the same distributions in Venice. Here, the introduction of a further bridge has determined a dramatic change in the distribution of global integration and therefore in the location of the integration core.

Fig. 13 The distribution of global integration value in the transformed axial map of Venice (without 'traghetti')

6 CONCLUSIONS

Some inferences can be easily drawn out of the findings sketched so far. First, a correspondence of the trend of global integration value with the distribution of the levels of centrality does exist, so that in both cases the integration core roughly coincides with the most crowded (with shops, offices, strolling people, etc.) streets of the settlement; the distribution of integration value in the grid of Pisa shows a far stronger gradient centre-periphery than in Venice, where, on the contrary, well integrated lines appears scattered all over the grid. In the case of Pisa the distribution of global integration and local one are somehow similar, so that we can observe a narrow correlation between them; on the contrary, in the case of Venice an evident discordance between them is attested by a poor correlation coefficient. Also the mean connectivity value is much higher in Pisa than in Venice. Such differences seems to prove the efficiency of these proposed parameters to reproduce the level of resilience, what is confirmed by the relevance of changes in the configurational pattern that a local grid transformation actually determines: slight changes in the case of

Pisa, radical changes in Venice. At the same time, those findings appears to confirm the typical labyrinth-like structure of Venice and the consequent difficult wayfinding: what actually results from the intuitive experience of every street user, but can also be objectively stated (predicted, and even measured) by means of the configurational analysis of its grid.

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ACKNOWLEDGMENTS
This paper comes from a joint thinking over relations between configurational analysis (V. Cutini) and pedestrian modelling (G. Rabino). Both the authors thank A. Coda and other students for helping in input data (Venice) construction and doing a number of software (Depthmap) runs.

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TeMA Journal of
Land Use, Mobility and Environment

TeMA 2 (2012) 23-53
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: 10.6092/1970-9870/920

review paper. received 7 June 2012, accepted 14 July 2012

www.tema.unina.it

CITY AND MOBILITY

TOWARDS AN INTEGRATED APPROACH TO RESOLVE ENERGY PROBLEMS

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ABSTRACT

The issue of integration among city, mobility and energy plays a central role in the current EU policies, aimed at achieving energy saving targets, independence from fossil fuels and enhance of the urban systems resilience, but the strategies of the single states are, however, still far from its implementation. This paper proposes a reading of the current policies and of the recent initiatives aimed at improving the energy efficiency of settlements, implemented at both Community and national level, aimed at laying the groundwork for the definition of an integrated approach between city and mobility to resolve energy problem. Therefore, the paper is divided into six parts. The first part describes the transition from the concept of sustainability to the concept of resilience and illustrates the central role played by this one in the current urban and territorial research; the second part briefly analyzes the main and more recent European directives related to city, mobility and energy, while the third part describes how the energy problem is afforded in the current programming and planning tools. The fourth and fifth parts, are intended to describe the innovative practices promoted in some European and Italian cities concerning energy efficiency aimed at the integration between urban and transport systems. The last part of the paper, finally, deals with the definition of a new systemic approach for achieving objectives of energy sustainability. This approach aims at integrating strategies and actions for strategies of mobility governance, based on the certain assumption that the core for the most part of energy problems is mainly represented in medium and large cities.

KEYWORDS:
resilience; urban transformations; sustainable mobility; energy efficiency

1 FROM THE CONCEPT OF SUSTAINABILITY TO THE CONCEPT OF RESILIENCE

In the different fields in which the concept of resilience has been used it has always taken a positive sense, from physics where it indicates the ability «to withstand hardship and disturbance and to regain one's original shape after deformation» (Dosch, Porsche 2011) to ecology and social sciences in which the resilience of a system is defined as «the capacity to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks» (Holling 2004). However it is the debate on climate change that has contributed, in the last ten years, to the popularization of the term so that some authors consider resilience as the key issue of the future (Levin et al. 1998, Perrings 2006). The effects of climate change on urban areas are widely treated in literature, thanks to the authoritative report developed at world and EU level as the IPCC IV Assessment Report (IPCC 2007) or the European Environment Agency's report "The Impacts of Europe's Changing Climate: 2008 Indicatorbased Assessment" (EEA 2008). It is important enhancing resilience of urban systems so that they can resist and adapt to threats from both natural and anthropogenic risks (Boscher 2008), because the built environment and the urban infrastructure provide the setting for human activity and in Europe about 75% of the population lives in urban areas (EEA 2010).

Fig. 1 The building of resilient cities is based on strategies of mitigation and adaptation and requires a multidisciplinary approach related to the ability to integrate economic, ecological, technological innovation within National government policies.

In this regard, there are many authors and institutions that have only recently transferred the concept of resilience in urban and regional sciences (Alberti et al. 2003, EEA 2005, UN 2012, IPCC 2012), identifying in building resilient cities the guiding principle for the future development of the cities (Galderisi et al. 2010). Cities play simultaneously actions of opposite sign: on the one hand they represent one of the principal source of pollution and global warming and, on the other hand, they try to develop strategies of mitigation and adaptation to help combat the effects due to climate change.

Therefore, in this field, resilience can be defined as «the ability of a socio-economic region, to absorb the endogenous or exogenous disturbances by change processes, so that the main functions, structures and relationships being essential for the well-being and sustainability of the region remain intact» (Lukesch, Payer, Winkler, Rieder 2010).

The definition given above underlines the connection between the concept of resilience and that one of sustainability; some authors emphasize that: «resilience is to the 2000s and 2010s what sustainability was to the 1980s and 1990s» (Foster 2010) and also that «a development strategy is not sustainable if it is not resilient» (Perrings 2006). The concept of sustainability considers the evolution of urban systems as mainly related to endogenous factors and tends to achieve a stable equilibrium state when the present generation meets his own needs «without compromising the ability of future generations to meet their own needs» (WCED 1987). Instead the concept of resilience looks at urban development as a process that evolves as a result of both endogenous and exogenous events, unexpected and unpredictable, involving the reorganization of the urban system towards a new dynamic equilibrium state.

For over twenty years the urban system has been defined by some authors as a system whose equilibrium state is only apparent because, in reality, it is in stationary equilibrium or in dynamic stability. In line with the "catastrophe theory" elaborated by Thom and according to Morin's philosophy of heterogeneity, they consider city as «a system characterized by an inextricable complementarity between "disordered phenomena" and "organizers phenomena", who regulate themselves in a subsequent state of stationary equilibrium» (Papa , Gargiulo 1993). In this sense, urban system is characterized by its own structure, which can be understood as an aggregate of additional factors in relation to each other to form a complex unit, as the product of interrelationships/interactions between the constitutive elements, the internal organization, the conditions and the external constraints (Papa, Gargiulo 1995).

Because of its complexity, within the definition of strategies to counteract the effects of climate change we must take into account the potential impact that a local event may lead to the overall functioning of the system. The effects of climate change, in fact, affect the different urban components (physical, functional, anthropic ones and so on) on different levels and with different intensity (Fistola 2010). In summary, it is necessary that the tools and techniques of territorial transformation government «are no longer static projection tools or techniques of formal control, but they should adapt to the dynamism and diversity of the city» (Papa, Gargiulo 1995).

Despite the several definitions of resilience provided in urban science and the difficulties of controlling and managing complex phenomena, it is obvious how complicated is to identify strategies for building resilient cities. From the reading of international treaties and of policies and projects at European level, it is clear that the only strategies able to enhance resilience of urban systems are of two types: mitigation and adaptation. Mitigation strategies are aimed at reducing anthropogenic emissions of greenhouse gases and simultaneously at implementing natural mechanisms of absorption (carbon sinks);instead adaptation strategies are intended to anticipate the possible negative effects of climate change and to prepare plans, actions and measures for the construction of settlements that are able to conform to the consequences of climate change (IPCC 2001).

The essential role played by land use policy (mixed use, compact settlements) may cause a lower consumption of fuel for travel by private means, and therefore may have an indirect but crucial role in the pursuit of strategies for mitigation. For their own purposes, mitigation strategies determine changing lifestyles mainly related to mobility and energy production and consumption in urban areas (Provincia di Siracusa 2011). Moreover, while mitigation strategies act at local level but are dictated by international, Community and national policies, adaptation has mainly a local character.

This is related to the effects of climate change that assume different declinations according to the characteristics of the territory on which they act and need a structured and flexible response of the community in terms of defense actions, urban planning and social organization (Nguyen Xuan A. 2011).
In consideration of the foregoing it is clear that mitigation and adaptation strategy are complementary and need an effective integration to counteract the causes of the changes already in place and prepare urban areas for the unpredictability of future events. Integrating mitigation and adaptation strategies means, finally, focus on the integration between urban and mobility system in order to achieve high levels of urban resilience as soon as possible.

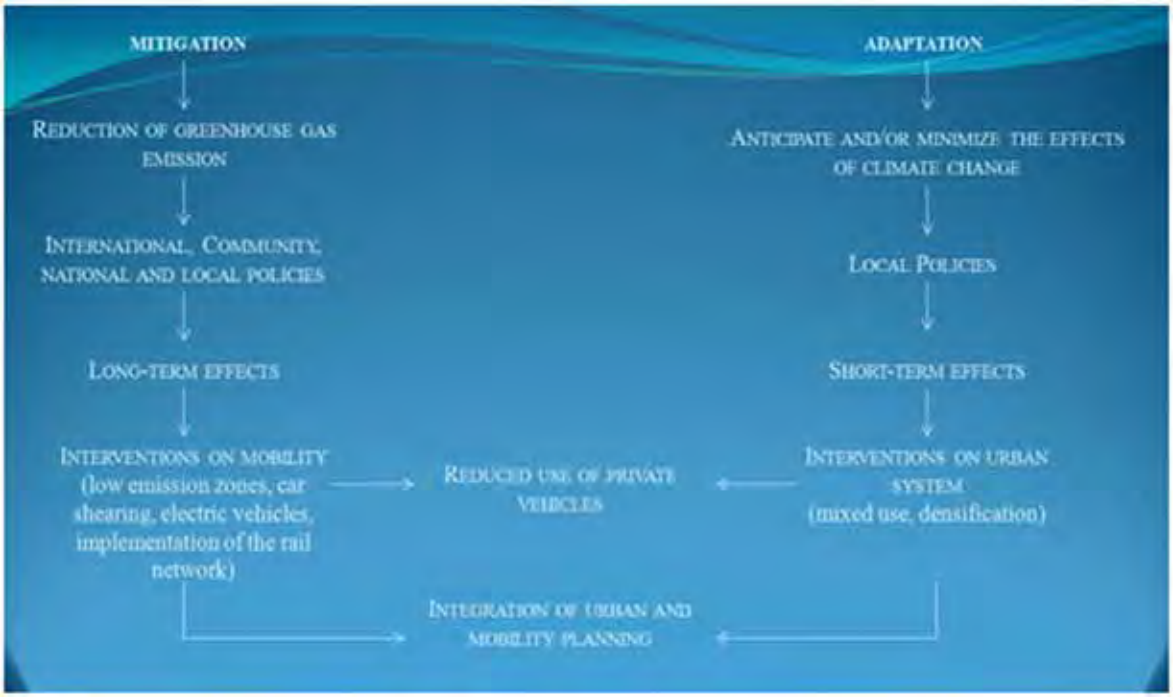

Fig. 2 The strategies to put in place to enhance the resilience of urban systems are mitigation and adaptation whose effectiveness cannot be separated from their integration and, given the areas on which they act, also from the integration of the territorial transformation government and mobility management.

2 CITY MOBILITY AND ENERGY: EU POLICIES

The European Union (EU) has been committed to tackling climate change and has placed it high on its agenda since 1992, when the UN Intergovernmental Panel on Climate Change's (IPCC) first assessment report warned of rising global temperatures caused by greenhouse gas emissions. The EU committed itself that same year to stabilizing its carbon dioxide (CO_2) emissions at the 1990 level by 2000.
The EU intensified its actions after the Kyoto Protocol was agreed in 1997. In 2000 the European Commission set up the European Climate Change Programme (ECCP) as the key vehicle for identifying and developing, with Member States, policies and measures that can be taken at EU level to reduce greenhouse gas emissions (EU 2005). After then, there have been numerous directives issued on climate change aimed at integrating different levels of government and the various disciplines involved: from the Green Paper "Adapting to climate change in Europe – options for EU action" published in 2005, to the White Paper "Adapting to climate change: towards a European framework for action" in 2009, until the most recent strategy "Europe 2020 – for smart growth, sustainable and inclusive".

The last one provides by 2020, to reduce greenhouse gas emissions by at least 20% compared to 1990 levels, to increase the share of renewable energy sources in our final energy consumption to 20%; and to improve the energy efficiency of 20%. According to the European Commission «environmental problems prevailing in the city are mainly related to the use of fuels derived from oil, emitters of CO_2 and air and noise pollutants» and especially «the transport sector is one of the most difficult to manage in terms of emission of CO_2» (EU 2007).

Most of the actions on the mobility system promoted by the EU are therefore related to mitigation strategies, with the aim of obtaining a significant reduction of greenhouse gas emissions by well-defined time horizons and a reduced dependence of the transport sector by oil, for a more sustainable mobility.

In the Green Paper published in 2007 entitled “Towards a new culture for urban mobility”, the European Commission, identifies among the challenges that European cities will face for the construction of “a new urban mobility culture” the one related to the “improvement of urban traffic”. Promoting walking and cycling, improving the attractiveness and safety of travel by alternative means of transport to the private car, promoting co-modality, adopting a parking policy aimed at reducing traffic, further integrating the distribution of goods within the city limits are the solutions proposed to overcome this challenge that have indirect effects on the reduction of polluting emissions.

The actions strictly related to the reduction of polluting emissions focus, instead, on sustainable urban transport projects, and are aimed: at the promotion of the use of clean and energy efficient vehicle technologies and alternative fuels, such as biofuels, hydrogen and fuel cells; at the application of restrictions for heavy polluters and the realization of privileged access for low-emitting vehicles in sensitive areas; at the introduction of local traffic restrictions and urban charges. The most recent White Paper on transport “Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system” (EU 2011) provides also, by 2050, a reduction of greenhouse emissions by at least 60% compared to 1990 levels, including intermediated stages by 2020 and 2030.

In line with the flagship initiative “Resource efficient Europe” set up in the Europe 2020 Strategy (Communication of the European Commission n. 2020 of 2010) and the new Energy Efficiency Plan 2011 (Communication of the European Commission n. 109 of 2011), « the paramount goal of European transport policy is to break the transport system’s dependence on oil without sacrificing its efficiency and compromising mobility and to help establish a system that [...]offers high quality mobility services while using resources more efficiently. In practice, transport has to use less and cleaner energy, better exploit a modern infrastructure and reduce its negative impact on the environment and key natural assets like water, land and ecosystems» (UE 2011).

For this purpose the document identifies three strategies for the reduction of polluting emissions which are divided into ten objectives:

- Developing and deploying new and sustainable fuels and propulsion systems:
  1. Halve the use of ‘conventionally-fuelled’ cars in urban transport by 2030; phase them out in cities by 2050; achieve essentially CO_2-free city logistics in major urban centres by 2030.
  2. Low-carbon sustainable fuels in aviation to reach 40% by 2050; also by 2050 reduce EU CO_2 emissions from maritime bunker fuels by 40%.
- Optimising the performance of multimodal logistic chains, including by making greater use of more energy-efficient modes:
  3. 30% of road freight over 300 km should shift to other modes such as rail or waterborne transport by 2030, and more than 50% by 2050, facilitated by efficient and green freight corridors.

4. By 2050, complete a European high-speed rail network. Triple the length of the existing high-speed rail network by 2030 and maintain a dense railway network in all Member States. By 2050 the majority of medium-distance passenger transport should go by rail.
5. A fully functional and EU-wide multimodal TEN-T “core network” by 2030, with a high quality and capacity network by 2050 and a corresponding set of information services.
6. By 2050, connect all core network airports to the rail network, preferably high-speed; ensure that all core seaports are sufficiently connected to the rail freight and, where possible, inland waterway system.

– Increasing the efficiency of transport and of infrastructure use with information systems and market-based incentives

7. Deployment of the modernised air traffic management infrastructure in Europe by 2020 and completion of the European Common Aviation Area.
8. By 2020, establish the framework for a European multimodal transport information, management and payment system.
9. By 2050, move close to zero fatalities in road transport. In line with this goal, the EU aims at halving road casualties by 2020. Make sure that the EU is a world leader in safety and security of transport in all modes of transport.
10. Move towards full application of “user pays” and “polluter pays” principles and private sector engagement to eliminate distortions, including harmful subsidies, generate revenues and ensure financing for future transport investments.

3 THE ENERGY ISSUE IN THE CURRENT PROGRAMMING AND PLANNING TOOLS

In 1992, 28 European nations signed the United Nations Framework Convention on Climate Change (UNFCCC), which states that parties are committed to« formulate, implement, publish and regularly update National and, when appropriate, regional programmes containing measures to facilitate adequate adaptation to climate change» (UNFCC 1994).

The European countries involved are at different stages in forecasting, formulating and implementing adaptation and mitigation strategies at national level. Starting from Finland who was the first European country to implement an adaptation strategy in 2005 with the FINADAPT, 23 other European nations including Spain, Germany, France, United Kingdom have adopted national strategies in the field of climate adaptation and some countries, such as Denmark, have already released the third update of its national action plan. Italy, Cyprus, Luxembourg, Poland and Slovenia are the only countries that have not yet developed a national adaptation strategy.

The only national environmental and energy plans developed in Italy are related to specific aspects such as energy efficiency and renewable energy. The PAN (National Action Plan for Renewable Energy 2010), implementing the Directive 2009/28/EC, promotes the production of energy from renewable sources and aims at reaching a share of renewable energy equal to 17% of gross final consumption by 2020; at the same time, the EEAP (Italian Action Plan for Energy Efficiency 2011) is aimed at reaching the Community objective of saving energy corresponding to 9.6% by 2016.

Italian Regions have acquired energy competences in recent years without the necessary equipment of regulatory and synthesis tools promoted by the central administration (Camera dei Deputati 2009).

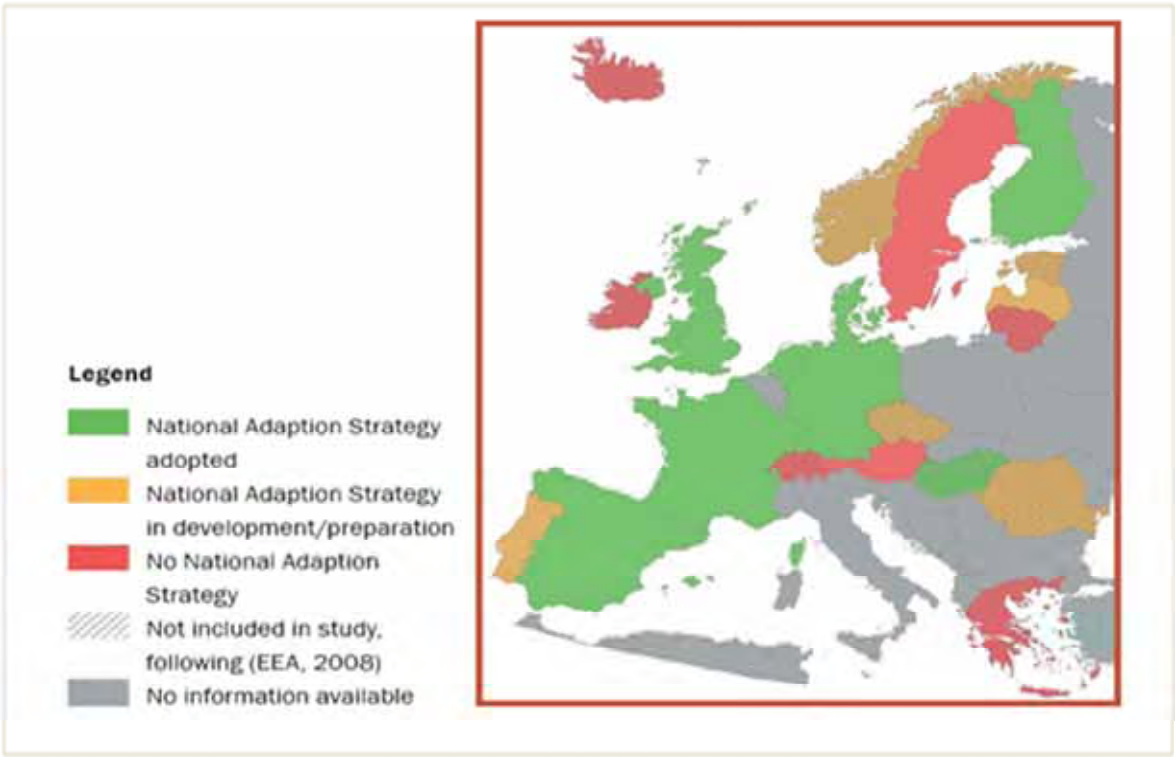

Fig. 3: The status of adaptation strategy developed in Europe: Italy is one of the few European countries that has not developed a unified plan of action at national level.

There are a lot of Regional laws that govern the territorial energy planning (Lombardia Regional Law n. 11/12/2006 24 “Acts for the prevention and reduction of air emissions to protect the health and the environment”, Basilicata Regional Law n. 1 of 19/01/2010 “Acts on energy and Regional Environmental Energy Plan”).

Emilia-Romagna Region was the first in Italy to regulate, through the Regional Law 3/1999, the energy issue by giving to the regional administration the task to define the objectives and the guidelines of regional energy policy within the Regional Energy Plan (20007). This Plan is implemented through three-year Action Plans and Annual Programs. Among the various actions related to the seven lines of action developed in the Second Three-year Action Plan of the Region Emilia Romagna (2011), those connected to the 5th axis of intervention "Promotion of sustainable mobility", are:

- improve the attractiveness of local public transport;
- promote modal interchange and pedestrian mobility;
- integrate planning and database of indicators concerning mobility and transport;
- support measures aimed at spreading low emission vehicles;
- support measures aimed at furthering the rail transport of goods and people;
- support measures aimed at optimizing the logistics business.

All regional laws are characterized by detailed measures on renewable sources, energy saving of buildings and rational use of energy. The role played by the transport sector in reducing polluting emission, however, is still marginal and the regional guidelines don’t find practical application in specific action plans at local level (both provincial and municipal).

At regional level, therefore, energy policies affect only some components that contribute to high energy consumption without recognizing the benefits due to their synergistic effects. A similar situation is recorded

at the provincial level, although at this level there is a greater integration between aspects regarding climate, energy and mobility.

For instance, Modena Province has in its Provincial Territorial Coordination Plan (PTCP) "Strategies on sustainable energy" which defines the goals for the planning tools at the local scale:

- trigger processes of urban "densification" and promotion of a more compact city model;
- increase the energy performance of new settlements;
- implement environmental policies for the regeneration of urban areas;
- polarize the major urban functions and units of new housing in relation to energy and public transport network;
- promote procedures for energy certification of buildings (Province of Modena 2009).

To achieve these objectives in the section n.84 of the Technical Implementation Rules "Addresses and guidelines for energy sustainability of Municipal Structural Plan" is expected that «in defining the physical and functional structure of the urban system, the urban densification policies must be implemented in order to distribute the demographic weight with respect to energy sustainability of settlements both from the availability of resources and the indirect effects of mobility on energy consumption» to «draw up demand and supply of energy and reduce energy consumption related to mobility».

The relationship between urban planning and sustainable transport in order to reduce energy consumption. is supported by the section 99 of the Technical Implementation Rules: «the achievement of sustainable forms of mobility involves first the presence of correct spatial relationships between urban services, above all if of daily access (schools, neighborhood shops, etc..), and distribution of residences and work places»; the same section suggests specific indicators (average distance of residential areas, weighted with respect to the resident population, from the primary services; percentage of population in comparison to the total one that resides within the catchment of the principal axes of public transport; percentage of areas, compared to the total, that host tertiary, commercial and production activities of high density of employees) that the municipalities must use in setting up its planning tools.

Also Venice PTCP aims at adapting its territory to climate change and combat its negative effects through «the precautionary principle in assessing opportunities and alternative actions and policies of mitigation and compensation of impacts» (Provincia di Venezia 2010). The PTCP sets that the urban planning tools will pursue the following objectives (section 35):

- minimize the increasing mobility of people and goods and in any case not produce increased levels of air pollution beyond the normal limits;
- make accessible by public transport the new urban areas, and provide them with bike paths, foot paths and public parking space car.

Even in Venice PTCP, hence, the reduction of polluting emissions is pursued by integrating interventions on the urban system and interventions on the mobility system.

Unlike the Provinces of Modena and Venice, the Province of Syracuse in its Provincial Territorial Plan only outlines the possible scenarios. The annex "Strategies for mitigation and adaptation to global climate change" of the Syracuse PTP defines scenarios and mitigation and adaptation strategies, related to mobility and energy systems, to the management of water resources and to the reduction of urban heat islands. Even if the proposed measures are purely proactive, it is interesting to note the relevance given to the mobility system. In particular, in this plan the promotion of sustainable transport modes represents the main mitigation measure to reduce emissions of greenhouse gases and suggests that the municipal planning tools should promote public transport through:

- the management and the rationalization of existing road system through the activation and the expansion of pedestrian areas, the institution of low emission zones in the historical centers and residential areas where the speed limit is 30 km/h;
- the reduction and the slowdown of the road traffic promoting pedestrian mode;
- the activation of car-sharing and car-pooling;
- the implementation, the upgrading and the rationalization of public transport systems, giving priority to environmentally friendly vehicles or low emission vehicles;
- the construction of reserved lanes for public transportation system or roads exclusively reserved to the public transport (dedicated roads).

The approved draft Provincial Territorial Coordination Plan of Naples (2007) has dedicated a specific annex (Annex A) of its Technical Implementation Rules to “tackling climate change" (2007) identifing mitigation and adaptation strategies scheduled by the PTCP of Naples. The entries for the mitigation strategies provide interventions related to:

- sustainable mobility, through the promotion of public transport : «in the PTCP is designed a provincial tramway complementary to the regional metro system. Municipalities in the drafting of the Municipal Urban Plan should give priority to public transport, through the creation of reserved routes, low emission zones and the redevelopment of public spaces served by public transport»;
- renewable energy by requiring that each program for the implementation of the PTCP shall provide the use of alternative energies (wind, solar, etc.);
- building construction, optimizing building in terms of energy through interventions on both the building envelope and the electrical, plumbing, and heating systems;

Regarding adaptation strategies, instead, priority is given to the use of water resources «according to the latest IPCC scenarios climate change will lead in the Mediterranean area and in Italy to a reduction in water availability». The PTCP also contains a set of laws concerning the permeability of soils:

- urbanization containment through the technique of densification;
- preservation of open space within urban areas;
- obligation percentage of permeable surfaces in building projects.

The guidelines set out in the planning tools at provincial level are implemented in the Municipal Energy Plans drawn up by some Italian municipalities as provided by the law 10/91 "Acts for the implementation of the national energy plan on energy efficiency, energy saving and renewable energy sources", which at the section 5 provides that: «the the municipal planning tools, in the city with more than fifty thousand inhabitants, must include a specific plan regarding the use of renewable sources of energy». From the analysis of some of the Municipal Energy Plans and their associated Action Plans (City of Bergamo 2011, City of Udine 2009, City of Reggio Emilia 2008) it is interesting to observe that the actions for the mobility sector would lead back to:

- promote sustainable transport modes, encouraging a greater use of public transport and innovative transport modes;
- rationalize and enhance the public transport system, through direct actions on the physical system (upgrading the transport system) and actions to improve livability of urban areas (institution of low emission zones, pedestrian island, etc.).

These actions result substantially in individual initiatives promoted by the municipalities and, even if they represents good examples, they are not integrated in an unitary point of view. The City of Ferrara, for example, has promoted the initiative "C'entro in bici" with the aim of increasing sustainable transport mode by providing free bicycle rental outlets.

Similarly, the City of Rimini has promoted the project "Riminibici" started in 2008 and upgraded in 2010 that allows use bikes, provided by the municipality, for free. The city of Genoa has adopted the innovative service of car sharing: vehicles may enter the Low Emission Zones, along the bus lanes and use for free the fee parking.

In Florence since 1998, contributions have been paid, from 200 € to 3,000 € for the purchase of electric vehicles and 107 free charging stations for electric vehicles have been realized (Florence municipality 2005).

Beyond the individual initiatives, during the last few years, there are many municipalities that, on a voluntary basis, have joined the Covenant of Mayors promoted by the European Commission, in the second edition of the EU Sustainable Energy Week on 29 January 2008. This initiative aimed at involving European cities in the path towards energy and environmental sustainability. By their commitment, Covenant signatories aim at meeting and exceeding the European Union 20% CO2 reduction objective by 2020, according to the European Union strategy 20-20-20. In order to translate their political commitment into concrete measures and projects, Covenant signatories notably undertake to prepare a Baseline Emission Inventory and submit, within the year following their signature, a Sustainable Energy Action Plan, that many Cities have already adopted, outlining the key actions they plan to undertake to achieve the objectives of reducing carbon dioxide emissions by 2020 (Covenant of Mayors website).

In the coming years, then, our country should integrate the actions promoted by single municipalities into an unitary action plan at national level for addressing the problem related to climate change in the perspective of "think globally and act locally." The tools promoted at national level for sustainable energy should then be implemented and integrated with the planning tools at local level in order to make compatible and synergic the mitigation and adaptation strategies, contextualizing them in reference to the main socio-economic variables that characterize the territory they are referred to. The path to follow thus requires a multidisciplinary approach, linked to the ability to integrate interventions on the urban system with interventions on transport system which, as detected by the Chamber of Deputies, is the responsible for around one quarter of national emissions of greenhouse gases (Camera dei Deputati 2009).

The definition of a national strategy, however, seems increasingly remote because during the last Conference of the Parties COP17 held in Durban, South Africa in December 2011, the nations who attended the conference have agreed to enter only by 2015 a formal and legally pact that legally bind the different country to reduce greenhouse gas emissions by 2020. This means that until 2020 the signatory countries of the IPCC should only respect the voluntarily commitments made in past years.

4 MAJOR EXPERIENCES IN EUROPEAN CITIES

The key role that urban mobility is hiring in building resilient cities is evident from the description of some of the most current planning experiences that are bringing forward in Europe. Global warming, climate change, and the next lacking of oil are topics for which the transport sector has a significant weight.

Energy consumption linked to mobility is growing, although this trend has slowed down starting since 2008-2009, i.e., from the biennium of deeper international economic crisis from the second post-war period to today; in Europe about 20% of primary energy consumption is accounted for by transport and about 98% of the energy used in this sector comes from fuel use. The current expectation at the European Commission's 2020 also estimate an increase in energy demand of 35% for passenger transport and 50% for freight transport; considering, then, only the power consumption on roads, which grows on 0.8% annually average, it's clear the need to activate measures that encourage a shift of traffic on modalities and energy efficiency technologies.

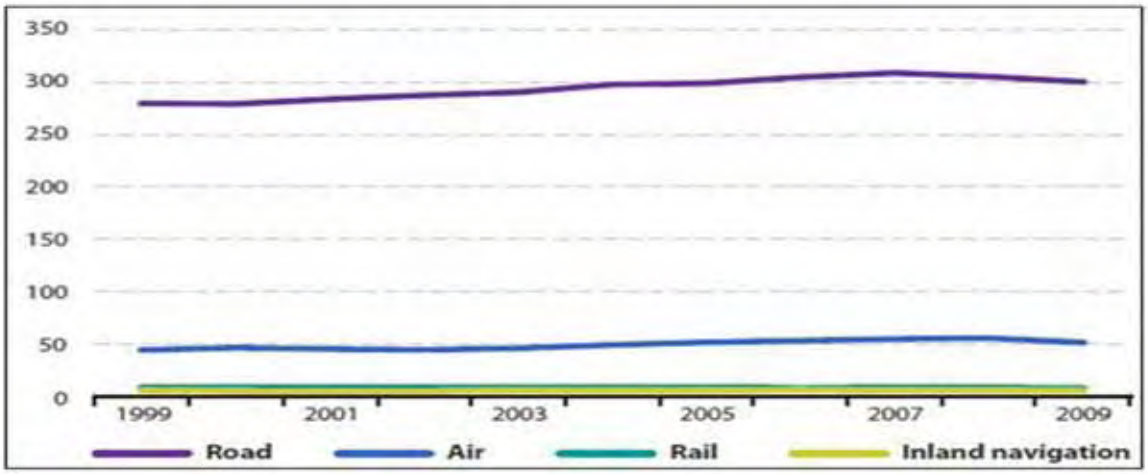

Fig. 4: In 2011 Eurostat energy consumption analysis of the decade 1999-2009, road transport was characterized by greater power consumption in Europe: approx. 300 Mtoe (million tons of oil equivalent).

At the same time, the overall weight of urban mobility in terms of displacements carried out with private vehicles, rises in all Member States so far faster than those made with rail transport and buses. The reasons for the success of road transport are not only tied to clear advantages arising from its use, such as greater flexibility and ease of operation, but that can be also explained by the adoption of policies that favoured the road transport in order to open up the market to the most important industrial production and, therefore, privilege economic development and employment. The ability to achieve progress in sustainability key appears to be sorely tested by the dominance of road transport which limits the possibility of expanding more valuable alternatives from a point of view of energy efficiency and emission reduction.

The new long-term vision for Europe is directed towards a strategy of growth of low-carbon type, based on the strong reduction of greenhouse gas emissions and on independence from non-renewable sources, both recognized as priorities for action in each member country. A good example is represented by London that, was among the first cities in the world to address climate change issue, creating special organizations for study and development of urban policies. Since 2000 London has developed and adopted an effective integrated approach to the themes of energy, sustainable mobility and climate change to ensure that it becomes «the best big city in the world» (Mayor's Energy Strategy 2011), characterized by low levels of carbon dioxide in the atmosphere and a high quality of life. In the numerous planning tools of London the action strategies follow the addresses and purposes contained in higher-level plans, such as the 2008 Climate Change Act aiming at the reduction of 34% in greenhouse gas emissions by 2020 and at least 80% by 2050 through economic development based on renewable sources instead of petroleum or other fossil fuels. Therefore the urban and economic development fits well with the principle of sustainability through densification that involves the use of already urbanized areas and higher building density.

The resulting benefits include both a much lower consumption of soil and the potential reduction of trips (Moccia 2009). These two lines of action are developed in synergy with the Mayor's Transport Stategy (MTS, approved in 2010) that forms the transport plan that has been processed synergically with territorial planning tools (The London Plan: Spatial Development Strategy for Greater London 2011) and economic ones (The Mayor's Economic Development Strategy for Greater London 2010). The main objectives identified in the MTS are all geared to sustainable urban development, the improvement of the offer of transport services and increased resilience to climate change.

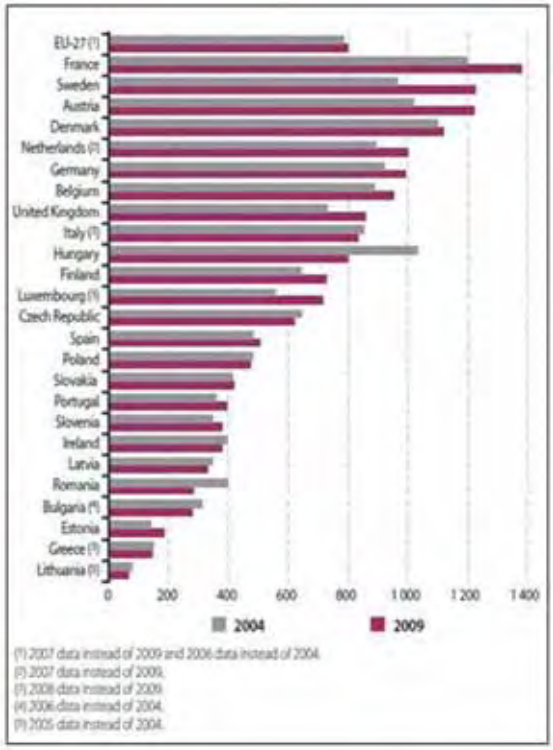

Fig. 5: Number of passenger-per kilometer on rail network in 2004 and in 2009. In 2009 France has the highest rate of use of rail transport; the highest increase compared to 2004 was recorded in Sweden, Austria and Luxembourg.

The current MTS is more strongly geared to promoting pedestrian and cycle mobility compared to earlier versions, that perceived policies of road pricing as the best way to discourage individual motorized movement. Measures such as the Congestion Charging Zone, which represented the most significant measure of 2001, and that established toll charges to access the central urban area, or the Low Emission Zone, the main project of 2006 designed to restrict access to the London area for large vehicles intended for the transport of persons or goods, may be valid systems for reduction of use of private cars as long as properly associated with the promotion of public transport modes. The intention of London Government to adopt the bicycle mobility as a real lifestyle, was reaffirmed in 2010 with the drafting of the document “Cycling Revolution London” which contains projects and actions to make London “cyclised city”. The three main programs are:

- London Cycle Hire Scheme : 400 bicycle rental stations in all public parks and several other points in the city, located in such a way that there is one out of every 300 meters.
- Cycle Superhighways: by 2015 will be implemented twelve "highways" to biking to and from the city centre.
- Biking Boroughs: is a program oriented at implementing strategies and action plans for the development of cycling networks in the municipalities surrounding the city.

The "Cycling Revolution" is one of many valid actions aimed at reducing the dependency on fossil fuels and CO_2 emissions set up in the Mayor's Climate Mitigation and Energy Strategy, that is the Sustainable Energy Action Plan (SEAP) that the signatories of the Covenant of Mayors produce it signing the Pact. The Pact is part of the larger strategy 20-20-20 the European Union which aims at reducing emissions of harmful greenhouse gases by at least 20% by 2020, compared to 1990 levels, increasing at the same time the level of 20% energy efficiency and boost the share of renewable energy to 20% of total consumption of 2020, through the promotion of sustainable development of the territory. These three objectives are closely interrelated, since the release of CO_2 a greenhouse gas, is a consequence of production processes and consumption of electricity from non-renewable fossil fuels. London joined the Pact in February 2009 and presented, then, the SEAP in 2011, developing its own action strategies for saving on three pillars: retrofitting green London (retrofitting existing buildings in order to reduce the energy consumed to heat environments and produce hot water), greening London (increase the arboreal soil of 5% by 2025 for a report of a tree for every Londoner and create a network of green areas) cleaner air for London (improving air quality by focusing on the use of non-fossil fuels).

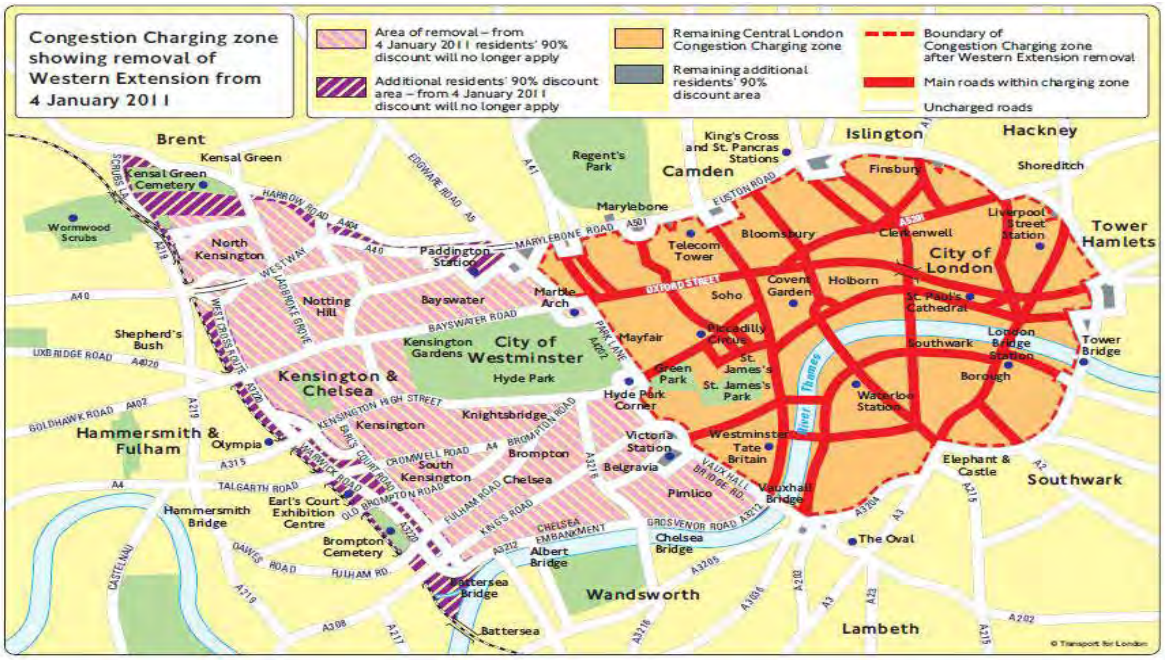

Fig. 6: The Congestion Charging Zone in London since 2011. The excluded areas are purple and lilac ones; in the Congestion Charging Zone (orange area) it is possible to run paying a toll of 10 pounds a day.

Among the many strategies outlined in terms of cleaner air for London, there are those inherent in the urban mobility, on which the Department for transport has conducted a series of studies for the development of more effective measures against dependence on private cars. The 36% of trips, in fact, is still using their cars, despite the British transport system is highly efficient and has also increased the number of people who prefer, instead, riding a bike. But if we consider that almost all of the transfers made by Londoners is referred to a distance less than 5 km, and of these approximately one third is under 2 miles in a straight line, we can easily guess that there is a great opportunity to make a modal rebalancing in favour of public transport, and the possibility of Bikeability.

Governmental authorities are conscious of having to face a long and difficult challenge in taking to away to cars the primacy of modes of transport, considered the advantages of flexibility and independence in its use and, in some cases, it is the only way to move around. This awareness has pushed policy makers to draw up specific plans of action, such as The plug-in vehicle[1] Infrastructure Strategy (2011) and the Hydrogen Action Plan (2010), in order to encourage and promote the purchase and use of green vehicles, as those powered by hydrogen, electricity, and even those with low carbon dioxide (ultra-low emission vehicles).

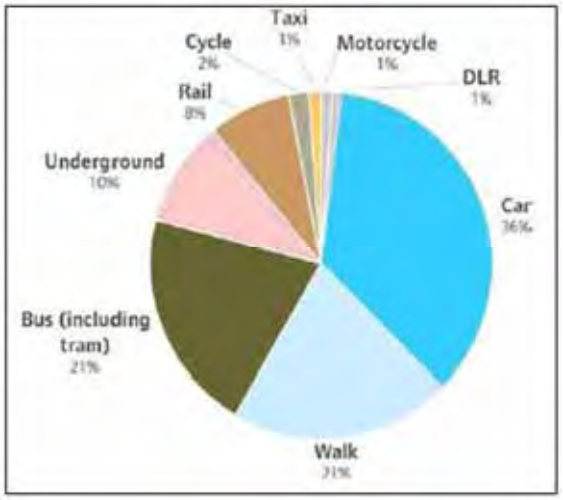

Fig.7: The transport sector analysis conducted by TfL in 2008 show that Londoners, after the car, prefer moving on foot or by bus. However, the comparison made by TfL between 2000 and 2008 has shown an increase in the use of public transport.

[1] The term plug-in vehicle is used to describe a wide variety of different technologies that use electric drive to power, or assist in the powering of, a vehicle (The plug-in vehicle Infrastructure Strategy, 2011).

The Government, in order to «reach the milestone of 100,000 electric vehicles on London's roads as soon as possible» (SEAP 2011), is working in partnership with car companies and those related to the production of electricity, in order to encourage the purchase of electric vehicles or plug-in. By the end of this year, finally, 300 hybrid buses circulate through the roads of London, of which some of them are already hydrogen-fuelled and in service for some years, as a result of the city to join the project CUTE (Cleaner Urban Transport for Europe) which aims at demonstrating the effectiveness and convenience of using this alternative source of energy. All the measures and strategies of intervention contained in London SEAP and in other plans or documents prepared in these last ten years have been developed not only to reduce energy consumption, but also to develop an economy "low carbon intensity" with which to be able to avoid the energy gap in the coming years.

As London also Amsterdam aims at becoming a world leader for green and innovative mobility by 2040. Transport, energy and environment policies of the Dutch capital are integrated, developed and implemented contemporarily with planning model adopted at national level, the Polder Model, which ensure a sustainable future. To encourage change in the use of energy and reduce carbon emissions, Amsterdam has developed two strategic documents: Amsterdam Climate Program and the Amsterdam Smart City, both in line with the recommendations of the Intergovernmental Panel on Climate Change (IPCC) which aims at reducing greenhouse gases of 80-90% by 2050 for developed countries. In particular, the Amsterdam Smart City appears as a great opportunity for collaboration between government agencies, the community and entrepreneurship to design and implement projects in the fields of labour, housing, mobility and production of renewable energy, in order to demonstrate «how energy can be saved, now and in the future» (Amsterdam Smart City 2011). Amsterdam has joined the Covenant of Mayors in early 2009, with the goal of 40% reduction in CO_2 emissions compared to 1990, the reference year of the BEI (Baseline Emission Inventory). Actions identified by its action plan are aimed at energy saving, sustainable energy exploitation and efficient use of non-renewable sources and are articulated with respect to short, medium and long term (up to 2015, 2015-2025-2025, 2040). In this document there are two key actions for energy sustainability: the total use of renewable resources and the diffusion of electric vehicles. Using solar and wind energy, or that produced thanks to a sustainable waste cycle, in practice a form of clean energy to meet not only the city's energy needs, but also and above all to feed the cars means to allow a truly sustainable development of the city, acting on all its components. Moreover, if we consider that the city has already undertaken this process of technological and social transformation, thanks to the active involvement of all stakeholders, to large research funding and policies aimed at changing travel patterns, then we are already half done.

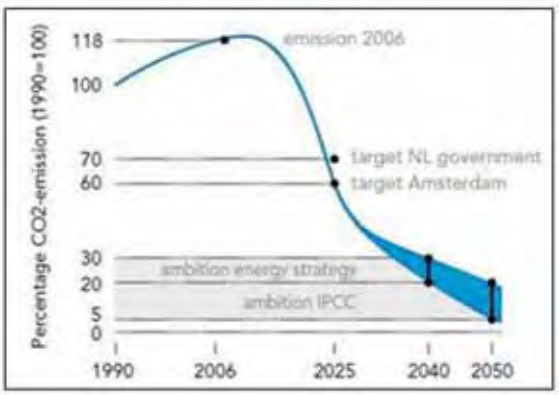

Fig.8: Amsterdam aims at reducing its carbon dioxide emissions of 75% by 2040 to achieve IPCC targets. the actions of environmental and energy plans were developed to achieve an even more ambitious goal: independence from fossil fuels in the near future.

Fig. 9: In Amsterdam all the charging points (for cars, scooters, vans, boats, electric bicycle with pedal assistance) are user friendly and they are in strategic areas for accessibility to central areas

Since the market for purchase of electric cars is still early in its expansion phase, the Dutch Administration wants to privilege local businesses as primary users as they are “heavy users” that account for a large number of road-kilometres each year so as to increase the visibility and demonstrate the valuable alternative that these vehicles compare with traditional fuel combustion cars. In addition to the electric Amsterdam is investing even hydrogen, to become a world leader in both sectors: tourist boats have been so powered since 2009 and in 2010 for local bus transport as well. Amsterdam is one of the founding members of the National Hydrogen Coalition that brings together Governments, research institutes, public institutions that wish to work together to use hydrogen on large-scale, rapidly developing this technology and creating new job opportunities.

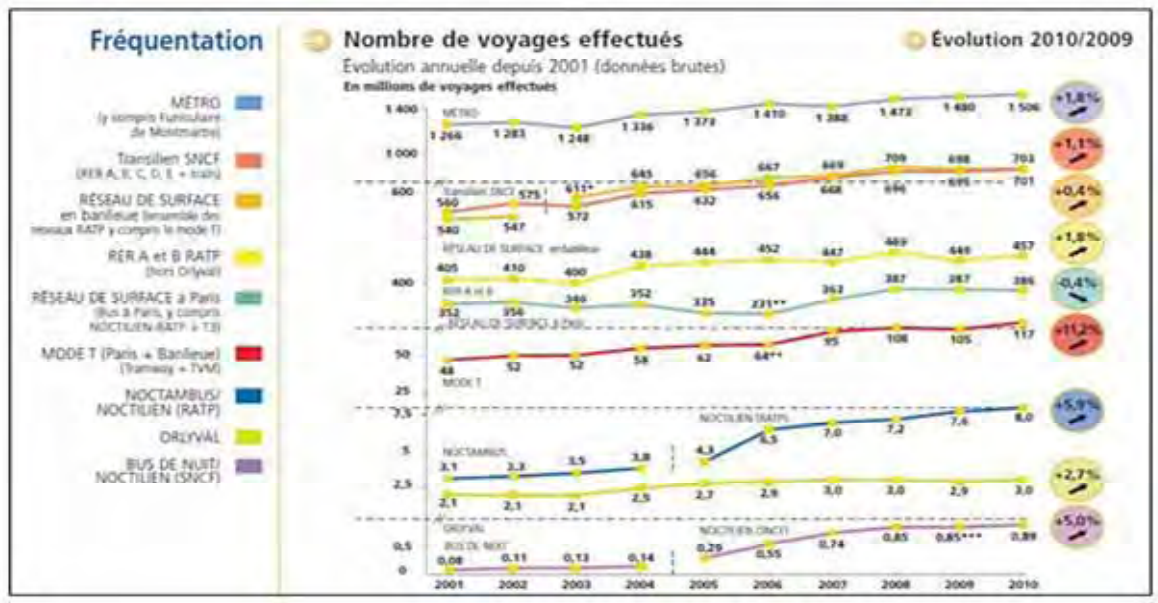

Fig. 10: In Paris between 2009-2010 there has been a general increase in the use of public transport modes, excepted the road transport.

Among the European cities that have integrated transport policies with environmental ones, assigning to the energy and environmental sustainability, in general, a key role, there is Paris which puts as its main objective of planning strategies the improvement of accessibility and quality of life. In 2006, after consultation of citizens and local communities, has been approved for the entire region of Ile-de-France the "Plan de la Protection de l 'Atmosphere" (PPA) aiming at respecting the limit values for air quality based on 16 measures. Nearly all of these measures affect urban mobility, identified as the sector that most of all is a difficult obstacle to the achievement of the objectives of air quality, for its obvious harmful impacts.

The development of PPA has been paralleled by the "Plan de Deplacement de Paris" (PDP, is the PUM approved in 2007) which has strengthened the addresses defined already in 2001 by the municipal administration to expand the offer of alternative moving modes to the car. The PDP has been integrated with the environmental plan for reducing greenhouse gas emissions (Plan de lotte contre le dereglement climatique) which constitutes the SEAP referred to the entire region of Paris, developed in 2007. A close-up fight oriented to climate change had already been drawn up in 2005 and was the continuation of all transport, urban and environmental policies, in order to ensure the consistency of the measures to realize. This continuity of planning tools also features the 2007 update, which aims at broadening and extending the measures contained in the PDP in order to:

- increase the transport demand met by public transport;
- reduce of 30% private motorized traffic and the values of CO_2 emissions within 2020 and of 75% by 2050, compared to 2004 (reference year of BEI);
- satisfy the 30% of energy needs through renewable energy sources.

In fact, these are the objectives relating to the city of Paris, because for the entire Ile-de-France region, plan aims at achieving goals far more ambitious than those of European strategy: not 20-20-20, but 25-25-25. The determination of the French Government to reduce air pollution and emissions of CO_2 and other toxic agents related to urban transport has led to a further update of SEAP in 2011 that aims mainly at electrical and even more at cycling mode. In order to revolutionize urban transport, it has been developed Autolib project that offers citizens an evolved system of car sharing with more than 6000 charge stations and approximately 3000 cars available work fully. The area that will be affected by the Autolib service includes Paris and over 46 municipalities of Ile-de-France, an area with a very high number of potential users, if we consider that the inhabitants of the Paris region are seven million, to which must be added the more than 27 million tourists who choose every year the *ville lumiere* as a tourist destination. Velib (an acronym of the French words bike and freedom) is the service bike sharing initiated by 2007 and provides citizens and tourists about 20,000 bicycles. The peculiarity of Velib lies in the fact that you can rent a bicycle, taking it from a station and back to another 24 hours per day, in order to use the service even at night, when the underground trains and buses are no longer in service[2].

Fig. 11: In Paris, about 58% population own a car, thanks to the efficient and intermodal public transport network and to the implementation of projects such as Velib.

[2] Paris metro train system and bus service is available until midnight.

5 MAJOR EXPERIENCES IN ITALIAN CITIES

European strategies aimed at reducing energy consumption, particularly for the urban transport sector, although they have been accepted in our Country with considerable delay, they are succeeding in reversing the trend of growing energy costs and emissions, according to reports from some national reports referred to below as the Annual Report on Energy Efficiency (AEER) produced annually by ENEA. According to the EC Directive 2006/32, Italy has drawn up its national Action Plan for Energy Efficiency (EEAP) in 2007, aimed at defining ex ante measures to achieve energy savings of 9% by the ninth year of application of the directive (2016), calculated on the average value of annual energy consumption of the five years preceding the implementation of the directive. In July 2011 Ministry of economic development (MiSE) presented the new EEAP draft «intending to promote consistently and continuous actions by initiatives already foreseen in EEAP 2007 and to submit proposals for medium-long term based on innovative and reliable setting» (EEAP 2011). In parallel, the national Action Plan for Renewable Energies (PAN), drafted by MiSE and by Environment Ministry provides additional guidance for energy efficiency, as essential to the achievement of the renewable energy targets and CO_2 reduction. The analysis on final energy consumption for each sector in the EEAP 2011 emphasizes that the question of final use of transport represents the 31.5% of the total and has grown since 1990 at an average rate of 1.5% per annum. A progressive increase in consumption occurred until 2007, followed only for the years 2008 and 2009 a reversal due to the economic crisis (Gargiulo, 2009). Of these total consumption, about 2/3 are due to passenger transport, the remaining part to freight, and both are dominated by the road transport.

From a point of view of energy efficiency, urban mobility segment remains even less efficient because of the low average fill rate of only 1.2 passengers per vehicle, and the low efficiency of cars and commercial vehicles and trucks which are the main mode of transport of goods. All has a negative impact on energy efficiency index of the entire transport sector, grown only 1.1% in the period 1990-2009.

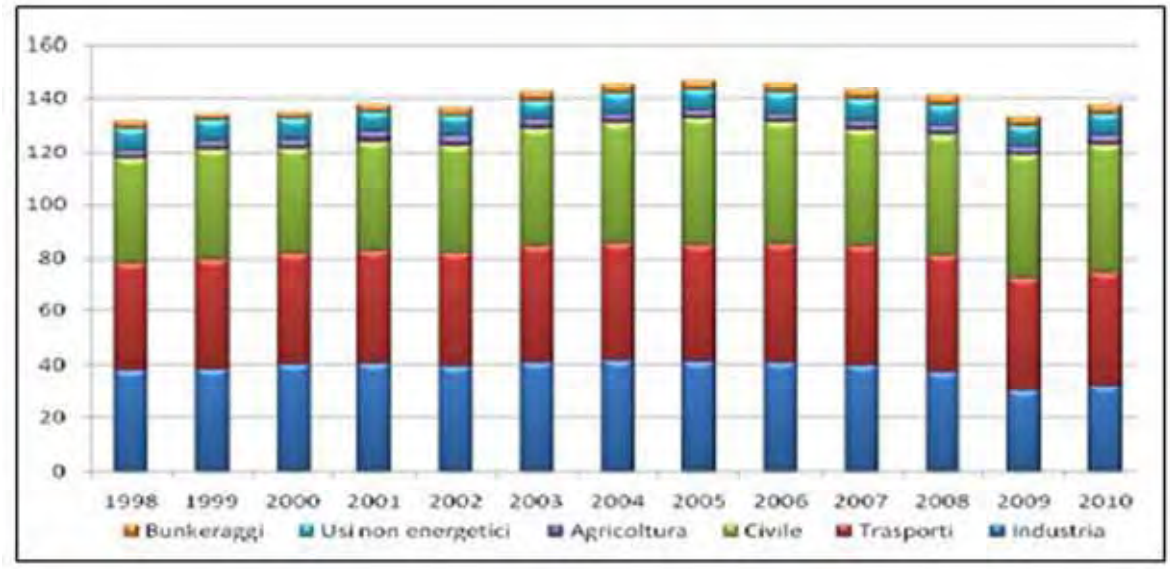

Fig. 12: In Italy in 2010 the final consumption of energy has been equal to 137,5 Mteps (Million of equivalent tons of oil), with a 3,6% increase compared to 2009. The final uses of energy are increased of the 8 ,7% in the period 2000-2005 and they are decreased of 9,2% during the years 2005 -2009. This reduction is due to the economic crisis and to the energetic efficiency incentives.

ENEA in its AEER evaluates the improving in efficiencies in different business areas (transport, manufacturing, residential) by suitable efficiency indexes that relate the energy consumption to produce goods and/or services with the quantity produced. In particular, the transport sector has shown an alternate trend compared to the other, showing more modest efficiencies.

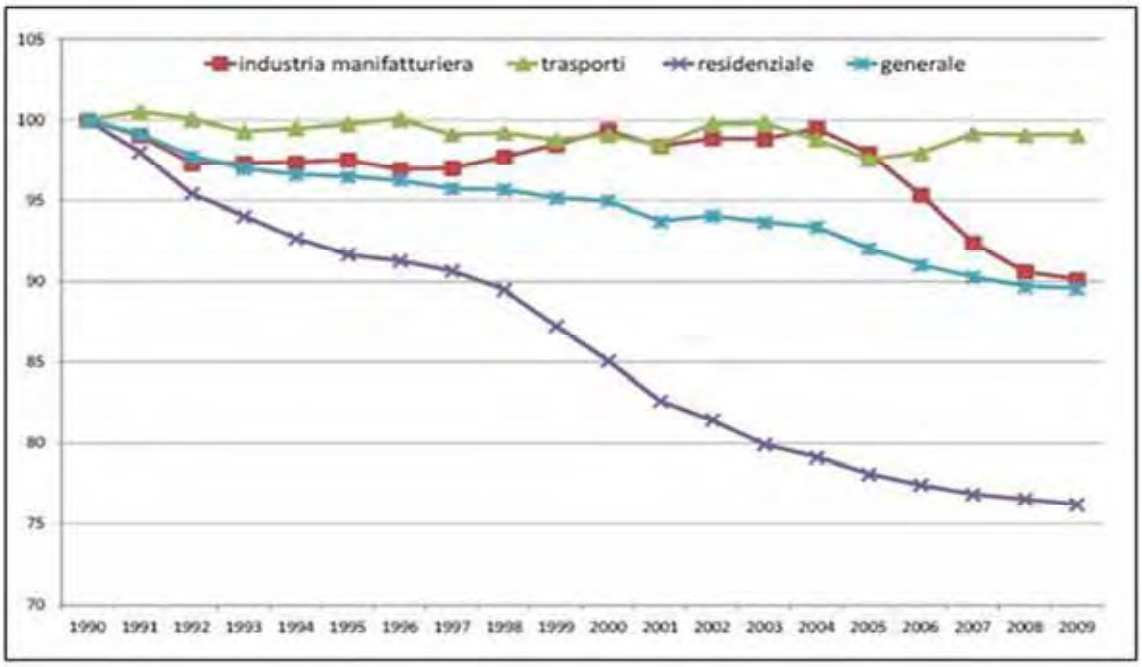

Fig. 13: Energetic efficiency index which ENEA refers to is the ODEX index (it has been developed within the ODYSSEE project-Energy Efficency Indicators in Europe).This index has measured the energy efficiency variation since 1990, year when the value is set equal to 100.

In addition to efficiency in the AEER is also assesses the energy intensity, calculated by comparing the final consumption of the sector to GDP (Gross Domestic Product), which shows in 2008 and 2009, negative growth rates of consumption for all transport modes. This reduction was determined by an ever greater use of fuel produced by alternative energy sources (LPG, biodiesel, biofuels) and greater sensitivity of consumers towards energy-environmental factors, and inexpensively. By then, a confrontation between Italy and some European countries more attentive to energy issues it emerges a general decreasing trend of mobility energy intensity, largely due to road transport and in particular to technological improvements in the car sector.

In the period 1999-2009 Italy has reduced its energy intensity in the transport sector less than half compared to other European countries and shows a modest increase in the use of public rail transport. This result indicates the need for more effective modal transfer policies, in order to contribute not only to energy saving, but also to the reduction of polluting emissions into the atmosphere. The recent economic crisis that has swept limited in transport: a decrease of 5% compared to the maximum value recorded in 2007, compared to a decline of 12% for all other sectors in 2009. The contribution of transport to the climate and energy emergency is therefore indisputable, and it is a matter that must surely be addressed if we consider the high environmental costs resulting. Hence the importance of initiatives such as the Covenant of Mayors, within the wider Europe strategy 20-20-20, which is also confirmed in the EEAP.

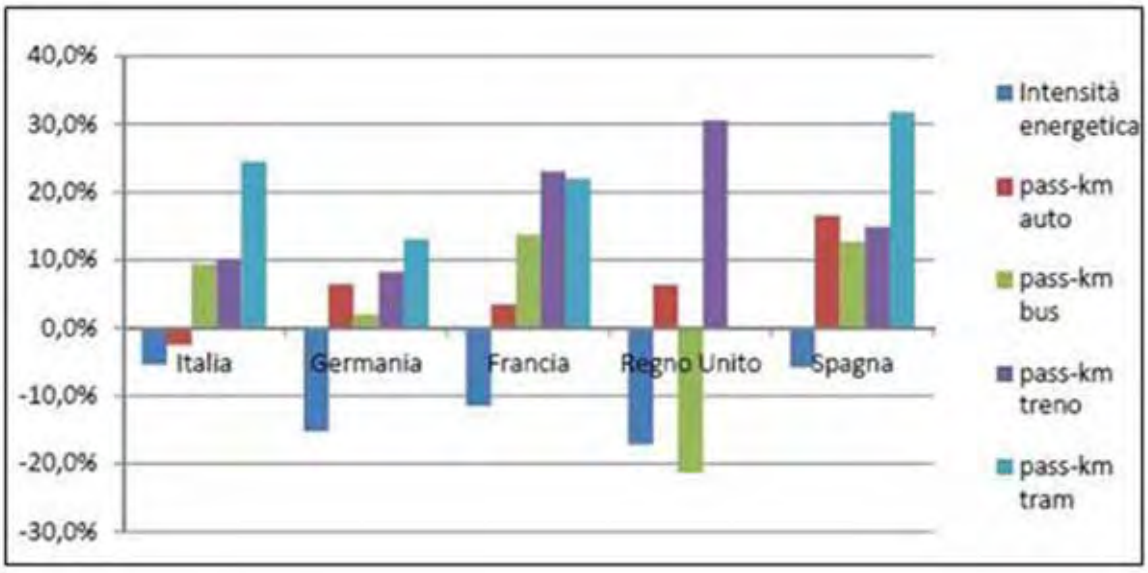

Fig 14: Energetic intensity variation of transport sector and of passenger traffic variation in the decade 1999-2009 related to the available data of the project ODYSSEE.

This agreement pushes cities «to take a commitment to reduce emissions, as well as national Governments, which must necessarily work together to reach the ambitious targets set for 2020» (EEAP 2011). 800 Italian cities have ratified the Pact including three main cities of the region Campania: Naples, Salerno and Benevento. Sustainable energy action plans (SEAP) presented by the municipal councils must contain measures to achieve the objective of reducing CO2 emissions.

The starting point for the drafting is the emission inventory (Baseline Emission Inventory-BEI) which constitutes a snapshot of municipal energy situation with reference to the year since then the reduction of carbon dioxide emissions shall be assessed. Among the many Italian cities that have signed the Covenant there is Genoa, which has defined a system of integrated policies in the medium to long term, making the SEAP interact with recent Urban Mobility Plan (PUM approved in January 2010) and Communal Plan (adopted in December PUC 2011).

In particular, the Document of he Objectives of PUC (2010) describes the project of a solid sustainable planning that reconciles the objectives of growth of the town ("Genoa City world, accessible and attractive") with the protection of territory, landscape and ecosystem. Genoa has the lowest inhabitant per vehicle ratio among the biggest Italian cities (one vehicle out of two inhabitants) and approximately 43% of trips by public transport, one of the highest rates of use of the collective transport of Italian cities. From the data reported in the BEI, for which the base year is 2005, has been shown that energy consumption of private and commercial transport is markedly higher than the public one.

The measures identified in the Genoa SEAP are aimed at the reduction of energy demand and polluting emissions reduction in the short (3-5 years) and long term (2020). In particular, actions referring the transport sector reflect the commitment that the municipal administration has long dedicated to the problems of this sector (granting the right to travel for all, improving the quality of public transport, reducing polluting emissions), proving to be in line with the most recent regional regulatory framework, based on the sustainable development of the energy system and mobility. Intervention strategies outlined in this regard focus on containment of traffic and on the improvement of energy and environmental efficiency. For the chief city of Liguria encouraging bikeability and car sharing means to pursue the objectives of sustainable

mobility and energy saving: on the one hand, individual motorized movement will be reduced and on the other hand, will be reduced the energy demand for transport of 55%.

Categories	Fleets	Energy consumption [MWh/2005]	Total per categories [MWh/2005]	CO2 emissions [t/2005]	Total per categories [t/2005]	TOTAL TRANSPORTS [t/2005]
Municipal Fleet	Cars	4452	37293	1129	9830,8	495533,4
	Two wheelers	1580		393,3		
	AMIU (Waste collection)	31261		8308,5		
Public transport	Buses (diesel, oil and hybrid)	96902	111271,9	25856,8	33234,6	
	Electric systems	14223		7338,6		
	Car sharing	146,9		39,2		
Private and commercial	Cars & Commercial vehicles	1380184	1704728	364462	452468	
	Two wheelers	324544		88006		

Fig. 15: In 2005 in Genoa, the major energetic consumption of transport sector is due to commercial and private vehicles

Intervention measures for energy efficiency are helped by those concerning the regulation of urban trips in order to discourage recourse to the car use by residents and cityusers.

This will determine less dependence on cars, an increasing use of public transport and of soft mobility, a decrease of energy consumption and polluting emissions. In this vein have road pricing policies and the creations of the Isole Ambientali have been strategic. In fact, acting synergically on restricting the use of private cars and the promotion of alternative transport modes allows to create a system of sustainable urban mobility. An evaluation conducted in SEAP shows that the new road pricing regime called Blue Areas, in force since 2005 and intended to expand in accordance with PUM, is allowing to reduce congestion in central urban areas and to secure a more rational accessibility to citizenship, thanks to more careful organization of parking areas.

The results expected from the implementation of all the measures referred to the transport sector are expressed in terms of reducing CO2 emissions (about 22.8%) and not also in terms of reducing energy consumption, contrarily to what stated in the initial part of the plan.

Rome has acceded to the Covenant of Mayors in 2010, pledging, in particular:

- to implement a series of measures aimed at energy efficiency, focusing heavily on the production of energy from renewable sources;
- to intervene on the planning and organization of transport system with strategic decisions concerning urban development;
- to inform and involve the citizens and other local stakeholders for a more intelligent use of energy;
- to prepare and implement pilot projects that can serve as examples of excellence (Benchmarks of Excellence-BoE) for the development of sustainable energy in urban contexts;

The issues considered in the Roman SEAP are integrated with other plans already adopted (such as the plan for sustainable mobility and the action plan for the achievement of the objectives of the Kyoto Protocol, both approved in 2009) or in the process of drafting, acting synergically with transport system, territorial planning, construction, and the use of alternative energy sources.

Starting from the analysis of the information contained in the BEI (reference year 2003) have been identified as priority areas of action (tertiary and residential mobility, as they represent the most responsible sectors for the polluting emissions) and initiatives to be undertaken shortly (next 3-5 years) and long-term (vision to 2020), to meet the CO2 reduction targets.

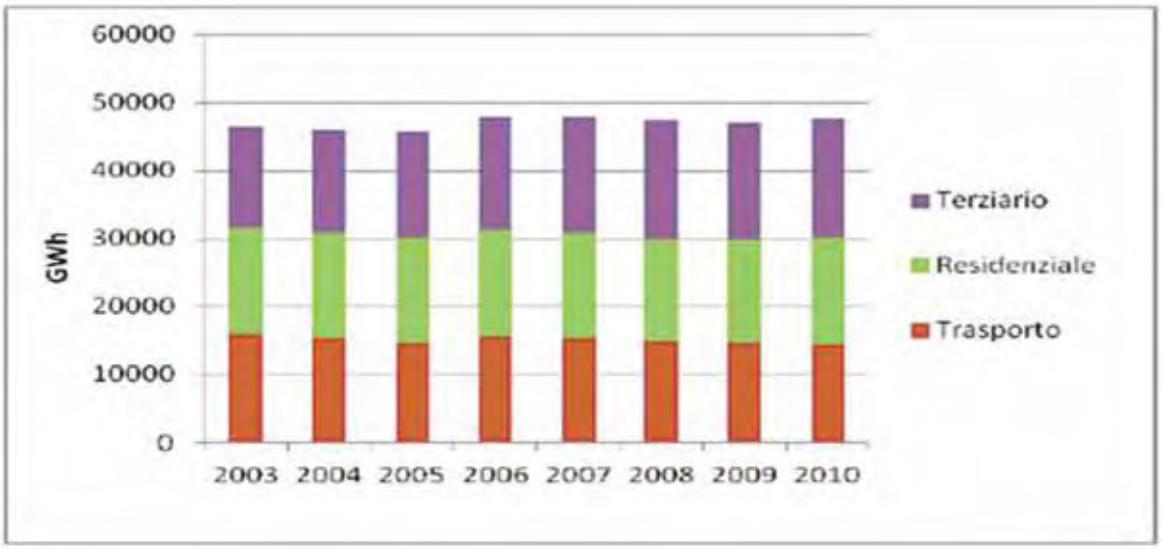

Fig. 16: Total energy consumption during the years 2003-2010 in Rome.

The most important element concerns the primacy that Rome holds compared to other European capitals, because urban trips made by cars is represented by 67%.

This alarming factor can be regarded as the outcome of two phenomena: an urban sprawl, an inadequate provision of public transport in the densely populated suburbs. Preferring cars to public transport causes, then, a strong congestion of radial arteries and ring roads surrounding the town and a considerable carbon dioxide emission (about 3.59 million tons/year).

Città	Londra	Parigi	Roma
Popolazione	7 557 000	2 153 600	2 718 770
Superficie comunale (kmq)	1.570	105.4	1.285
Lunghezza rete stradale (km)	14 926	1 644	5000*
Autovetture	2 497 000	673 600	1.897 672
Veicoli merci	21 000	117 700	182 397
Motocicli	116 000	102 000	379 000
Ciclomotori			156 000
Altri veicoli	376 000	-	44 294
Numero veicoli a motore	3 010 000	893 300	2 660 202
Tasso di motorizzazione (veic. x 1000 ab.)	**398**	**415**	**978**
Tasso di autovetture (auto x 100 ab.)	33	31	69

**interno al GRA*

Fig.17: In Rome the high motorization rate, compared to London and Paris, is confirmed by the data reported by the Urban Plan for sustainable mobility (SUMP 2007).

The SEAP identifies interventions aimed at reducing emissions of the transport sector on the basis of the lines of address Urban plan for sustainable mobility (PUMS 2009), by integrating them with urban planning, infrastructural and at to discouraging the use of private cars, particularly rush hours. In particular, the totality of operations for public transport is intended to modify the modal choice, to point users as much as possible towards a transport low environmental impact and innovative services.

To discourage the car use in urban central area, already identified as LEZ (Low Emission Zones), vehicular traffic interdiction measures even more restrictive are envisaged allowing transit only for vehicles powered by non-traditional fuels and establishing Privileged Zones or pedestrian traffic. This action of banning transit

in the centre will be implemented together with other measures which are viable alternatives to residents or for authorized users. Among the services provided there is the use of an electric vehicle to share with other users (electric car sharing), an initiative involving the absence from circulation of 5-6 private cars per each shared car and that, therefore, represents a positive impact on vehicular congestion problems that characterize Rome, as well as on the reduction of fuel consumption and emissions. Car sharing service has been activated already in 2005, in some areas of the historic center, and in 2008 was approved the development plan for the expansion of Rome Car Sharing service that included increasing the areas served and the number of cars, and awareness of potential users. To help encourage citizens to buy and use of electric cars, the SEAP provides for the development of a systematic action aiming at the diffusion on territory of charging infrastructure in public places.

The SEAP of Rome, finally, also contains measures regarding the diffusion of alternative fuels such as hydrogen, producing only water vapor. The municipal administration will use bus fuel-cells fed pure hydrogen and achieve, in the long term, two hydrogen production and distribution.

With the SEAP (approved in July 2011) the municipality of Modena aims at defining the optimal mix of actions and instruments capable of ensuring «the development of a sustainable and efficient energy system that gives priority to energy saving and renewable energy, as instruments for the reduction of the consumption of fossil fuels and CO2 emissions and for greater environmental protection» (SEAP 2011).

The action of the municipal administration on issues related to the reduction of greenhouse gas emissions has improved especially in recent years, through a series of local policies aimed, on one hand, at making more efficient the systems of production and consumption of energy and, on the other, to reduce consumption at both public and private levels. The starting point for the achievement of all these objectives is the integration of the main municipal planning tools relating to land use, transport and energy and energy variable, or, more precisely, of the availability of energy. The overall energy consumption, reported in 2009, the year of reference for the construction of the BEI, shows that in Modena the most incident sector is transport (1624 MWh), where the 98% of fuel consumption is due to the use of private or commercial vehicles, and only 2% is attributable to public transport.

The actions of SEAP in Modena for urban mobility are intended to:-Improve the intermodal transport of persons and local public transport.

- reduce transport and urban transit vehicles.
- implement the bikeability.
- increase efficiency in transport technologies.

Of these, the first three goals had already been recognized as a priority for action in the PUM (approved in 2006), aimed at strengthening the network and public transport, especially for surrounding areas. The energy component is invoked in all the measures relating to four areas of action, providing the value of energy saved (in MWh) through their realization. This helps understand more easily the actual benefits arising from implementing the SEAP, who should not be assessed only in terms of ton of carbon dioxide saved, but also and above all in terms of consumption of energy from fossil fuels avoided.

Mobility options identified by the Modenese Adminsitration tend to provide users with the widest possible number of valuable and flexible alternative to the car.

Intermodality, then, is pursued by acting simultaneously on several fronts: the enhancement of local public transport, the strengthening of the use of increasing bicycle, the bike sharing service "C'entro in bici", active since 2003, creating a station for interregional and regional rail transport integrated with public road transport, taxi and parking lots for cars and bycicles.

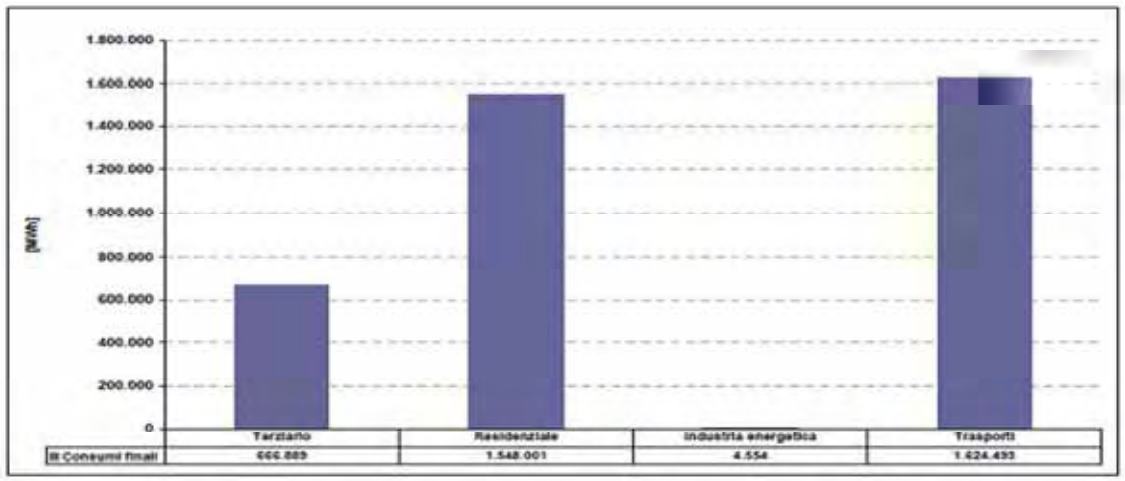

Fig. 18: The graph shows the energy consumption in 2009 in Modena.

Besides in Modena, Bari SEAP is the latest (May 2011) among the Italian cases and it is also the plan that from the "title" (SEAP-developing low carbon economy) reaffirms its intention not only to reduce CO2 emissions (a reduction of 35% compared with 2002, by 2020), but, mainly decarbonising the urban economy by increasing the use of renewable energy sources developing sustainable transport and promoting energy efficiency. These objectives can be achieved through «a systemic approach to planning, through coordinated actions with citizens first, and with the numerous public and private institutions» (SEAP 2011). Transversality and cooperation among urban planning tools and the close interdependence between land use, energy and urban mobility had already been favoured with Municipal Energy Environmental Plan (EEP 2006), by which the municipal administration has embarked on the path of implementation of the energy and environmental sustainability that is bringing to fruition with SEAP. The vision of a low carbon Bari has been defined on a grid of integrated interventions in order to increase the benefits from their synergistic implementation, and divided into vertical, and transverse sectors. Interventions both in education of behaviors and in energy planning can be considered as primary sectors since the success of the plan strongly on them. Changing patterns of use and consumption of energy, reoriented towards low-carbon lifestyles, and the development of a plan aimed at a rational use of soil and other natural resources, the upgrading of existing urban structure and a sustainable government of territory are elements saving energy policy shall depend on. The initiatives planned for the area of urban mobility, whose emissions in 2002 (reference year of BEI) are associated to the 96% to private transport, aim at counter balancing imbalances in the private transport, through the development of sustainable mobility systems alternative to cars, especially the bike. The future "on two wheels", in fact, is not only referred to the city of Bari, but to the entire region which will be the leader of the Italian regions involved in the project CY.RO.N.MED (Cycle Route Network of the Mediterranean). This project focuses on the definition of cycling network backbones of the Mediterranean area, through which it will be possible to enhance and develop sustainable transport modes. In order to facilitate soft mobility the SEAP shall promote the extension of the pedestrian area inside the LEZ active since 2008 in the historic part of the city. Other measures intended to reduce emissions of carbon dioxide are:

- identification of Areas 30, that are areas where the speed limit is of 30 km/h;
- Upgrading of rail transport and construction of three new railway lines, including the connection with the airport;
- renewal of the municipal vehicle fleet with low emission vehicles.

6 TOWARDS AN INTEGRATED APPROACH BETWEEN URBAN AND TRANSPORT SYSTEMS TO ENERGY EFFICIENCY

The population growth living in urban areas reaches 50% of the total, causing congestion, traffic, polluting air, noise and energy consumption, also due to the high density of urban activities. The combination of environmental effects clearly measurable and the energy price crisis produced by the explosion of global demand, reveals strongly the urgency to afford the problem in a multi-sectoral and systemic perspective. The weight of energy production from renewable sources out of the total production in Europe but especially in Italy, continues to be very low, and doesn't respect emission reduction targets. Furthermore the cost of the Kilovattora produced with the cheapest renewable sources available today (windpower) is even more triple than the one produced with traditional methods, such as from a coal-powered plant. This heavy gap doesn't allow the immediate solution to the problem but highlights how major benefits can be reached quickly with the lowest investment costs and how they are related to saving energy. It is essentially to rethink the development model, and, in particular, settlement and urban development, identifying the ways by which to reduce energy consumption maintaining sustainable economic growth rates and untying the link between economic growth and increasing energy consumption. Currently, in Italy, energy policy refers to the real estate already existing or just built are mainly focused on improving the efficiency of buildings but they reveal little effective because of the complexity of energy problem.

Fig.19: In order to reduce both carbon emissions and energy consume, a lot of cities are realizing interventions at building size, such as wind turbines on the roofs of the buildings

The choices that Italy and Europe are facing are clear though difficult: energy supply, reduce costs and energy consumption, reduction of polluting emissions are all long-term challenges that are taking increasingly serious aspects not be postponed. Italy responded to the growing attention from EU on these

issues, implementing policies aimed at improving both the efficiency and energy saving, but the absence of a clear strategic and integrated vision has generated a dispersion of resources in reaching the 20-20-20objectives, or more generally, in reducing the sustainability in energy sectors.
The measures to reduce emissions and to increase renewable energy are effective "only in theory", rather than in reality. For example, our country according to the EC Directive 77/2011 has to reach the goal 22% of renewable energy production by 2010, but, in recent years, the effective percentage of renewable sources for electrical uses has remained largely steady on the level of 16%. In addition, the transport sector is second only to the civil one for total energy consumption and 95% of the energy used comes from oil source. In fact, in spite of the policy of promotion intended to sell green vehicles diesel and gasoline vehicles are still used. The goal of greater efficiency in transport sector doesn't depend only on technological innovation, but also on an effective reorganization of urban trips discouraging private cars.
In this regard, ENEA in 2009 estimated that the doubling the current demand of alternative modes to private road transport, determines a total saving of approximately 2.7 Mtoe proving so that modal shift policies are as effective as those promoting energy efficiency through technological innovation. In our country we can therefore detect a gap between commitments at taken international level and the implementation of concrete actions aimed at reducing national energy consumption.

Transport sector	Alternative modes to road transport	Transport demand 2009	Current share [pax-km or ton-km]	Delta consumption unit 2009	Transport demand 2020	Delta consumption 2020	Saving energy 2020
		M pax-km or ton-km	%	Gep/ pax-km or/ton-km	M pax-km or ton-km	Gep/ pax-km or/ton-km	Mtep
City users	Pedestrian > 5 min	9434	n.d.	65,4	18867	52,3	0,5
	Public urban transport	18867	8,1	42,4	37734	33,9	0,6
Commuting	Regional rail network	26095	5,1	18,9	52190	15,1	0,4
	Regional buses	17208	4	29	34416	23,2	0,4
Long distance passengers	Long distance rail transport	22501	5,2	37,4	45002	33,6	0,8

Fig.20: The table provides For each alternative mode to private road transport the current demand (referred to 2009), energy savings per unit of traffic mode. The last columns are related to an hypothesis of modal transfer and energy saving 2020, referred to the suggested.

Through the analysis of urban planning tools and of mobility governance as well as the ones referred to the energy issue, results a strong awareness of the need to adopt strategies geared toward the reduction of polluting emissions to the implementation of natural mechanisms of uptake (mitigation) and new strategies aimed at contrasting the possible adverse effects of climate change. On the other hand, it's evident also that a national unified reference framework causes heavy restrictions on the implementation of concrete actions. For example, there is much diversity and generalization about addresses on sustainable mobility oriented to mitigate the effects due to climate change. On the contrary the measures referred to energy efficiency of buildings, are supported by laws and latest national public finance interventions.
The process of resolving energy issues has been slowed down by international choices such as the Conference of the Parties COP17 of Durban in 2011 that allows to develop solutions for the reduction of

greenhouse gas emissions starting in 2020. Therefore an energy policy environmentally sustainable, characterized by an integration between energy, mobility and urban system, should be quickly adopted. Henceforth initiatives such as the Covenant of Mayors might provide a valuable contribution, as SEAP (Sustainable Energy Action Plan) is based on interrelationship between these areas. However, the development of a synergy between programs, planning tools, and mobility governance still requires a great deal of cooperation and human and economic resources. The definition of SEAP is only on voluntary basis, which is an element of weakness for the success of European low-carbon policies. Considered the positive results that SEAP have been reaching it should be advisable to get compulsory these initiatives to get the sustainable energy objectives. Anyway the implementation of the SEAP has some points in common with various cities, though each city show its own characteristics and therefore needs specific solutions for transport problems they suffer. In all the European cases proposed has developed an integrated planning process, focusing on shared decisions among the various stakeholders and particularly with the community. An open participation is the fundamental element to achieve prearranged objectives as energy sustainability begins mainly with a radical lifestyle change. Italy too is making progress in the definition of integrated policies; however, the integration between urban and transport plans compared with the European cases analyzed often remains a theoretical aspect. Energy saving should therefore be regarded as a consequence of the reduction of polluting emissions and not as a goal.

All the examples referred to Italy have considered SEAP as an important opportunity in order to identify the best solutions for their own problems about energy efficiency and urban transport. Infact these elements represent both a challenge and an opportunity to rethink the future of cities, to transform and improve life conditions. Therefore, the elements to be brought into question should be: the path to be followed, the role of the subjects involved or to involve and the tools to use.

	London	Amsterdam	Paris	Genoa	Rome	Modena	Bari
COUNCIL DELIBERATION	2010	2010	2007	2010	2011	2011	2011
2020 CO2 REDUCTION	38%	40%	25%	23%	20%	21%	35%
MAJOR TRANSPORT MEASURES	Increasing the use of public transport; Increasing pedestrian and bike modes; Use of hydrogen buses; Promoting sustainable fuels; Car e bike sharing (electric too); expansion of the network of charge points for electric vehicles; Promoting electric vehicles.	Promoting hydrogen buses; Promoting electric vehicles; Promoting hydrogen vehicles; Increasing pedestrian and bike modes; Car and bike sharing electric too).	Increasing pedestrian and bike modes; Promoting hybrid vehicles Car and bike sharing (electric too); Renewal municipal vehicles.	Parking policies; Increasing pedestrian and bike modes; municipal green vehicles; Car and bike sharing; Green buses.	Increasing pedestrian and bike modes; Promoting sustainable fuels; Establishment ZTL for traditional vehicles; Electric car sharing; Bike sharing; municipal green vehicles; Promoting network of charge points for electric vehicles.	Increasing the use of public transport; Parking policies; Park and ride stations; Car pooling; Car and bike sharing (electric too); Promoting electric vehicles.	Car and bike sharing (electric too); Park end ride stations; Increasing pedestrian and bike modes; Promoting electric vehicles; Expansion of rail network.
INTEGRATION WITH OTHER PLANNING TOOLS	Cycling Revolution London; The plug-in vehicle Infrastruture Strategy; Hydrogen Action Plan; Mayor's Transport Stategy	Amsterdam Climate Program; Amsterdam Smart City	Plan de la Protection de l'Atmosphere	PUM; PUC	PUMS	PUC; PEC; PUT	PEC

Fig.21:Summary table for European and Italian analyzed cases

The above considerations allow immediately perceive that such things require a different and broader strategy to solve the problem. The extreme slowness and the fragmentation of the Italian law system witness the inadequacy of acts to build renewable energy plants and give evidence to the absence of a mature industrial market of green energy.

Italy is the European country with the best investment opportunities in the renewable energy but at the same time it is the Nation where is more difficult to achieve projects. The guidelines (D Lgs 387 2003) to approve the realization of renewable energy plants from are a plain example of this situation. The core of the problem of change climatic emissions is mainly represented in medium and large cities, where temperature is higher at least two degrees compared to less densely urbanized territory. Henceforth Europe has pointed out as seventh thematic strategy the urban environment, where it is necessary to integrate environmental policy with other actions.

A great deal of studies and research on energy and environmental has showed the lack of a systemic approach. The traditional division between city and countryside has determined a higher soil consumption causing the inevitable growth of road transport demand and worsening the territorial, environmental and energy unsustainability.

Fig.22: The experimental two-seat electric vehicle in New York

The research lines that afford the energy consumption reduction have been developing their field action only recently within the Relevant National Interest Research Programs (PRIN) and National Operational Programs (PON). The integration among territorial transformations, planning mobility and environmental sustainability opens interesting perspectives for the definition of new intervention strategies that tie together, into a new model of governance of the territory, different aspects such as: the reorganization of urban system, rail transport, social housing, urban regeneration and the implementation of energy policies and climate adaptation.

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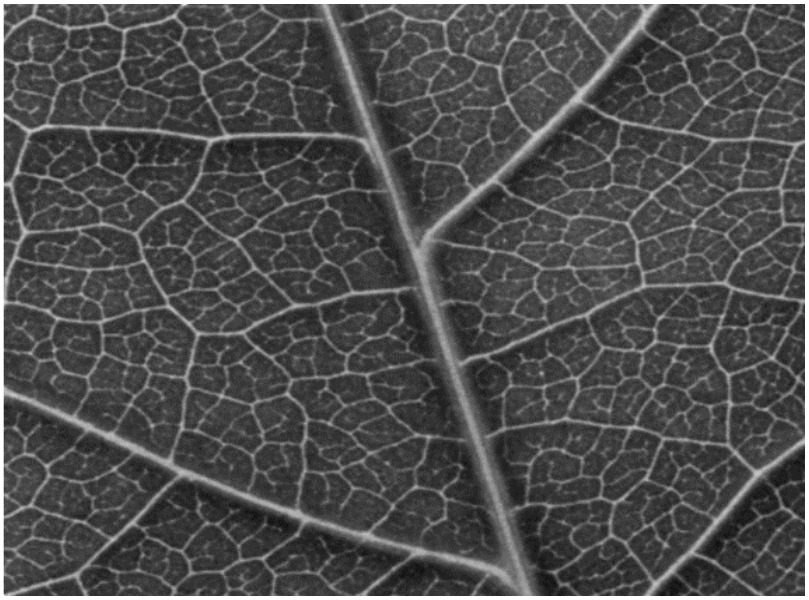
TeMA
Journal of
Land Use, Mobility and Environment

TeMA 2 (2012) 55-68
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: 10.6092/1970-9870/918

review paper. received 07 June 2012, accepted 23 July 2012

www.tema.unina.it



SYSTEMIC RESILIENCE OF COMPLEX URBAN SYSTEMS

ON TREES AND LEAVES

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ABSTRACT

Two key paradigms emerge out of the variety of urban forms: certain cities resemble trees, others leaves. The structural difference between a tree and a leaf is huge: one is open, the other closed. Trees are entirely disconnected on a given scale: even if two twigs are spatially close, if they do not belong to the same branch, to go from one to the other implies moving down and then up all the hierarchy of branches. Leaves on the contrary are entirely connected on intermediary scales. The veins of a leaf are disconnected on the two larger scales but entirely connected on the two or three following intermediary scales before presenting tiny tree-like structures on the finest capillary scales.
Urban system's structural resilience is highest when it is configured according to a scale free structure for its parts and for its connections. The spatial distribution and the intensity of connections in such a structure obeys a scale-free distribution. It states the frequency of an element's appearance and the span of a connection based on its hierarchic level: the smaller an element is, the more often it will be encountered in the system; the bigger an element is the rarer it will be. This fundamental law defines in itself the manner in which living organisms and things should be organized to optimize their access to energy, the use that they make of it, and their resilience. The history of urban planning has evolved from leaf-like to tree-like patterns, with a consequent loss of efficiency and resilience.

KEYWORDS:
Urban resilience, Complex systems, Scale hierarchy, Urban systemic

1 URBAN RESILIENCE THROUGHOUT HISTORY

Historical cities had the capacity to absorb successive transformations without losing their essential structure. In Paris, deemed capital of the 19th century by Walter Benjamin, no more than half of the buildings predating 1900 subsist within its historical boundaries and yet the city has managed to maintain its character thanks to the tenacious hold of the structure created by Baron Haussmann. In the historical European city, the extremely complex substrate, the subdivisions and the street grid can be traced back to the Middle Ages and sometimes even to the Roman Empire (Salat, 2011). The capacity of the city to retain its identity despite changes has vanished from the modernist city, since it has lost its distinctive character and its transformative power. The capacity to survive disasters and even to rise out of its ashes, like Lisbon after the 1755 earthquake, London after the Great Fire in 1666, Kyoto after the fires in the Middle Ages, Tokyo after the 1923 earthquake, is what we call urban resilience – a complex concept related to the permanence of a memory at once social, symbolic and material. The vast majority of historical cities is resilient and has managed to survive the centuries, often outlasting the civilizations that gave rise to them. Can modernist cities survive? Will they withstand the test of time like Rome and the great many cities that the Romans founded around the Mediterranean? Will they even manage to survive the century and hold out against the growing risks linked to climate change?

Fig. 1 Haussmannian Paris

The question is all the more important insofar as the fragility of modern cities is structural: they have exposed themselves more to risks by becoming more and more artificial and incorporating energies that are

hard to predict and control. This paper aims introducing urban resilience through the prism of history and progressively shift to a more dynamic understanding of this concept, using analytical insights from complex systems theory.

2 HYBRIDIZING THE NATURAL AND THE ARTIFICIAL

In cutting themselves off from nature, cities have become fragile. Indeed, they have internalized the most destructive dynamics of nature without learning how to regulate them. If natural elements are not incorporated into the planning and construction of cities, they risk collapse.

The material metabolism of cities is founded on the redeployment of the energy of nature through the construction of hybrids. The infrastructures of modern cities combine human dynamics and natural forces in ways that transform nature and change society. This phenomenon, verifiable in all cities since the birth of the urban world five thousand years ago, has become a predominant factor in modern cities. The redeployment of the forces of nature provides the energy for processes in which complex physical hybrids (motors, telecommunications, heating, lighting, water distribution systems, air-conditioning, etc.) and complex social structures (governments, national and transnational companies, universities, etc.) are built out of simpler components. The Industrial Revolution developed such hybrids on an unprecedented scale and they relied on massive injections of energy, mainly from fossil fuels.

Massive flows of energy from nature can travel across these hybrids in catastrophic ways, breaking them down into simpler element. Indeed, in these hybrid constructions, natural forces do not lose their potential autonomy. Despite human efforts, hybrids corrode, rot, explode, etc. But there is worse. These hybrids of nature and artifice exist in a much wider context of forces over which human beings have no control, like fire or ice storms, earthquakes, and floods. Modern technological hybrids, like dams, that oppose the resistance of a human artifact to the colossal pressure of masses of water, are much more fragile in the face of natural forces than older technologies, like the floating houses in the Mekong Delta that went with the movement of the water instead of resisting it. In both cases, there is a hybridization of the natural and the artificial, but traditional technologies construct with nature, whereas modern technologies construct against nature for the purpose of harnessing its forces.

2.1 THE LAWS OF EVOLUTION

Ecology was long dominated by a paradigm of stability but now we know that all natural systems are unstable. Nature's unpredictable character is not a temporary state in the construction of human knowledge; it is a fundamental feature of nature, as theories of chaos and dynamical systems have demonstrated. Cities exist in a vortex of continually changing dynamic energy flows that we call nature. One fundamental reason for the fragility of hybrids built by human beings is that they are informed by a simple mechanical logic whereas nature is organized in a much more complex way. The fragility today comes from the coexistence of two very different levels of complexity within a single hybrid construction. Consequently the complexity of urban systems must be enhanced to approximate the complexity of natural systems.

Living systems, because they developed and became more complex over four billion years of evolution, serve as the best model for the conception of a complex system that can enduringly survive the biological conditions of our planet. Local ecosystems in particular tell us much about the optimal organization for maintaining life in a particular region of the planet. We can look at living systems to understand how to design sustainable buildings, districts, cities and regions.

Evolution permitted the survival of species through constant transformations. We can thus find a functional order in nature without an architect or planner. Adaptation via incremental changes can lead to great

transformations and great formal diversity. Evolution involves a combination of continuity and change that occurs in response to the environment. It allows us to understand why organisms differ and yet are connected over time and space (Dawkins, 1986).

Can evolutionary theories be applied to cities? Despite evident differences between the evolution of living organisms and the development of cities, there are some commonalities. Cities can be classified by type. They change over time and the types also change even as they maintain great stability. Emerging schemes, however, are never simple. The global scheme of the city emerges from its agreement with local orders. A complex order is created from the evolution of the small scale and its influence on higher scales.

The evolutionist perspective can help us understand why the crisis of cities is so profound. Never were cities confronted with such massive changes on such vast scales in so little time. Thus we may be witnessing a radical break in an evolutionary process thousands of years old and even an end to the history of cities.

2.2 THE PERSISTENCE OF THE IDEA OF A CITY ACROSS THE METAMORPHOSES OF ITS FORMS

Cities are the physical human creations that have persisted over the longest period of time, more than two thousand years insofar as the Greek and Roman cities are concerned. The historical city was a “standard ideal” but never the sterile repetition of a model. Cities of Roman origin share certain qualities and elements that derive from common principles rather than from a rigid preconceived plan. Historical cities were changing organisms, all different. Over time, the city grew and became more complex in its own right. It came to incorporate conscious and unconscious memories, traces of forgotten rituals and forms along with original patterns that remained embedded in its construction. The destruction of its memory is the worst crime that can be committed against a city. To deprive a city of its memory is to destroy its identity and its singularity, to shatter the distinctive lines of its development, and eradicate its identity and its values. “The city of Florence is a concrete reality,” writes Aldo Rossi. “But the memory of Florence and its image are loaded with values that reflect other experiences. In addition, the universal value of its experience can never completely explain that special something that makes Florence Florence.” (Rossi, 1981)

By replacing the organic morphogenesis of cities by normative plans abstractly projected onto areas relieved of the weight of culture and history, Le Corbusier’s modernism replaced the infinite variety of the human world with the serial character of mechanical production. Normative processes did not form historical cities. They are not the static product of such rational plans as Lucio Costa’s for Brasilia. They are the outgrowth of creative evolution.

Time, temporality, and duration – all have a decisive impact. We have forgotten the virtues of a slow pace. The long term and the gradual spread of information in a fragmented world created the diversity of Western cities. A rich mantle of cities with complex patterns covered both sides of the Mediterranean at a time when centralized China had already developed a more homogenous urban system. In contrast to the European complexity and variety, the city patterns of urban America, which were planned at a time when information spread more rapidly, are more homogenous, ordered as they are by an omnipresent obsession with grids. One cannot simply opt for uniformity or variety as a matter of choices in urban design; they are the product of political centralization versus fragmentation, and cultural homogeneity versus diversity.

However, no matter how many different forms a city went through, its initial founding phase will be the most tenacious attribute of its morphology. Take a city like Bath in England. The street plans laid down by the Romans at the time of its foundation have survived thousands of years, despite periods of destruction and

adversity. And even though the buildings of Turin today reflect the Baroque designs of the Piedmont kings, its inhabitants are still walking in the footsteps of the Romans on the same streets.

The cities of Magna Græcia are still standing around the Mediterranean. The mosques of Istanbul took over the great concave spaces of Byzantine churches. Nation-states pass while cities remain. “Soon you will have forgotten the world and soon the world will have forgotten you,” Marcus Aurelius famously remarked but his Rome is still present in Fellini’s Rome. And although Rome may be eternal, who believes in the eternity of Italy? (Vance, 1990)

But is this still true today? Satellite images show us the inexorable dilution of the form of cities. At what point will the age-old balance of Dutch cities, as Vermeer and Peter de Hooch knew them, be destroyed by the massive emergence of the conurbation of Randstad? The slab blocks of the modern housing projects can be seen from the tower of Delft’s Neue Kerke and Vermeer’s famous view of Delft, still visible only fifteen years ago, is now disfigured.

2.3 MORPHOGENESIS AND EVOLUTION

Cities have changed more in the past twenty years than they had in two thousand years before. Their evolution can be described in ten processes:

1. Phases of evolution are connected more to the functional life of the city than to chronological time.
2. Even though the city changes over time, certain physical features like the network of streets or the urban fabric are remarkably unchanging. The city can be deformed, sometimes impoverished like the center of Boston, but without ever totally shedding its past. This is why the blank slate approach to urban planning that destroys the city or razes whole districts brutally interrupts and damages the city’s evolution.
3. Whereas forms tend to persist, functions change.
4. The capacity to have different successive functions fulfilled by the same forms or by gradually modified forms is the adaptation that characterizes historical cities.
5. The adaptation is not only a matter of the city’s physical structures. It is a process of continually adjusting form and function – a matter of mutual transformation rather than the primacy of functions over forms. The fundamental persistence of adaptation is the basis of the evolution and continuity of cities.
6. Throughout history cities have spread out in continuous processes in which changes of scale and size gave rise to integrated wholes. After the Second World War, modernism caused an explosion of the urban form and huge breaks in scale before the phenomenon of urban sprawl came to dilute the form and dissolve the scale in endless repetition.
7. Morphological dynamism was one of the characteristic traits of historical cities until serial sprawling cities put an end to the creative momentum of most cities and destroyed the continuity of their morphology.
8. The dynamics of historical cities made forms and activities converge, while modernism and urban sprawl separated the two.
9. The historical city increased its complexity and connectivity as it grew, whereas the morphology of the modernist city was simplified and its connectivity was reduced by a factor of twenty when measured with the help of graph theory.

The evolving nature of cities is linked not only to forms and functions but also to a key third element: connectivity.

An analysis of resilience has to be based on the forms, functions and connections. The connections are no doubt the most fundamental element for creating a living and sustainable city. Some periods are dominated by the creation of new forms, functions or connections while others are characterized by the persistence of existing patterns (Tannier, 2009). We have witnessed over the last thirty years the destruction of historical urban forms or their dilution in vast formless agglomerations, along with the destruction of connections (divided by two in the historical center of Boston), the erasure of forms and the segregation of functions. The accelerated urbanization of the planet is paradoxically a huge anti-urban production.

2.4 THE PERMANENCE OF THE PLAN

The study of city plans affords valuable indications as to their type and level of connectivity. Notwithstanding differences between periods and civilizations, historical cities display relative unity insofar as connectivity is concerned – a unity with which modernism made a radical break. We can analyze the resilience of an urban form by looking at the role of the street. The city is born in a precise place but it is the street that gives it life. “The association of the destiny of the city with communication arteries becomes a fundamental principle of development.” (Rossi, 1981)

The urban land is at once a fact of nature and a product of civilization. It is linked to the urban composition where each element must be the most faithful expression of the life of this collective organism, which is the city. According to Aldo Rossi, “at the basis of this organism that is the city is the persistence of the plan.” (Rossi, 1981) The concepts of persistence and of memory are essential to the resilience of cities. Rapid, brutal transformations of urban fabrics destroy the continuity and resilience of cities. Persistence is in fact the generator of the plan. The urban structure is a material structure formed of streets, monuments, and so on, but it is also a structure that internalizes continually changing social forces along with the forces of nature, subject to the unpredictability of deterministic chaos. Amid transformations, and sometimes amid catastrophic breaks, what persists is the urban fact. What constitutes an urban fact par excellence is the capacity to subsist within a totality in transformation. The functions, single or plural, that the city fulfils over time are only temporary moments in the reality of its structure. Resilient living cities maintain their axes of development; they preserve the placement of their arteries; they grow while continuing to conform to an orientation and a sense determined by older facts whose memory has often been erased.

To survive a city has to be able to evolve in a continuous metamorphosis and adapt to new needs, which necessarily implies deformations to its initial plan. The evolution of cities shows that successful urban developments are based on an interaction between urban planning and processes of self-organization that make the overly regular aspects of the initial organization more complex. In addition, the original form of the founded city must be able to deform successfully. The capacity of urban structures to last over time depends on the complexity of their organization, the intricacy of their network, the richness of their connectivity, and the creation of a fractal order of the same level of complexity on several very distinct scales. A city can be said to be resilient if the idea of its form is maintained through successive metamorphoses but not fixed for all eternity in an unchanging order. Cities like Turin, Florence or Rome survived the centuries and different civilizations. With each metamorphosis enough of their different successive forms was maintained to keep their memory alive while leaving their future open.

3 THE RESILIENCE OF FRACTAL URBAN FORMS

3.1 THE STABILITY OF FRACTAL URBAN SYSTEMS – EMERGING PROPERTIES

The fundamental notion that defines the stability of physical systems is that states are only stable if minor perturbations reinforce rather than destroy them. Dynamically stable urban states are those that display an enormous number of geometric and functional connections on different scales. When some connections are cut, others are created. These connective forces act on urban morphology to generate unique cities every time and transform them following singular trajectories. The process is exactly the opposite of the utopian or imaginary orders that architects try to impose on cities and that offer few connections. Huge quantities of energy are needed in such imaginary orders to maintain the urban system in a stable state. Modernist cities, with forms imposed from the outside, obstruct the emergence of connections whereas the continuous creation of connections in historical cities favored their evolution and hence their survival. Traditional buildings, because of their connective forces, have a stabilizing impact on the urban fabric and system. Modernist buildings do not connect into the urban fabric. They have a destabilizing impact and fail to create a human environment. Indeed modernist architects tried to reverse the laws of urban growth by working with large-scale elements. The brutal juxtaposition of vast homogeneous zones made of a repetition of very big objects hinders the appearance of emerging properties.

Emerging properties are properties that were not integrated into the initial conception of the system. For a property to emerge on a big scale, small scales need to exist to support it. Each scale supports the higher scales in the hierarchy. The fact that a system has emergent properties is what allows it to repair and stabilize itself and to evolve. We cannot understand emergent properties by breaking down the system and analyzing its parts. Emergent properties are analogous to the human brain (Edelman & Tononi, 2000). The three conditions needed for emergence to appear in a system are: a high connectivity, the presence of a mechanism that creates new connections and a sufficiently low degree of control, since less control implies more emergence and vice versa.

3.3 COMPLEXITY, COHERENCE AND URBAN RESILIENCE

A fundamental attribute shared by resilient living cities is a high degree of organized complexity. The geometric assemblage of elements constitutes a series of organized wholes on each successive scale and across the progression of scales. This fractal harmony is what distinguishes a coherent urban morphology from the repetitive serial din of modernist non-compositions. Urban morphology is fractal by nature. Modernist cities, on the other hand, are incapable of generating urban coherence. Geometric coherence is an indispensable quality insofar as it connects the city through forms across all scales. It is crucial to the vitality of the urban fabric.

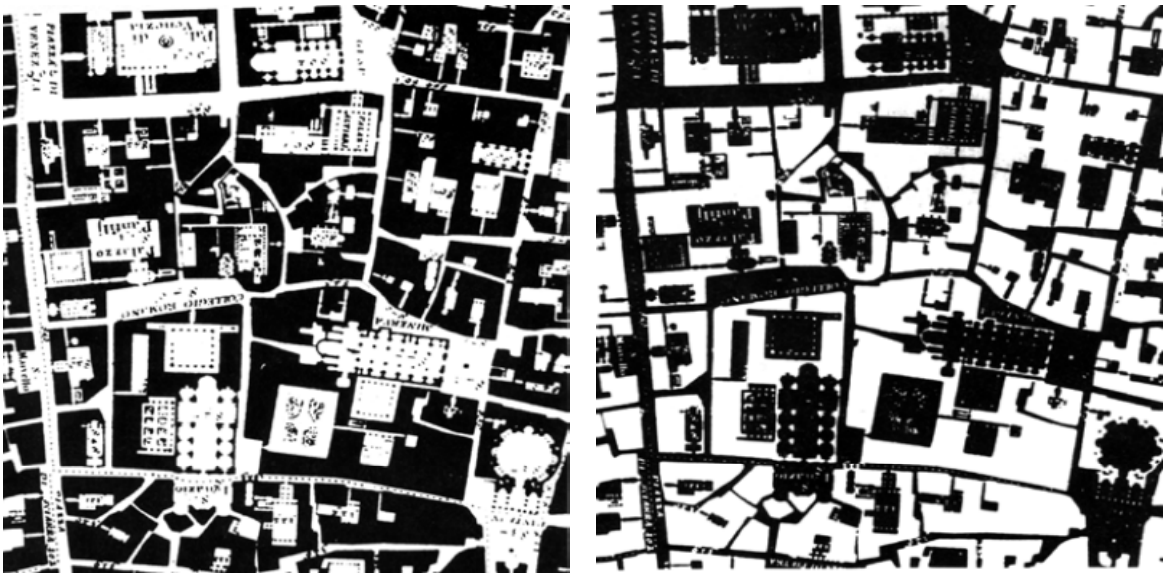

Fig. 2 The map of Roma drawn by Giambattista Nolli in 1748 (details)

In a fractal morphological field like the one we have just described the position and even the form of each element are influenced by its interaction on different scales with all other elements. When the result of all these interactions creates a form, it is neither symmetrical nor fixed. It displays a degree of plasticity that allows it to evolve. Evolution is only possible if the large scale is correctly defined on the basis of a great many connections obeying a hierarchy of scale.

The structure of the connections is what matters and not the nature of the components. In a multiply connected, living organic structure, the smaller components can be changed without affecting the overall structure. Building the whole from the parts in an organic way leaves room for evolution. Arriving at the parts, on the other hand, in a rigid way starting from the whole creates structures that cannot evolve. In concrete terms, modifying the whole once it has been established involves destroying a great many components on very different scales. It is, to the contrary, very easy to modify smaller components, like the arrangement of rooms in a house or the nature of buildings along a street. The streets themselves participate in the structure of the whole and display remarkable permanence over time.

According to Nikos Salingaros (Salingaros, 1998), the idea underlying the resilience of fractal street patterns is very simple: a complex city is a network of paths that are topologically deformable. This is particularly evident in Tokyo and Kyoto where, despite differences in form – in one case very regular, in the other, curved, labyrinthine and deformed by the topography – the topological structure of the graph of the two cities is identical and translates a fundamental anthropological dimension of Japanese society. In the same way, to be resilient, the urban form must be deformable and display a high degree of plasticity. It must be capable of accompanying the torsion, extensions and compressions of paths without tearing. To be deformable, the urban fabric must be strongly connected into the smaller scales and weakly connected into the large scale. This is also a characteristic of the Japanese city with its multiplicity of short-range connections and average distances between intersections of around 50 meters in Tokyo as in Kyoto. Connectivity on all scales following the inverse power law produces urban coherence. Tokyo and Kyoto are thus particularly coherent cities because they display a great number of small connections.

3.4 RESILIENCE AND MULTIPLE CONNECTIVITY

The multiplicity of connections enhances the resilience of a city and its possibilities of evolution, change and adaptation. In fact, the more connections there are, the more likely they are to be redundant. Thus, if the connections are cut, as they were for example during the successive fires in Kyoto, the city can continue to exist even as it changes. Districts can be reborn from their ashes, sometimes after centuries. They persist simultaneously the same and different, like Rome's Forma Urbis that continued to exist in Renaissance Rome and has survived in contemporary Rome.

Salingaros demonstrates that complex cities are those whose network displays a large degree of redundancy. If there are a great number of ways of getting from one point of the city to another passing through different nodes, then cutting a connection between two nodes will not keep the network from working.

Multiple connectivity also presents many functional advantages. Too many connections of the same type in a single channel can overload the channel's capacity. We can see this in overly hierarchical systems with the problem of collectors that gather the traffic from lower-level paths. On the other hand, connections of a wide variety of types create a less hierarchical network but one that is connected in a much more diversified way and this prevents the saturation of a single channel or gridlock caused by congestion at an unavoidable node. The different networks, on different scales, need not coincide. If they do, network saturation will take place faster. A good example of a resilient network is the Tokyo metro, which consists in multiple superimposed and intertwined networks.

4 SCALE HIERARCHY AND STRUCTURAL OPTIMIZATION

How are we to approach new urban projects in ways that embeds cities in the long term, and factors in the constraints we are facing in a finite world and the risks of climate change? Cities will have to reinforce their efficiency and resilience to meet these changes. They will have to be more efficient in their use of material and energy resources to reduce their ecological footprint and their climate impact. They will also have to rediscover the resilience of historical cities, in order to withstand climatic and natural shocks, and to absorb fluctuations in their environment, which will increase in number and intensity as the Earth's atmosphere warms.

We will show that for an urban fabric to be efficient and resilient, it must be structured in a complex way, strongly connected in the manner of a leaf, and hierarchized in a fractal way according to the Pareto scale-free distribution.

4.1 SIMON'S WATCHMAKERS' PARABLE

In a seminal paper, Herbert A. Simon (1962) introduced the topic of complexity architecture with a parable that has since largely influenced complexity sciences. He told the story of two highly regarded watchmakers, who constantly had to pick up the phone to answer clients. One of the two fine watch businesses, run by Hora, prospered, while the other, run by Tempus went bankrupt.

The two watchmakers had to construct watches out of 1000 parts each. Tempus' watch was designed so that if he had partly assembled it and had to put it down to answer the phone, it immediately fell to pieces. The more clients he had, the more they phoned him, the more difficult it became to have enough time to finish a watch. On the contrary, Hora's watch were designed so that he could put together subassemblies of about ten elements each, then put together ten of those subassemblies into a larger subassembly, and so on. Whereas a phone call caused Tempus' work to fall entirely into pieces, it only causes Hora a

subassembly to fall into pieces. No need to argue further that the probability for Hora to finish a watch is much higher than for Tempus.

This parable was meant by Herbert A. Simon to highlight the role of hierarchy within complex systems: a complex system made up of coherent subassemblies has a greater ability to evolve and adapt quickly. And as we will see later in this paper, adaptability has crucial implications on resilience ability.

4.2 SCALE HIERARCHY, FLUCTUATIONS, AND RESILIENCE

Historical cities, over the course of their long history, were slowly transformed by incremental phenomena of destruction and reconstruction of the urban fabric. Structures that were not resilient enough were eliminated. And so historical cities have come down to us with extraordinary capacities of efficiency and resilience. In a process of ongoing, spontaneous self-organization to adapt their forms to fluctuations in their environment, historical cities acquired the capacity to absorb fluctuations by reinforcing their structure and order, and becoming more complex and richer as a result of the changes that take place in them.

Fig. 3 A free scale network (left) and the Parisian street network (right)

Scale hierarchic structures optimize urban flows and are also vital in giving cities the resilience that they are lacking today. The more structured and complex the city, the more readily it can be nurtured by the perturbations to which it is subjected, absorbing them without letting them upset the stability of its structure. And it is in assimilating the fluctuations and tensions that it complexifies and absorbs them all the more easily. Hence, there is an ongoing dialogue between the city's capacities of resilience and the constraints to which it is subjected, between the fluctuations from the outside environment and its resistance to these fluctuations.

The resilience of a city is intrinsically linked to its self-organizing capacities. But self-organization is inevitably lodged in time, and the long span of natural fluctuations is not that of contemporary cities; the latter are designed and built very rapidly by authoritarian, rigid forms of urban planning to accommodate an ever growing number of rural migrants irresistibly attracted to cities. These cities are designed nearly instantaneously in emerging countries, without the time and distance needed to evaluate the quality of their interactions with the environment, the adaptation of their forms to the flows that run through them, and the systemic efficiency that determines their resilience. These are cities that are expected to survive for

centuries but the long span of their existence is almost never taken into consideration when they are designed.

Alongside these long fluctuations, whose effects over centuries are sometimes imperceptible, there are short-term, even catastrophic fluctuations, which are becoming more frequent today, with their share of deaths and destructions. Cities were always subjected to them. Cases in point are the Great Fire of London in 1666 and the earthquake in Lisbon that outraged Voltaire so. But London and Lisbon both managed to live through these disasters and maintain their form, whereas contemporary cities are more and more vulnerable to earthquakes, droughts, floods, and natural and energy crises. They are vulnerable, to begin with, due to their low efficiency, and their voracity in energy and resources. They are also vulnerable because they are not adapted to their sites, to the environment they inhabit all in the same way and which, from one day to the next, may violently remind them of its existence and its identity, like the Chao Phraya delta into which Bangkok is inexorably sinking. Finally, they are vulnerable because of the disordered uniformity of their urban fabric, its absence of hierarchized structure, of identity based on the complexifications of a long history that forges a city's capacities of resilience.

Following Simon's parable (1962), the resilience of scale hierarchic structures is linked to their power to complexify so as to absorb fluctuations, to transform the currents of the waves of history and time into a constructive rather than a destructive force. Urban resilience can be understood as the robustness of urban structures and networks against random failures. Such failures might be small-scale failures (local transport network disruption, local energy supply disruption, etc.) or large-scale ones. According to Buhl et al. (2004, 2006), the resilience of a network – its robustness – can be evaluated by studying how fragmented the structure becomes as an increasing fraction of nodes is removed. The network fragmentation is usually measured by the fraction of nodes contained by the largest connected component (Buhl, et al., 2004). The move removal can be chosen either randomly or selectively. According to Albert et al. (2000) and Holme et al. (2002) real networks clearly deviate from the prediction made for random graphs. Moreover, several real networks have proved to be highly resilient to random node removal and highly vulnerable to selective node removal. Although they might not be the unique ones (Newman, 2002; Dunne, et al., 2002), scale-free networks do exhibit this specific feature (Albert, et al., 2000).

Counteracting the vulnerability of contemporary cities requires a real paradigm reversal, and a shift from a mono-scale conception to a scale hierarchic conception of cities. Only scale hierarchic structures in the case of flow networks can secure optimal efficiency and resilience, while limiting the propagation of local perturbations. But another parameter is just as fundamental for the capacities of resilience of cities, and that is the fine-grained connectivity of their subjacent structures. This parameter entails pushing our thinking beyond the tree-like structures prescribed by simple thermodynamic considerations.

4.3 ARBORESCENCES AND LEAF STRUCTURES

An arborescence is a highly hierarchic structure, and this hierarchization is precisely what causes its efficiency (Salat & Bourdic, 2011). This then is the first element we are seeking for the sustainable structure of the urban system: a strong scale hierarchy ensuring system efficiency. However, the connectivity of a tree is low: between two points there is only one possible path. And connectivity is an essential parameter of cities. For a city to be connected, it must be structured not like a tree but like a leaf.

A series of connections whose intensity obeys a Pareto distribution – scale hierarchic - increases resilience by preventing rapid and catastrophic fluctuations from spreading quickly through the system and disorganizing it. There should be few long-range connections and these connections should be weak to prevent the spread of disrupting fluctuations. Indeed, weak connections are what allow the fluctuations to be absorbed. On the

other hand, a great many strong short-range connections ensure the system's deformability. If efficiency is linked to the arborescence of elements, resilience seems to be linked to a more abstract arborescence, that of the system of connections between elements the intensities of which should also obey a Pareto distribution.

As Alexander has noted (Alexander, 1965), one can readily see that street networks are not structured like trees: small streets are more often linked to one another or to several higher level streets, which is not the case in a tree structure. In fact, the underlying structure of these networks is what is called a "semilattice". A striking image of this type of structure is the system of veins on the leaves of most deciduous trees. Their leaves manifest a remarkable exception to the many tree-like systems observed elsewhere in nature. They display the same scale hierarchy, which proves again the universality of the Pareto distribution, but the midsize veins and the venules connect to one another, like the streets of a city, and so the connectivity is much stronger than in a tree-like structure.

4.4 THE MULTIPLE PATHS OF LIFE

The multiple connectivity and scale hierarchy that leaves and cities have in common enhance both their efficiency and their resilience.

Firstly, the loops that these structures contain, as Francis Corson has demonstrated, (Corson, 2010) manage variable flows more efficiently. The tree structure is most efficient when it comes to distributing stationary flows. But one of the characteristic features of urban flows is their extreme variability, both in time and in space. The semilattice structure absorbs these variations by distributing flows along different possible paths. This is impossible in a tree-like structure, where there is only one path between two points.

Secondly, the semilattice structure imparts greater resilience to a network. When a branch of a tree is cut, all those that grew from it will die too. In a leaf, if a vein is interrupted, the redundancy of the network will allow the flow to get around the interruption via secondary paths, so that it will only be partly slowed down by the degradation of the network. This is why cities structured like leaves are more resilient. Just imagine that a path is blocked by an accident: the flow is simply deviated onto other paths to irrigate the far side of the perturbation. A part of the leaf's network can be amputated and the leaf will go on living and converting light energy into nutrients. Thanks to the dilatation symmetry or the scale invariance linked to the Pareto distribution, nature has provided for redundancy on all scales to ensure the permanence of its structures. The simultaneous existence of small and big nervures having the same function contains a natural redundancy for living organisms that answers the objective of efficiency and resilience with an economy of volume.

5 CONCLUSIONS

We have discussed the theoretical underpinnings of what a sustainable and resilient city should be. This is a conceptual framework, governed by fractal geometry for spatial planning, the power law for distributions, and leaf structures for connections. The scale relationships between the different hierarchic levels of an arborescence, a leaf, and the blood and oxygen circulation systems in our bodies obey such a mathematical law. It states the frequency of an element's appearance and the span of a connection based on its hierarchic level: the smaller an element is, the more often it will be encountered in the system; the bigger an element is the rarer it will be. This fundamental law defines in itself the manner in which living organisms and things should be organized to optimize their access to energy, the use that they make of it, and their resilience.

City planning today has lost all its complexity and hierarchy of scale. It has become so simplistic, mechanical, and functional that its structural inefficiency causes an enormous waste of energy. It should

possess the qualities that history has conferred upon cities: complex, connected, and structured according to scale hierarchies based on the Pareto distribution.

To reach these high levels of connectivity, complexity and scale hierarchy that make the efficiency and the resilience of historical urban fabrics, a set of innovative tools based on the science of complexity has to be settled. It is meant to be applied to the design of new cities, but also to the restructuring of hastily built cities, denatured by the ideas of modernism, mechanical bodies completely disconnected from the time of historical, organic cities.

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TeMA
Journal of
Land Use, Mobility and Environment

TeMA 2 (2012) 69-87
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: 10.6092/1970-9870/936

review paper. received 13 June 2011, accepted 4 July 2012

www.tema.unina.it

ENHANCING URBAN RESILIENCE IN FACE OF CLIMATE CHANGE[1].

A Methodological Approach

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ABSTRACT

Climate change can be considered as one of the main environmental topic of the 21st century (IPCC, 2011). It poses a serious challenge for cities all over the world (EEA, 2012): cities show, on the one hand a high level of vulnerability in face of climate change, on the other hand, they are responsible for 60% to 80% of global energy consumption and greenhouse gas (GHG) emissions, which represent the main causes of change in climate conditions. In 2011, the 73% of European population was living in urban areas and the level of urbanization is expected to be at 82% by 2050 (UN, 2012). Due to the evidence that in Europe the 69% of all GHG emissions are currently generated by cities, larger and larger is the attention devoted, by scientific literature and policy makers, to outline strategies for urban adaptation to climate change, both at European and local scale. Governments and scholars currently highlight the need for strengthening urban resilience in face of climate change and related consequences. By this perspective, some actions are already running, even though a clear identification of the features which make a city resilient in face of climate change is still missing. To fill this gap, this contribution is mainly addressed to:

- provide, by integrating different disciplinary perspectives, a conceptual model of the set of adaptive capacities and properties that characterize a resilient system;
- verify, starting from a snapshot of current strategies and actions for urban adaptation currently implemented at European level, the consistency between those strategies and the identified set of resilience capacities and properties.

KEYWORDS:
urban resilience, adaptation, climate change

1. CLIMATE CHANGE: RELEVANCE, FEATURES AND CONSEQUENCES

According to the numerous Intergovernmental Panel on Climate Change (IPCC) reports, set up from 1990 to 2007, the research projects and the large scientific literature focused on the topic, climate change is "one of the great challenges of the 21st century" (IPCC, 2011). To understand the importance assumed in the last decade by researches on climate change, it is worth mentioning that, since 2003, more than 130 research projects directly focused on climate change as well as other projects related to the effects of climate change in the areas of environment, energy, transport, agriculture, fisheries, natural hazards, have been supported by the European Community (EU, 2010). Moreover, the eligibility criteria of the last European Research Programme (FP7) allow partners from all over the world to participate in climate change research projects, according to the awareness that climate change represents a global threat. As stated by Rodríguez (2010) "the diversity of European research confirms that climate change is an encompassing matter touching on nearly every dimension of our society".

Climate change refers to any change in climate over time, whether due to natural variability or as a result of human activity. This interpretation differs from the one provided by the United Nations Framework Convention on Climate Change, where climate change is referred to a change of climate directly or indirectly attributed to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods (IPCC, 2007).

Climate change induces a set of slow-moving phenomena, such as the increase in air and ocean average temperature and in the sea level, the decrease in snow and ice, the change in the global precipitation amount (with significant increases in some regions and declines in others). Furthermore, in the last decade an increase in the number of occurred natural hazards has been recorded: according to the Centre for Research on the Epidemiology of Disasters (CRED), the number of natural disasters in Europe rose from 59 disasters on average per year in the time-span 2000-2009, to 70 disasters in 2010. Such an increase is mostly due to a rise in the number of hydrological (avalanches and floods) and climatological (extreme temperatures, drought and wildfires) disasters (Guha-Sapir et al., 2011). Although these events cannot be directly linked to climate change, last IPCC Report (2007) has clearly highlighted that climate change contributes to the occurrence of more frequent, severe and unpredictable weather-related hazards, such as floods, droughts, tropical cyclones and heat waves. Hence, referring to climate change, both slow as well as quick-moving phenomena have to be taken into account. Moving to the causes of the mentioned phenomena, the GHGs emissions are widely recognized as the main contributors to climate change: carbon dioxide (CO_2) is the most important anthropogenic GHG and recent data confirm that consumption of fossil fuels accounts for the majority of global anthropogenic GHG emissions (IPCC, 2011).

Europe is responsible for approximately the 12% of the annual global anthropogenic direct GHG emissions (EU, 2011). According to the Kyoto Protocol, adopted in Kyoto in 1997 and entered into force in 2005, numerous efforts have been undertaken to curb emissions in Europe: total emissions had a significant decrease in the period 1990-2009 (more precisely from 2004 to 2009), going below the Kyoto target (8%), but an increase has been recorded in 2010 (Fig. 1) (EEA, 2012). Data provided by the Annual European Union GHG Inventory highlight that in EU 27, in 2010, the sectors that have mostly contributed to GHG

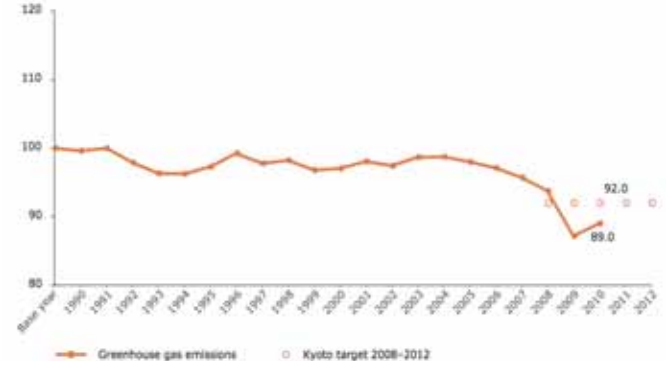

Fig. 1 GHG emissions in Europe (1990-2010) in respect to the Kyoto threshold.

emissions were Energy Production, Transport and Households Services (Fig. 2) (EEA, 2012). Broadly speaking, in respect to the heterogeneous phenomena induced by climate change, the most affected elements and systems can be identified in the coastal areas, exposed to increasing risks, including coastal erosion and sea level rise; natural ecosystems, which are threatened by the combination of climate change related disturbances (floods, drought, wildfires, etc.) and other global change drivers such as pollution, fragmentation of natural systems, etc..

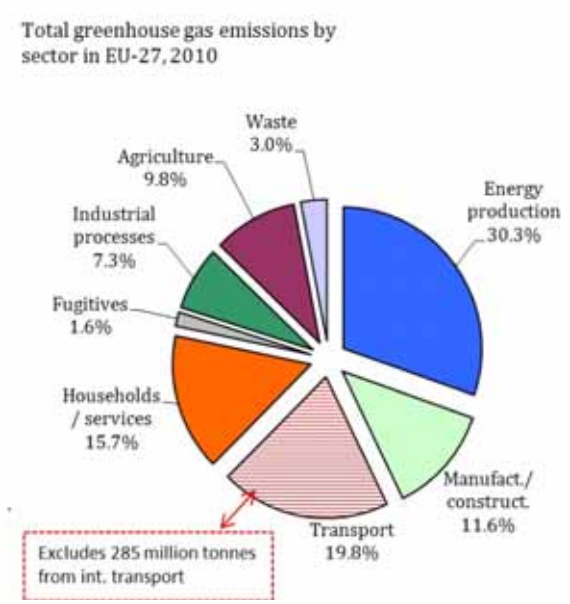

Fig. 2 Sectors contributing to total GHG Emission in 2010 (EU27).

Crop productivity can be also positively (in some regions) or negatively (in others) affected by change in local temperatures, whereas impacts on water availability would be a critical issue all over the world. In Europe, especially in the northern area, referring to IPCC (2007) scenarios, negative impacts of climate change can be referred to the increased risk of inland flash floods and to more frequent coastal flooding and increased erosion (due to storminess and sea level rise). In southern Europe, climate change could worsen livability, due to high temperatures and drought and reduce water availability, hydropower potential, summer tourism and crop productivity. Moreover, it is also expected to increase health risks due to heat waves and frequency of wildfires.

2. EUROPEAN STRATEGIES FOR TACKLING CLIMATE CHANGE

According to the features and the potential consequences of climate change shortly described above, two are the main typologies of strategies that at global, European and local level are currently put in place:

- mitigation measures, aimed at reducing GHG emissions;
- adaptation measures, aimed at adjusting natural or human systems in response to actual or expected climatic stimuli or their effects (UNISDR, 2009).

The two types of strategies also differ one from each other, both from a temporal and a spatial perspective. Mitigation measures are generally the result of international strategies, although applied at national or local levels, and are referred to a long-term perspective.

Adaptation measures are strongly characterized as site-specific measures; they generally refer to the scale of the impacted system and are undertaken at local level, although based in some cases on a wider common platform at national or upper level (Walsh, 2010; EEA, 2012a)

Focusing on strategies for tackling climate change, in 2007 the European Council adopted ambitious energy and climate change objectives for 2020 consisting in:

- a reduction in European GHG emissions of at least 20% below 1990 levels (12% less than the Kyoto target);
- an increase in the share of renewable energy up to 20%;
- an improvement of 20% in energy efficiency.

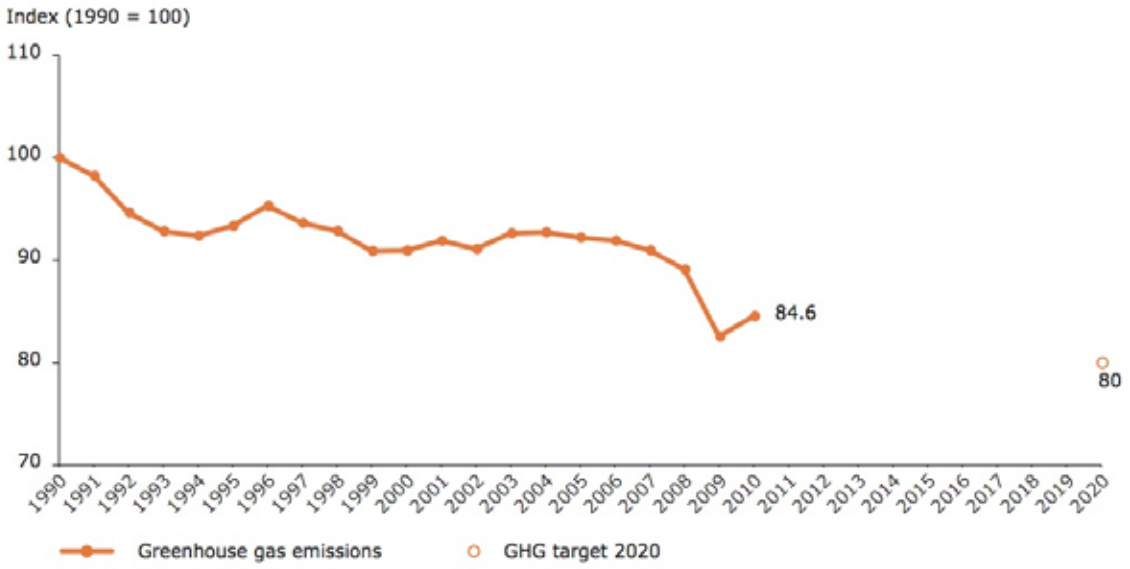

Fig. 3 Trend in total GHG emissions in Europe (1990-2010) in respect to the EU 20-20-20 Strategy threshold.

Currently EU is on track to meet the first of the mentioned targets (fig. 3), despite the increase in GHG emissions registered in 2010; good results have been recorded also in respect to the second target, but it is still far from achieving the third one, the energy efficiency target.

Hence, the priority remains, on the one hand, to achieve all the targets already set for 2020 (EC, 2011); on the other hand, to define new targets for further reducing GHG emissions. In order to keep climate change below 2°C, in February 2011, Europe has established new targets, related to a long term temporal scenario. In detail, the main aim is to reduce GHG emissions by 80-95% by 2050 compared to 1990, in the context of the necessary reductions that, according to the Intergovernmental Panel on Climate Change, have to be pursued by developed countries. A Roadmap fixing the actions that, by 2050, could enable Europe to deliver GHG reductions, in line with the agreed 80 to 95% target (EC, 2011), has been also established. The pathway towards an 80% reduction by 2050 is shown in fig. 4; in detail, it highlights how emissions due to different sectors could evolve, if additional policies were put in place, taking into account technological options available over time. To achieve these goals, EU has defined the main strategies to be followed in each sector. In detail in the power sector, the key role of renewable energies is largely emphasized and investments in smart grids are defined as crucial for a low carbon electricity system.

In respect to transport sector, technological innovation is defined as the key tool for "a more efficient and sustainable European transport system by acting on 3 main factors: vehicle efficiency through new engines, materials and design; cleaner energy use through new fuels and propulsion systems; better use of networks and safer and more secure operation through information and communication systems. According to the Roadmap, "emissions from road, rail and inland waterways could be brought back to below 1990 levels in 2030, in combination with measures such as pricing schemes to tackle congestion and air pollution, infrastructure charging, intelligent city planning and improving public transport" (EC, 2011). In respect to the built environment a significant improvement of the energy performance of buildings could be achieved thanks to the prescriptions included in the Energy Performance of Buildings Directive (EU, 2010).

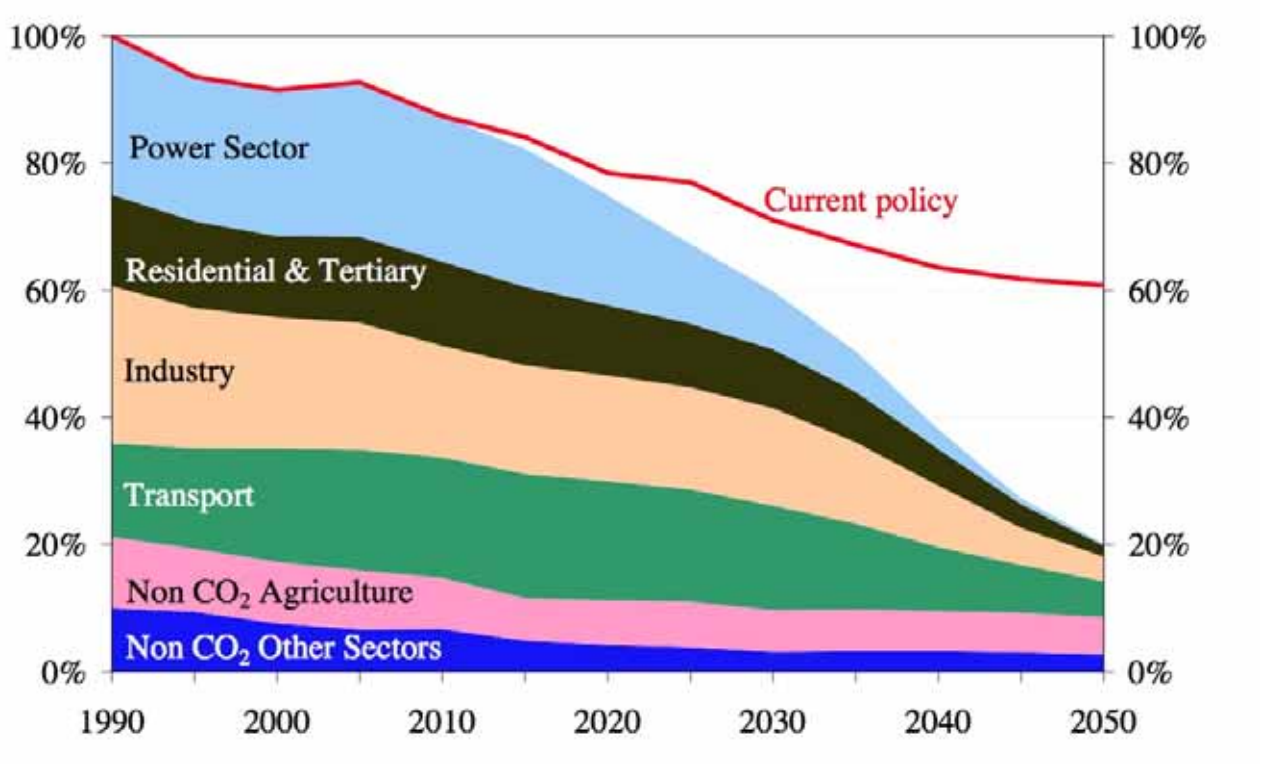

Fig. 4 Sectoral emissions pathway towards an 80% reduction by 2050.

Referring to the industrial sector, it is expected to achieve positive results from the application of more advanced resources and energy efficient industrial processes and equipment, increased recycling, as well as abatement technologies for non-CO^2 emissions for reducing related emissions (EC, 2011).

Finally, in the sector of agriculture "non-CO_2 emissions could be reduced through policies focused on options such as further sustainable efficiency gains, efficient fertilizer use, bio-gasification of organic manure, improved manure management, better fodder, local diversification and commercialization of production and improved livestock productivity, as well as maximizing the benefits of extensive farming" (EC, 2011).

The need for addressing climate change is more and more significant, when moving from individual sectors towards urban areas. The awareness that climate change poses a serious challenge for cities all over the world (EEA, 2012) –being cities highly vulnerable to the consequences of climate change and, in the meanwhile, important contributors to global GHG emissions and to global energy use– is more and more widespread at present.

Therefore, European Commission has recently published a report focused on Urban Adaptation to Climate Change (EEA, 2012a). It provides a range of adaptation measures classified, according to the White Paper "Adapting to climate change: Towards a European framework for action" (EC, 2009), as follows:

- "grey infrastructure", related to physical interventions or construction measures and using engineering services to make buildings and infrastructure essential for the social and economic well-being of society more capable of withstanding extreme events;
- "green infrastructure", devoted to the increase of ecosystems resilience and to the reduction of biodiversity loss, waste of water and degradation of ecosystem.
- "soft measures", consisting in policies, plans, programs and procedures implemented for achieving behavioral changes that can be very relevant in contexts characterized by high levels of uncertainty, due to the fact they contribute to increase adaptive capacity (UNECE, 2009).

Therefore, cities seem to play a crucial role in all the European strategies for tackling climate change, in terms both of mitigation, being relevant to all measures related to the sectors of power, transport and built environment, and of adaption measures, specifically tailored on urban areas.

3. URBAN ADAPTATION TO CLIMATE CHANGE: A CRITICAL ISSUE FOR THE NEXT FUTURE

At present, more than half of the world population lives in urban areas and it will further increase by 2050 (UN, 2012) (fig. 5). Europe is one of the less urbanized area in the context of developed countries; nevertheless, in 2011, 73% of its population was living in urban areas and its level of urbanization is expected to be at 82% by 2050 (UN, 2012). Hence, cities currently represent a crucial issue for addressing climate change: looking at global scale, cities are responsible for 60% to 80% of global energy consumption and of all global emissions; in Europe, 69% of all greenhouse gas emissions are generated by towns and cities (EU, 2011).

According to the trends of population growth, these data could significantly worsen in the next future.

In cities both causes and impacts of climate change are highly concentrated: here, indeed, the demand for energy and associated services to meet basic human needs (e.g., lighting, cooking, space comfort, mobility and communication) is constantly increasing, whereas "at the very same time, densely built-in urban spaces allow for less air displacement and thereby less natural cross-ventilation. (....) Potential risks related to climate change - such as natural disasters, shortage of food or increase of food prices, etc. – threaten more intensively urbanized areas, where more people are influenced by certain impacts" (EU, , 2011a).

Thus, being cities, namely, the urban way of life, part both of the problem and of the solution (EU, 2011), in addition to reduce emissions, the issue of adapting them to a changing climate is becoming more and more prominent as well and larger and larger attention is currently devoted both by scientific literature and by decision makers at European and local scales to outline strategies for urban adaptation to climate change. Grounding on the awareness of the role played by cities, a reflection on "how we create our built environment is" indeed "critical in lessening our dependence on oil and minimizing our carbon footprint" (Newman et al., 2009). In order to analyze current strategies and actions for urban adaptation, it is worth firstly classifying them according to the main sectors which may influence or which may be affected by climate change in urban areas. These sectors can be identified as follows:

- energy;
- transportation;
- water management;
- natural hazards;
- waste management;
- planning;
- governance.

In respect to these sectors, a snapshot of the strategies and measures which are currently the most widespread ones in the European cities is provided in table 1.

Within this list, settlements have been not included as specific sectors, although almost all mentioned measures directly or indirectly affect them. Nevertheless, long term strategies specifically related to the re-shaping of urban areas with the aim to create a climate-friendly urban structure would be required; among them, for example, strategies addressed to the promotion of "compact-city" models at local scale and polycentric urban patterns at regional level, able to counterbalance urban sprawl phenomena, and the reduction of transport needs, favoring mixed land uses.

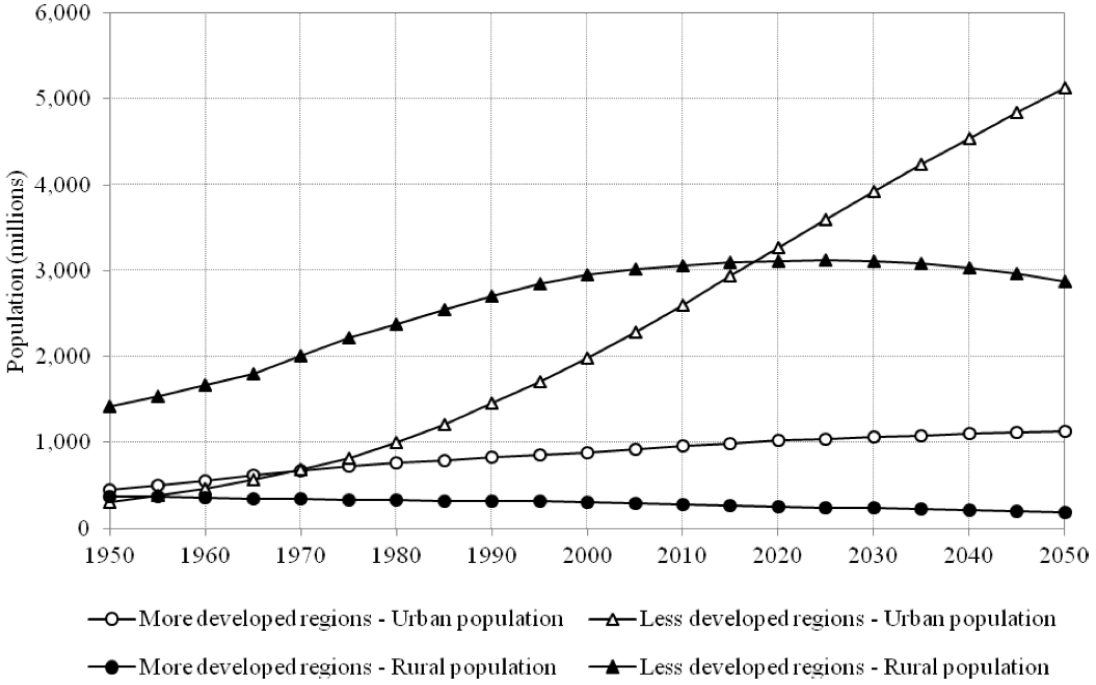

Fig. 5 Urban and rural population trends (1950-2050) in developed and less developed regions.

In detail, energy sector includes strategies and actions aimed at improving energy efficiency and saving. Among them: retrofitting of existing buildings and criteria and rules for guaranteeing high energy performances of new buildings, according to the 2002/91/EC and 2010/31/EU Directives; promotion of renewable energies (solar, geothermal) for supplying domestic hot water; promotion of building automation for energy saving. Moreover, large attention is devoted to improve urban infrastructures for energy distribution, such as smart grids or district heating, and to increase the spread of renewable energy sources (photovoltaic roofs, wind plants, biogas). These are mainly “grey measures”, essentially engineering solutions exploiting innovative technologies, although in many cases they require soft measures to be effectively implemented (e.g. rules or plans which may favor the rehabilitation of building stock according to energy efficiency principles).

Due to the relevance of transportation sector for addressing climate change, a common framework for European cities is represented by recommendations and actions included in the Action Plan on Urban Mobility carried out in 2009. Transportation sector includes both grey and soft measures; among them: increase of a low emission vehicles in public transport, promotion of environment friendly modes (rail networks, bicycles, pedestrian), development of Intelligent Transport Systems (ITS) for urban mobility, introduction of traffic reducing/calming measures (pedestrian areas, car sharing/carpooling, congestion charge, parking charge, etc.).

Water management is an important sector for dealing with some of the long term consequences of climate change which are very likely in some regions, such as drought. Therefore, in areas where water scarcity is going to become a priority, strategies addressed to water saving are currently in progress (e.g. systems and devices for collecting rainwater or recycling grey-waters in individual buildings or in dense urban areas).

Another important sector is related to the prevention and mitigation of the main climate related hazards, such as floods or heat waves. Current strategies for flood prevention mainly refer to structural measures (dams, dikes and diversion channels) or to regulative approaches (land use planning, flood proof buildings or infrastructures). Nevertheless, large attention is also devoted to the maintenance of urban drainage systems and to the role of urban green networks: the cooling effect of green areas through evaporation may reduce

both the threat related to heat waves and may have significant effects in reducing pressure on urban drainage.

Waste management might play a significant role in climate change mitigation effects, mainly in respect to the disposal of the collected waste. Some cities are testing new solutions for waste management, combining recycling and composting, or creating complex waste treatment plants, in which recycling facilities, biogas power plant as well as landfill sites with a landfill gas collecting system are combined. In respect to planning sector, it is worth noting that numerous cities are currently engaged in carrying out planning tools specifically addressed to mitigate climate change effects, such as Energy Local Plan and Urban Mobility Plans specifically addressed to reduce GHG emissions. Despite these efforts, the main challenge that should be faced in this sector is the development of an integrated approach (unfortunately still missing) to land use, mobility and environmental planning which seems to be, at present, a key-requirement for an effective urban adaptation to climate change.

SECTORS	STRATEGIES
Energy	Retrofitting of existing buildings (insulation of roof and walls, replacement of windows, replacement of light bulbs) Energy performance criteria for new buildings Solar thermal systems Production of energy from RES (Renewable Energy Sources) Improvement of power and heat generation (cogeneration, heat pump) Building automation (sensors, timers) Public Lightening Smart grids District heating
Transportation	Substitution of public vehicles (e.g. electric vehicles) Car sharing/car pooling Promotion of cycling and pedestrians paths Mobility Management Development of ITS and cleaner emission technology
Water management	Water saving devices Grey water recycling systems Rain water harvesting systems
Natural Hazard (floods and heat waves)	Urban green networks (useful both for reducing pressure on urban drainage and for counterbalancing heat waves) Maintenance of drainage systems Temporary water storage in basins Dams, flood defense Forecasting and early warning systems Adapting building and planning codes in respect to floods Flood risk management plans
Waste management	Promotion of recycling Solution for reducing the amount of CH_4 emitted from landfills
Planning	Updating of local Master Plan codes (by an energy perspective) Urban Mobility Plan City Energy Plan Sustainable Action Energy Plan (SEAP)
Governance	Climate Action Plan City Networks (e.g. Climate Action Network-Europe) European Programmes (e.g. INTERREG, URBACT) Training courses for Public Administration Green Points Observatories for Energy Green Public Procurement (GPP) Fiscal incentives Promotion of ESCO's role

Tab.1 The main strategies for urban adaptation to climate change in European cities.

A first step towards such an integrated approach might be represented by the Sustainable Energy Action Plan (SEAP), which is the main outcome of the voluntary European initiative "Covenant of Mayors", involving local and regional authorities committed to increase energy efficiency and use of renewable energy sources on their territories in order to meet the 20-20-20 targets.

The last sector to be considered is related to governance; it is a cross-cutting sector and it is particularly important since urban adaption to climate change requires a multi-level governance cooperation. In Europe, some steps towards a better cooperation among cities have been currently undertaken through the establishment of global, European or national city networks (e.g. Climate Action Network-Europe, Association of Finnish Local and Regional Authorities-ALFRA), networks of experts (e.g. Energie Cités), or through European programmes devoted to transfer knowledge and experiences in different fields, including climate change (e.g. INTERREG, URBACT). Besides these initiatives, the sector concerns all the strategies addressed to inform people, for increasing climate change awareness both at institutional and at community levels (e.g. creation of green points or observatories on energy, implementation of training courses for public administrations), and to the establishment of regulations, for improving energy efficiency (e.g. introduction of energy efficiency criteria in public spending or fiscal incentives, establishment of Energy Service Companies (ESCO), providing financial support to the realization of energy efficiency projects.

Summing up, despite the large efforts currently underway, policies at city level are still fragmented and effective tools to support decision-making processes are still lacking (Corfee-Morlot et al. 2011).

On the opposite, looking at the theoretical and methodological approaches provided by scientific literature as well as by institutional documents, it has to be noticed that the awareness that urban adaptation to climate change requires a multi-level, integrated and participatory approach is at present widely recognized (EEA, 2012a) (fig. 6).

Most of recent studies and researches seem to converge towards the idea that urban adaptation strategies have to be addressed to increase the resilience of natural and human systems in face of current and future impacts of climate change and that, according to the variability of climate change effects on different contexts, they have to be highly site-specific (EEA/JRC/WHO, 2008).

Although the reference to the need for strengthening urban resilience in face of climate change is becoming more and more widespread both in scientific literature and in institutional documents and numerous related initiatives at European, national and local scale are already running, a clear identification of the features able to make a city resilient in face of a threat, such as climate change, is still missing.

Fig. 6 The pillar model of the climate friendly city

Thus, in the following paragraph, the concept of resilience will be deepened and -based on the review, from a multi-disciplinary perspective, of current scientific literature- the main features of a resilient system will be outlined.

4. RESILIENCE, CLIMATE CHANGE AND UNCERTAINTY

The concept of resilience has been developing since the Fifties through different disciplinary fields, from physics to psychology, from ecology to management science, although it is hard to find out a shared interpretation of the concept in the different domains.

The term found wide room in Ecology in the Seventies, although it was probably embedded in this field since the Fifties (Kelman, 2008). At the beginning of the Seventies, Resilience was defined by Holling (1973) as a "measure of the persistence of systems and their ability to absorb changes and disturbance and still maintain the same relationships between populations or state variables". The aspects related to the capacity to resist and absorb change and disturbance were later more properly included in the "stability" concept by Berkes and Folke (1998), underlining that resilience concept mainly refers to the opportunity for the recombination of modified structures and processes in face of a disturbance. This aspect became preeminent when discussion on resilience moved from the ecological to the socio-ecological field. The importance of "adaptation" within the resilience concept has been largely emphasized also in the field of psychology (Masten et al., 1990).

Resilience was officially introduced in the disaster field in 1994; in the Guidelines for the World Conference on Natural Disaster reduction the need for strengthening "resilience and self-confidence of local communities to cope with natural disasters through recognition and propagation of their traditional knowledge, practices and values as a part of development activities" (UN, 1994) was largely emphasized. A lot of documents published under the umbrella of relevant international institutions and NGOs followed the 1994 one.

Resilience was firstly introduced into the 2004 UNISDR Glossary on Disaster Risk Reduction and defined as "the capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure". Therefore, such a definition embodies both the concept of stability and the opportunity for change in face of a given threat.

In the last updating of the UNISDR Glossary on Disaster Risk Reduction the definition of resilience was re-defined as follows: "The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions" (UNISDR, 2009). It is worth noting that in the latest definition of Resilience provided by the UNISDR, the relevance attributed in the first one to the change has been significantly revised, putting more emphasis on the ability to resist and to recover.

Nevertheless, the importance of adaption and transformation in face of a disturbance is also stressed by CRSI (2011) that defines resilience as the capability of a community to anticipate risk, to limit impact, and to recover rapidly through survival, adaptation, evolution, and growth in the face of turbulent change.

Despite the difficulty in finding out a shared definition, Resilience is nowadays largely recognized as a key concept for a "shift in thinking" in the field of disaster analysis and management, due to the opportunity that it provides for dealing with concepts like uncertainty, cross-scale effects, non-linear dynamics, etc. which are very important mainly in face of urban disasters, showing a higher and higher level of complexity (Ensure, 2010).

These concepts seem to be crucial also for addressing the set of slow-moving and instantaneous phenomena related to climate change, from the increase in average temperatures to the numerous "climate related hazards" such as heat waves, storms, hurricanes, floods, drought, forest fires, and so on, which are largely characterized by uncertainty, cross-scale effects and so on. From this point of view, the resilience perspective appears significant in order to improve the capacity of social as well as territorial systems to cope with, adapt to, and shape change (Folke, 2006; Bahadur et al. 2010).

According to Fiksel (2003), indeed, where the conditions are stable and where projections about the future are generally clear, the concept of anticipation works better, although it must be employed judiciously; but where uncertainties are large, the resilience concept is probably most suitable.

What it is worth emphasizing to our aims is that, according to the large scientific literature on the resilience concept (Handmer and Dovers, 1996; Wildavsky, 1988; Folke, 2006; Berkes, 2007) and namely on its importance for coping with uncertainty, resilience can be an useful concept for driving strategies addressed to urban adaptation in face of climate change, mainly due to the following aspects:

- resilience is conceived as a conceptual approach to deal with uncertainty and future change with respect to traditional approaches mainly focused on system's control;
- resilience represents a premise for a proactive response to disasters as it embodies the concept of adaptive and learning capacity, which is typical of living systems;
- resilience gives room to the emergence of new configurations of the system (even more desirable than the previous ones) after a disturbance, as a result of the self-organization capacity that is typical of complex systems.

5. CAPACITIES AND PROPERTIES OF A RESILIENT SYSTEM

"Coping with ongoing trouble immediately raises the questions of (…) capabilities. A tank or a battleship is resilient because it has armor. A football team is resilient because its players are tough and its moves are well coordinated. (…) organizations are resilient because they can respond quickly or even redesign themselves in the midst of trouble. (…) organization's flexibility is often a key factor in organizing to fight the problem. They are thus 'adaptive' rather than 'tough.' This is true, for instance, of learning during conflict or protracted crisis. Many examples of such learning are apparent from the history of warfare. There are many aspects to such learning. One aspect is learning from experience" (Hollnagel, Woods, 2006).

This long quotation highlights some of the numerous capabilities that may contribute to make an element or an organization resilient in face of a trouble or a crisis.

Researches and studies seem currently to converge towards an interpretation of resilience as a set of interrelated adaptive capacities (Norris et al. 2008; Paton, 2008; Chapin et al. 2009; Gibson and Tarrant, 2010). Nevertheless, although the large debate on the capabilities making a system resilient developed in the last decade, a consensus on which capacities/properties make a territory or a community resilient is still missing. As a consequence, it is also difficult to understand how and on which elements or components of a systems to act in order to increase resilience. An effort in this line has been carried out in the ENSURE project (2010), mainly addressed to enhance resilience of communities and territories in face of natural and na-tech hazards. The similarities existing between natural hazards and climate change - since both of them represent a relevant "threat" for settled communities- allow to extend the main findings of this project to the topic at stake. Grounding on the review of institutional documents and scientific literature, carried out according to a multi-disciplinary perspective, the main capacities and properties contributing to make a system resilient in face of disturbances have been singled out and arranged into a conceptual framework (Fig. 7). In such a framework, Resilience, meant as the final aim of a continuous process, is placed in the core of the framework and is progressively specified, in operational terms, through a set of interrelated capacities/properties, which have been sorted according to a hierarchical structure -widely applied in planning- linking goals, objectives and actions.

Such a structure allows to compare current policies and actions aimed at enhancing urban resilience in face of climate change and capacities and properties of a resilient system, checking their mutual compliance.

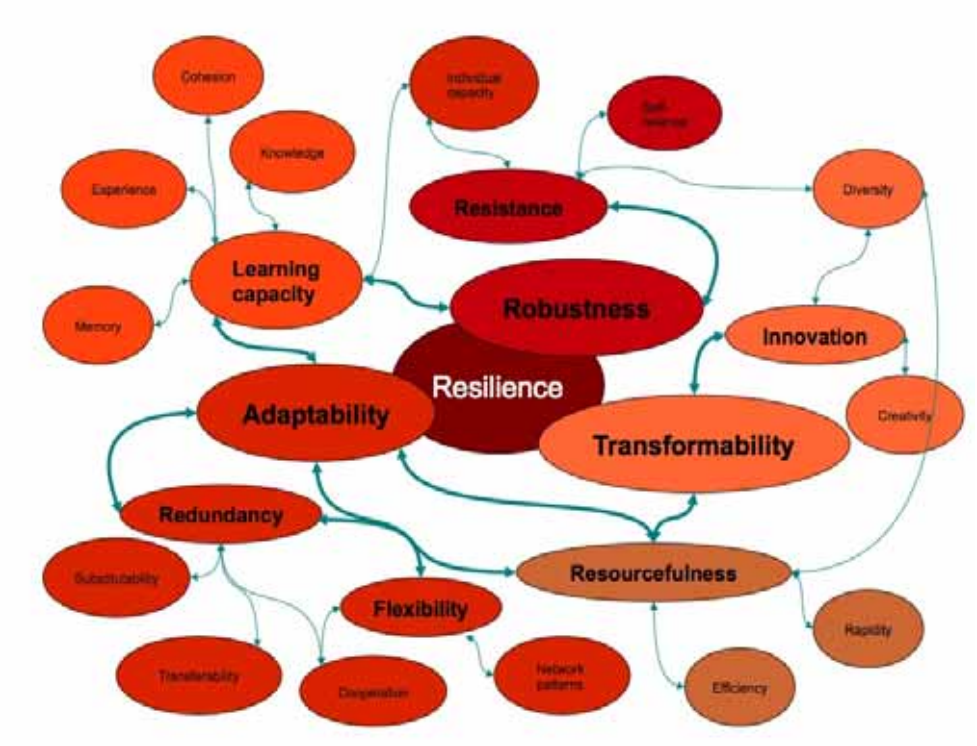

Fig. 7 The set of interrelated capacities/properties/ of a resilient system (Adapted from ENSURE, 2010)

Robustness, adaptability and transformability have been recognized as three distinct components of resilience and, as a consequence, identified as the three main goals to pursue for enhancing systems' resilience.

Robustness, in the field of climate change, has been defined as "the ability of a system to continue to perform satisfactorily under load" (UKCIP, 2003); *adaptability* represents the capacity of a system to adapt in face of the consequences of a given threat or perturbation; *transformability* represents the capacity of a system to turn a threat, a disaster into an opportunity, by creating new conditions, different and sometimes more desirable in respect to the previous ones.

Following the hierarchical structure, the three facets of resilience have been specified through six capacities or properties, related to one or more facets, which represent the main objectives to be pursued for strengthen them.

Resistance, closely related to the concept of robustness, is generally meant as the ability of systems to withstand the stress, maintaining its features in face of a given stress. According to numerous authors, resistance is related to the capacity to absorb, without being damaged, disturbance (Folke, 2006; Berkes and Folke, 1998). *Learning capacity*, typical of living systems such as communities, refers to the ability of learning from past event in order to foresee and cope with the future. It has been recognized as part of the resilience concept by Resilience Alliance (Folke et al., 2002) and plays a key role for improving both robustness and adaptability. The concepts of *Flexibility* and *Redundancy* are closely related to adaptability. In detail, the former is a key aspect of adaptive capacity (Godshalk, 2003) and is proper of adaptive systems which are able to learn from experience, process information and adapt accordingly (Bankoff et al., 2004). Redundancy can be interpreted as the presence within a system of several actors or elements performing the same function, so to assure the function may continue if one actor/element fails (Chuvarajan et al., 2006). Therefore, it is a relevant concept in order to cope with uncertainty. *Resourcefulness* is related both to adaptability and to transformability and refers to the availability of resources and skills and to the capacity to mobilize and apply material and human resources to achieve goals in case of adverse events (Bruneau et al., 2003). It is a key ability for improving preparedness and planning in face of a threat or in case of emergency (Buckle et al., 2000). *Innovation,* directly linked to transformability, refers to capacity of change

and innovation of a system, which makes it able to re-think and re-organize previous social, economic, ecological conditions (Walker et al., 2004).

The last group of capacities/properties further specifies the previous ones and each of them is related to one or more of the previous mentioned one. *Individual capacity* and *self-reliance* represent the main properties that might be improved for enhancing resistance. Self-reliance refers to the ability of satisfying basic needs locally with the aim to eliminate dependence on imported resources (Chuvarajan, 2006). In economy, self-reliance has the advantage of strengthening local economies, decreasing energy consumption for transportation (Ekins, 1986), and makes local economy stronger and less vulnerable to global economy fluctuations (James and Torbjorn, 2004). Individual capacity is related both to resistance and to learning capacity, since it refers to the capacity of the individual actors to cope with external stresses which depends both on the livelihoods but also on the learning capacity, which is crucial for enhancing preparedness.

The success of a learning process depends on the interrelated aspects of *experience*, *memory*, *knowledge* and *cohesion*.

Memory and experience are relevant both for preventing future events and for the re-organization of a system after a disturbance. Furthermore, they largely contribute to increase knowledge (of events, damages, mitigation measure, best practices, etc.) which is crucial for an effective learning process too. Finally, learning capacity is also influenced by the level of cohesion existing within the community: in case of a good cohesion level, indeed, experience is more easily communicated and memory more easily preserved.

Redundancy can be specified in terms of *transferability* and *substitutability* (Van der Veen et al., 2005), which refer to the availability of elements or systems which can replace or substitute another one if the need arises (Van der Veen et al., 2005).

Flexibility can be enhanced through different properties or mechanisms aimed at overcoming dependency. Among them, *spatial and organizational network patterns* - designed or spontaneous - which can be singled out as properties ensuring a higher flexibility in respect to the hierarchical ones; *cooperation* among the different actors within a system, especially by an institutional perspective. It is worth noting that cooperation can also enhance redundancy, in that it provides a multiplicity of opportunities that are very useful, especially in face of a threat.

Other key-properties to improve resourcefulness can be recognized in *rapidity*, viewed from an organizational perspective, and *efficiency*, aimed at optimizing the available resources, making a rational use of them.

Diversity is another property to strengthen for enhancing resourcefulness; it supports the richness and the variety of available resources. Diversity has been widely recognized as a crucial property of a system for coping with uncertainty and surprise, facilitating redevelopment and innovation following a crisis (Folke et al., 2002). Therefore, diversity has been also linked to the innovation capacity. The latter depends also on another intangible resource, *creativity*, which is a crucial property to cope with surprise or, in other words, with threatening events that can't be easily foreseen. It is extremely important also for developing future scenarios taking into account less likely threats and can be defined as the ability to achieve a higher level of functioning by adapting to new circumstances and learning from the experience (Maguire and Hagan, 2007).

6. CURRENT POLICIES FOR URBAN ADAPTATION TO CLIMATE CHANGE AND RESILIENCE CAPACITIES: ARE THEY CONSISTENT?

In this paragraph the consistency between strategies and actions currently implemented in European cities for adapting them to climate change and the capacities/properties which characterize a resilient systems will be discussed.

In the Table 2, a first attempt to verify such a consistency has been provided. In detail, each strategy/action may contribute to strengthen one or more of the identified capacities/properties. The consistency has been investigated in respect to the group of resilience capacities/properties placed at the lower level of the hierarchical structure: they represent, indeed, a specification of the previous "levels"; hence these capacities/ properties are those which have to be strengthen through specific measures in order to increase resilience.

Only strategies included in "planning" sector have been left aside from this consistency exercise: referring to this sector, indeed, the match with resilience capacities should make no sense, due to the fact that the former includes, in turn, multiple strategies and actions. Thus, the consistency should be sought between the measures included in each planning tool and the resilience capacities. Therefore, in this case, the resilience model should represent an useful tool guiding planning tools in enhancing urban resilience.

At a first glance, current strategies seem to be mainly addressed to enforce some resilience capacities (such as efficiency, knowledge) more than others (e.g. cohesion, memory). This might have a double meaning: on the one side, we should consider that a large effort in defining capacities and properties that make a system resilient has been done in the ecological domain as well as in the field of natural hazards, in which some capacities, such as memory, play a relevant role, being less relevant to climate change; on the other side, one could argue that current policies are more addressed to improve some aspects of resilience, namely flexibility, resourcefulness and resistance, than others.

In detail, current actions in almost all the considered sectors seem to be mainly addressed to improve efficiency that, as mentioned above, aims at optimizing available resources, making a rational use of them, contributing to increase the amount of available resources (resourcefulness) of a system in case of disturbance.

Action addressed to improve cooperation and knowledge seems to be also very relevant, mainly in the field of governance, even due to the fact that the different kinds of solutions (grey, green and soft measures) ground on knowledge.

On the opposite, in the future initiative to be undertaken for tackling climate change, the key role of diversity and self-reliance should be further stressed, being them key-properties for enhancing resistance, innovation and resourcefulness and, through them, robustness, adaptability and transformability, which are the three main sides of resilience.

Other capacities which should play a more significant role are those related to redundancy (substitutability and transferability): in face of uncertainty, indeed, the presence within a system of several actors or elements performing the same function, so to assure the function may continue if one actor/element fails is obviously crucial.

Rapidity seems currently to play a secondary role, although it is relevant for all measures related both to deal with climate-related hazards and to monitor the effectiveness of strategies and actions undertaken in each sector. Moreover, creativity should be further encouraged, by investing firstly in the field of research and IT in order to provide spurs for innovate cities in face of a changing climate but also by rethinking cities, even in their shape and structure, according to old common practices adopted for preventing some climate related events, such as heat waves.

Finally, in respect to memory and cohesion, which seems to be not affected by current policies, it is worth noting that the former could play a key role if interpreted as the capacity to recover traditional rules for building construction and settlements organization able to guarantee a better defense from climate conditions, without a broad use of air-conditioning; the latter is crucial for improving self-reliant communities addressed to be sustainable and resilient.

SECTORS	STRATEGIES	RESILIENCE CAPACITIES
Energy	Refurbishment/rehabilitation of old buildings (insulation of roof and walls, replacement of windows, replacement light bulbs)	**Efficiency**
	Energy performance in new buildings	
	Solar thermal systems	**Efficiency**
	Production of energy from RES (Renewable Energy Sources)	Diversity/Substitutability
	Improvement of power and heat generation (cogeneration, heat pump)	Diversity/Substitutability
	Building automation (sensors, timers)	Diversity/Substitutability
	Public Lightening	**Efficiency**/Rapidity
	Smart grids	**Efficiency**
	District heating	Network pattern/Self-reliance
		Network pattern/Self-reliance
Transportation	Substitution of public vehicles (e.g. electric vehicles)	**Efficiency**
	Car sharing/car pooling	**Efficiency**
	Promotion of cycling and pedestrians paths	Diversity
	Mobility Management	
	Development of ITS and cleaner emission technology	**Efficiency**/**Knowledge**
		Creativity/**Efficiency**
Water management	Water saving devices	**Efficiency**
	Grey water recycling systems	**Efficiency**
	Rain water harvesting systems	Self-reliance
Natural Hazard (flood and heat waves)	Urban green networks (useful both for reducing pressure on urban drainage and for counterbalancing heat waves)	Network patterns
	Maintenance of drainage systems	**Efficiency**
	Temporary water storage in basins	**Efficiency**
	Dams, flood defense	Resistance
	Forecasting and early warning systems	Rapidity
	Adapting building and planning codes in respect to floods	Resistance
	Flood risk management plans	**Knowledge**
Waste management	Solutions for reducing the amount of CH_4 emitted from landfills	Creativity
	Promotion of recycling	**Efficiency**
Planning	Updating of local Master Plan codes (by an energy perspective)	
	Urban Mobility Plan	
	City Energy Plan	
	Sustainable Action Energy Plan (SEAP)	Cooperation
Governance	City Networks (e.g. Climate Action Network-Europe)	Cooperation
	European Programmes (eg. INTERREG, URBACT)	**Knowledge**/Cooperation
	Training courses for Public Administration	
	Green Points	**Knowledge**
	Observatories for Energy	**Knowledge**/Individual
	Green Public Procurement (GPP)	Capacity
	Fiscal incentives	**Knowledge**
	Promotion of ESCO's role	
		Individual Capacity
		Rapidity

Tab.2 The resilience capacities affected by current strategies for urban adaptation. In detail, in bold violet the main affected ones, in blue all the others.

7. CONCLUSION

Summing up, in this paper the main reasons that make climate change a serious challenge for the world population in the next future and the key role of cities being, in the meanwhile, hotspots of vulnerability to climate change and responsible for a large amount of GHG emissions, have been discussed.

Then, a snapshot of the most widespread strategies and measures currently undertaken both at European and local scale for addressing climate change has been provided: what clearly arises is that, despite the large efforts currently underway, policies at city level are still fragmented and effective tools to support decision-making processes are still lacking. On the opposite, focusing on the theoretical and methodological approaches provided by scientific literature as well as by institutional documents, the need for an integrated approach for developing an urban adaption strategy addressed to increase the resilience of natural and human systems in face of current and future impacts of climate change is more and more emphasized.

Hence, being the resilience concept still so vague that it "is in danger of becoming a vacuous buzzword from overuse and ambiguity" (Rose, 2007), a resilience model has been carried out, grounding on an interpretation of resilience as a set of interrelated adaptive capacities and on the review of the resilience capacities/properties developed from a multi-disciplinary perspective. The resilience model is characterized by a hierarchical structure in that, moving from the core towards the outer side, a progressive specification, in operational terms, of the resilience concept and of the capacities and properties that characterize a resilient system has been provided.

Finally, the consistency of the strategies and actions currently implemented in European cities for adapting to climate change with the capacities/properties characterizing a resilient system has been investigated. The analysis shows how current strategies seem to be mainly focused on some capacities/properties (such as efficiency or knowledge), neglecting others, which could also be very significant in enhancing urban resilience.

It is worth stressing that this contribution has to be interpreted as a first stage of a wider research work addressed to deepen the resilience model, even by refining it from a climate change perspective. Indeed, the resilience model might represent a key tool for supporting a multi-level, integrated and participatory approach, extremely welcomed towards such kind of issues and for enhancing urban resilience in face of climate change by driving future strategies at local scale.

Notes

1 Although this paper is the result of a common research work, paragraphs 1, 4, 5, 6 and 7 have been written by A. Galderisi and paragraphs 2, 3 have been written by F.F. Ferrara.

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TeMA
Journal of
Land Use, Mobility and Environment

TeMA 2 (2012) 89-100
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: 10.6092/1970-9870/888

review paper. received 30 May 2012, accepted 15 July 2012

www.tema.unina.it

IL SISTEMA OSPEDALIERO E LA RESILIENZA URBANA

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ABSTRACT

The concept of resilience is critical when addressing the issue of natural hazards. The role of an urban planner is to analyze the territorial system, consisting of several functional systems and its vulnerability. In a city, there are strategic elements that should not lose functionality during or following a natural event; the definition of specific scenarios could put structures exposed to risk on safety in order not to compromise the system. I report an experience of research carried out within the hospital system that, in case of occurrence of a natural event, is often simultaneously exposed, and therefore need of rescue, and it is a dispenser of rescue. Given the importance of the theme there are several initiatives, also promoted by The Italian Civil Protection, in particular the drafting of hospital emergency plans. The described methodology has allowed the definition of risk simulations for the hospital system, starting from the determination of qualitative and quantitative indices of hazard, vulnerability and exposure in support of plan emergency hospital. Specific focus was directed to the exposure, determined dynamically, going to know how the situation changes in the hospital complex, depending on the passing of hours a day. In these scenarios we introduced the parameter "time", concept of the time policies. The new "Planning and emergency hospital Plans" could well be a step forward for the safety of the territory. These could be an integral part of the town civil protection plans (dedicated to the emergency and to forecast), in turn attached to urban plans in order to become operational tools of strategies and policies needed to increase urban resilience.

KEYWORDS:
Sistema ospedaliero, piani di emergenza ospedalieri, sicurezza da eventi naturali

1 LA RESILIENZA DEL SISTEMA TERRITORIALE ED EVENTI NATURALI

Il concetto di resilienza, introdotto nei primi anni Settanta, definisce la capacità dei sistemi naturali di assorbire perturbazioni, conservando le proprie funzioni e la propria struttura (Holling 1973; Laszlo 1985). Tale concetto risulta fondamentale quando si affronta la tematica dei rischi naturali. Il rischio naturale (o danno temuto), come noto, viene definito come la funzione di tre diverse grandezze, pericolosità, vulnerabilità ed esposizione, che nella letteratura scientifica, sono studiate attraverso approcci metodologici diversi. In particolare, compito di un urbanista è quello di analizzare il sistema territorio, costituito da diversi sotto-sistemi funzionali (abitativo, scolastico, sanitario, ecc.) e la relativa vulnerabilità.

Riprendendo una definizione di Fortune e Peters (1995), la vulnerabilità di un sistema sociale o territoriale può essere definita come l'opposto della sua capacità di assorbire perturbazioni, ovvero come l'opposto della sua resilienza.

La resilienza pertanto può essere espressa come funzione del "carico" che un sistema naturale può assorbire prima che il sistema stesso cambi la sua struttura, mutando variabili e processi che ne controllano il comportamento.

Un sistema resiliente è, dunque, un sistema in grado di assorbire l'azione perturbatrice, ripristinando il precedente stato di equilibrio o trovando nuove condizioni di equilibrio dinamico (Galderisi 2004).

Una città o un territorio può essere suddiviso in sottosistemi che costituiscono elementi non solo statici ma anche dinamici, in quanto aventi proprie funzioni e propri bacini di utenza.

Un sistema territoriale pertanto è costituito da sistemi funzionali di tipo insediativo (scolastico, sanitario, produttivo, ecc.) ed infrastrutturale (reti tecnologiche o lifelines, quali ad esempio elettrodotti, metanodotti, acquedotti, …) o strutture per la mobilità (strade, autostrade, ferrovie, ecc.).

Ogni sistema funzionale (afferma Ugolini 2004) può essere scomposto in componenti di primo e secondo livello; le prime considerano le differenti tipologie di strutture, di più immediato riferimento, costituenti detto sistema, mentre le seconde costituiscono possibili disaggregazioni delle precedenti in termini funzionali e/o gestionali.

Per poter disporre di una conoscenza specifica del territorio, prima del verificarsi di un evento calamitoso (ad esempio prima di un terremoto, che fra l'altro non ha un tempo di allerta) sarebbe necessario, per ogni sistema funzionale, analizzare diversi aspetti[1] e successivamente realizzare delle simulazioni di rischio.

In una città, infatti, esistono degli elementi strategici che non devono perdere funzionalità durante o a seguito di un evento naturale; nel merito attraverso la definizione di specifici scenari si potrebbero mettere in sicurezza quegli esposti capaci di non far collassare il sistema territorio.

In quest'ultimo si possono individuare luoghi che rivestono ruoli diversI, la definizione dei ruoli e il conseguente ordinamento gerarchico dei luoghi non è però dovuta solo al tipo e all'entità delle funzioni localizzate; essa è strettamente correlata anche da un'ipotesi di svolgimento di flussi di persone e beni.

Gli effetti di un evento disastroso su un sistema territoriale possono essere di due tipi:

[1] A riguardo si ricordano:
- riferimento, in ciò includendo normative tecniche di organismi nazionali e comunitari competenti;
- il quadro funzionale ed interrelato delle competenze istituzionali di riferimento e dei soggetti "attori" e/o "fruitori" dei diversi servizi, sia a livello nazionale che locale;
- le componenti dei diversi sistemi funzionali, distinte quantomeno in due diversi livelli, in termini di congruità ed incisività (ciò per consentire elaborazioni a differenti e progressivi livelli di approssimazione e di dettaglio);
- l'individuazione di parametri, specie di uso comune, come "descrittori" quali-quantitativi di aspetti significativi delle entità considerate;
- algoritmi ed indicatori usati in letteratura e riferiti ad aspetti pertinenti, anche se con visioni parziali;
- valori dimensionali e/o progettuali di riferimento, connessi ad esperienze di "buona pratica" sufficientemente testate;
- note metodologiche volte ad indirizzare il successivo processo di elaborazione in modo da favorirne la coerenza (Ugolini 2004).

- perdita di efficienza delle attrezzature localizzate nei luoghi;
- modificazioni della capacità di connessione, conseguenti ad una perdita di efficienza delle infrastrutture che costituiscono il sottosistema delle comunicazioni;

sia l'uno che l'altro possono essere causa di modificazioni del ruolo dei singoli luoghi sul territorio e del loro ordinamento gerarchico. Infatti, a causa di una catastrofe si può verificare che un luogo, prima polo attrattore di flussi, perda tale capacità di attrazione sia per la perdita di funzionalità (o il collasso) delle strutture forti, che per il venir meno delle condizioni favorevoli di accessibilità (Tira, 1997).

Alcune esperienze presenti nella letteratura scientifica hanno approfondito il sistema territorio per la fase specifica dell'emergenza; si ricordano a riguardo il concetto di Struttura Urbana Minima (Sum) e Rete Urbana dell'Emergenza (Rue). Gli elementi della SUM sono costituiti dagli edifici strategici per il funzionamento della struttura urbana (quali ad esempio le attrezzature sanitarie), dagli spazi pubblici da utilizzare anche come aree di raccolta o di prima accoglienza, dal sistema di accessibilità in emergenza. Tali elementi, da un lato, si configurano come l'insieme delle dotazioni utili in fase di emergenza, dall'altro, risultano elementi strategici anche al fine della riqualificazione urbana. Nell'ambito della Rete Urbana dell'Emergenza, le principali reti vengono considerate quella delle attività strategiche (strutture sanitarie, decisionali, operative e gestionali) e quella delle aree e delle strutture di accoglienza (aree di attesa, aree di accoglienza).

2 IL SISTEMA OSPEDALIERO

Nel presente paper si riporta una specifica esperienza di ricerca svolta nell'ambito del sistema funzionale sanitario. In particolare l'attenzione è rivolta al sistema ospedaliero che, nel caso del verificarsi di un evento naturale, può risultare contemporaneamente sia esposto, e pertanto bisognoso di soccorso, che erogatore del soccorso stesso.

In tutte le analisi di esposizione, grande importanza viene data al sistema dei servizi sanitari, sia perché ospita della popolazione a rischio (i degenti concentrati negli ospedali), sia perché un suo corretto funzionamento è indispensabile nella fase dell'emergenza (Fera 1991).

Un ospedale, una caserma dei vigili del fuoco assumono un peso diverso a seconda degli scopi rispetto ai quali se ne valuta la vulnerabilità. Un ospedale, infatti, può essere considerato per i servizi che può fornire nel corso della gestione dell'emergenza, o per i servizi che può continuare a fornire durante la crisi come se nulla fosse successo –continuando cioè ad espletare i suoi compiti ordinari per i suoi utenti ordinari, non per i feriti del disastro– (Menoni 1997).

Il sistema ospedaliero rappresenta un sistema complesso, costituito da componenti strutturali e non strutturali. E' considerato strategico, perché deve garantire la funzionalità del suo servizio indipendentemente dal verificarsi di eventi esterni, quali quelli naturali.

Non esaustiva è la letteratura scientifica riguardante l'analisi del sistema ospedaliero nei confronti di tali eventi. Trattasi principalmente di studi relativi al problema dal singolo edificio "ospedale" (anche complesso dal punto di vista strutturale, impiantistico, funzionale, ...) e non al sistema ospedaliero in quanto tale, anche rapportato alle ripercussioni derivanti da una perdita di funzionalità dell'ospedale stesso nell'ambito del sistema territorio.

Tra le poche esperienze di ricerca riguardanti tale sistema si ricordano quelle relative ad analisi di tipo fisico-strutturale ed altre di tipo urbanistico-pianificatorio, oltre ad interessanti iniziative condotte dal Dipartimento della Protezione Civile Italiana, che riprendendo l'ottica statunitense, ha introdotto strumenti specifici per il sistema ospedaliero.

Sono state effettuate analisi riguardanti la consistenza del patrimonio ospedaliero italiano e dei danni subiti in terremoti passati (Nuti, Santini, Di Pasquale 1997; DGXII European Commission 1997), analisi di dettaglio per la fragilità di singoli ospedali (Monti e Nuti 1996), analisi di sistemi ospedalieri regionali (Nuti e Vanzi 1998) ed infine, più in generale, analisi del rischio del patrimonio ospedaliero italiano (Nuti, Santini e Vanzi 1998)[2].

Gli ospedali sono considerati edifici strategici ai quali si richiede la continuazione delle attività di servizio anche in condizioni di emergenza, quali quelle successive all'evento sismico. Pertanto a differenza degli edifici convenzionali, il collasso deve essere misurato non solo rispetto alla perdita di stabilità strutturale ma anche alla perdita di funzionalità.

Per quanto concerne il discorso strutturale si ricorda che il patrimonio ospedaliero italiano è stato in gran parte costruito prima dell'emanazione di precise regole antisismiche e quindi molti degli edifici che garantiscono oggi la sicurezza rappresentano in realtà punti critici del territorio stesso.

Nello studio citato, una volta definite le curve di fragilità di ciascun edificio e i valori di pericolosità sismica per ciascun ospedale è stata ricavata, dal confronto, la probabilità di superamento dello stato limite considerato (funzionalità o collasso).

I risultati condotti hanno dimostrato una elevata vulnerabilità dei manufatti; tale approccio può rappresentare uno strumento utile nella decisione di strategie di intervento per l'adeguamento sismico di ospedali esistenti.

Un secondo approccio rivolto al sistema sanitario, ha analizzato il sistema attraverso l'individuazione della normativa di riferimento, dei soggetti che entrano in gioco, della schematizzazione del sistema in componenti di primo e secondo livello e nell'individuazione di parametri per consentire prime valutazioni quantitative[3].

Tra le componenti di primo livello rientrano i centri socio-sanitari, i poliambulatori di analisi, diagnosi e prevenzione, le farmacie e, naturalmente, gli ospedali. Questi ultimi possono essere distinti per tipologie (generali, specializzati, per convalescenti); occorre poi distinguere le diverse specialità.

Significative per tale sistema sono state inoltre le esperienze condotte dalla Protezione Civile Italiana, in particolare per il caso del verificarsi dei terremoti, che più volte hanno colpito il nostro Paese.

Come noto, gli ospedali sono opere strategiche ai fini della protezione civile, essenziali per la gestione delle emergenze nel caso di rischi naturali o antropici. Pertanto, importante è prevedere e migliorare le prestazioni di tali esposti a seguito di eventi, quali un terremoto, che hanno la caratteristica di interessare grandi estensioni di territorio.

Come già accennato, il patrimonio ospedaliero costruito con tecniche non sempre antisismiche (molti ospedali sono stati costruiti o ampliati prima dell'introduzione della classificazione sismica dei comuni) e l'elevata complessità che caratterizza gli ospedali stessi (sia dal punto di vista strutturale sia da quello funzionale impiantistico) li rende particolarmente vulnerabili ad eventi naturali, soprattutto al rischio sismico.

Per tali ragioni il Dipartimento della Protezione Civile italiana ha manifestato attenzione per le strutture ospedaliere e per la loro organizzazione in caso di emergenza[4].

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[2] Approccio sulla sicurezza sismica dei sistemi ospedalieri del gruppo di ricerca dell'Università di Chieti-Università di Roma Tre.

[3] Approccio relativo alla messa in sicurezza del sistema territoriale da eventi naturali dell'Università di Genova (Ugolini 2004).

[4] Nel 1998 sono state emanate le linee guida per la pianificazione introspedaliera in caso di una maxiemergenza che definiscono le modalità di gestione dell'ospedale in caso di afflusso di feriti da incidente esterno o un danneggiamento dell'ospedale a causa sempre di incidente esterno. Nel 2001 sono stati emanati i criteri di massima per l'organizzazione dei soccorsi sanitari nelle catastrofi che definiscono criteri tra le regioni per una specifica cooperazione atta a garantire i soccorsi sanitari in emergenza sovra regionale. Nel 2003 è stato elaborato inoltre un documento da sottoporre alle Regioni per fornire alle stesse "Raccomandazioni per il miglioramento della sicurezza sismica e della funzionalità degli ospedali", che però non considera l'OPCM 3274/2003 entrata in vigore successivamente.

Tra tutte le esperienze, da sottolineare è la collaborazione avviata nel 1999 con Applied Technology Council (organizzazione USA specializzata nello sviluppo di criteri di riduzione di rischio sismico) per la preparazione di un documento di base sulle problematiche da affrontare negli ospedali italiani su diversi temi: dalla normativa italiana per la pianificazione in emergenza e i piani attuali negli ospedali presi a riferimento; dalle metodologie in Italia e USA per la valutazione della vulnerabilità sismica degli ospedali; raccomandazioni per miglioramento e sopralluoghi post-sisma; addestramento personale e riduzione rischio sismico allo sviluppo di piani di emergenza sismica.

Trattasi del *"Rapporto ATC-51 U.S.-Italy collaborative recommendations for improving the seismic safety of hospitals in Italy"* in cui sono indicate diverse azioni da intraprendere nel breve termine.

Successivamente nel 2002 è stata sviluppata l'azione ATC-51 *"ATC-51-1 Recommended U.S.-Italy collaborative procedures for earthquake emergency response planning for hospitals in Italy"*[5] che ha previsto lo sviluppo di piani di emergenza sismica e la definizione di procedure per la valutazione della sicurezza nell'immediato post evento.

Nel rapporto è riportata una sintesi delle normative italiane in tema di pianificazione dell'emergenza e dei piani vigenti in ospedali presi come riferimento; inoltre è descritto il sistema per la risposta all'emergenza degli ospedali americani, sistema che potrebbe essere adattato anche a quelli italiani.

In Italia, alcuni ospedali hanno adottato piani di emergenza per problematiche principalmente quali incendio, incidente stradale, perdita di sostanze tossiche, contaminazione da materiale radioattivo, inondazioni. Attualmente i piani vigenti sono il Piano di Emergenza Interno (PEI)[6], il Piano di Evacuazione (PEVAC)[7] e il Piano di Emergenza Intraospedaliero per il Massiccio Afflusso di Feriti (PEIMAF)[8].

Il primo riguarda la specifica struttura ospedaliera considerata mentre il secondo ed il terzo si occupano, per certi aspetti, anche del rapporto tra l'ospedale ed il sistema urbano.

Nel PEVAC, ad esempio, nell'ambito della pianificazione operativa, vengono individuati due diversi scenari: l'evacuazione parziale e quella totale.

La prima (orizzontale o verticale) consiste nel trasferimento all'interno o all'esterno della struttura di persone dalle aree interessate dal fenomeno calamitoso o pericolose ad aree più sicure in relazione alla tipologia dell'evento e alla sua ipotetica evoluzione (Piano di Evacuazione parziale); il secondo considera lo sfollamento generale e totale in aree urbane sicure esterne alla struttura (Piano di Evacuazione totale).

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5 Tale rapporto illustra le procedure per la gestione dell'emergenza, l'organizzazione della documentazione e delle informazioni riguardanti l'edificio ed i sistemi in esso ospitati, i livelli di prestazione prevedibili a fronte di diversi scenari di scuotimento sismico, la vulnerabilità sismica, i primi interventi per limitare il danno, i piani e percorsi di evacuazione, i sopralluoghi post-sisma, l'addestramento degli operatori, la riduzione del rischio sismico per mezzo del miglioramento delle strutture e dei sistemi o attraverso la riorganizzazione delle funzioni sanitarie.

6 Il Piano di Emergenza è stato concepito in modo da avere le seguenti caratteristiche: è formulato sulle strutture e sugli organici esistenti per una immediata attuazione; si integra con il Piano di Evacuazione ed il Piano di Massiccio Afflusso di feriti; è operativo 24 ore su 24; è impostato con particolare attenzione al rischio incendio, ma è adattabile anche agli eventi quali scoppio, inondazione e attentato; prevede le procedure organizzative e i protocolli operativi di gestione dell'emergenza; è materia di formazione del personale ospedaliero. Tale procedura ha lo scopo di mettere in atto tutte le azioni necessarie per ridurre le conseguenze di un evento; deve essere attuata da tutto il personale presente nel momento del verificarsi dell'evento e deve gestire l'emergenza. La sua efficacia è funzione del grado di formazione e informazione del personale.

7 Il Piano di Evacuazione è composto da una parte in cui vengono raggruppate procedure e allegati comprendenti le schede di evacuazione per ogni comparto dell'ospedale. Queste ultime riportano le istruzioni da attuare in caso di emergenza grave e immediata nel comparto incidentato ed in quelli adiacenti. Tali indicazioni risultano essere solo indicative, in quanto non è determinato con esattezza l'effetto di un emergenza (tipo di evento, persone coinvolte, personale presente,...). I rischi considerati sono, tra quelli naturali i terremoti, le inondazioni e gli incendi; tra quelli tecnologici il nucleare, chimico/biologico e sociali, e tra quelli sociali, gli attentati.

8 Viene attivato quando il numero e/o la gravità delle vittime eccede la capacità di risposta intrinseca alla normale operatività del DEA. Garantisce lo stesso standard di assistenza anche nei periodi in cui possono verificarsi flessioni nel numero del personale a causa di festività o di fascia oraria (notte) ed è adattabile a qualunque tipologia di emergenza per prestare assistenza ad un elevato numero di vittime.

Il terzo strumento, PEIMAF, ha il compito di codificare le soluzioni logistico-operative per un adeguato trattamento e ricovero delle vittime in caso di catastrofe limitata o estesa che coinvolga il territorio limitrofo. In caso di emergenza sanitaria si ricorda, infatti, che l'ospedale costituisce l'anello finale del sistema organizzato di soccorso, sotto il comando della centrale operativa 118, che coordina l'azione sul luogo del disastro delle squadre addette alle operazioni di soccorso e recupero sul campo; l'installazione della struttura campale di soccorso per il supporto logistico alla fase di intervento sul campo; l'attivazione negli ospedali del Piano di Emergenza Interna per massiccio afflusso di feriti.

Diverse sono le emergenze considerate in tali piani. Sicuramente la maxi emergenza è un evento catastrofico che può generare un afflusso consistente negli ospedali, e quindi è necessaria l'elaborazione di uno specifico Piano di maxi emergenza che definisca le misure organizzativo- tecnico- sanitarie da adottare al fine di non portare al collasso le strutture sanitarie più esposte. Ad esempio, importante, nella valutazione di potenziali condizioni di rischio, è la prossimità dei complessi ospedalieri a reti infrastrutturali, quali autostrade o strade di grande comunicazione, ferrovie, aeroporti militari o civili,...o la localizzazione rispetto a strutture limitrofe di soccorso (sanitarie o sedi di soccorso pubblico, distaccamento dei Vigili del Fuoco,...). Inoltre indispensabile è la presenza di una rete di azione/coordinamento con le Istituzioni, quali Prefettura, Autorità Locali, Protezione civile, ...

Attualmente i piani sopra descritti non si occupano di tutti gli eventi calamitosi; il rischio naturale solitamente preso in considerazione è quello da inondazione. Pertanto necessaria sarebbe una rielaborazione di tali strumenti in base ai possibili eventi naturali insistenti su un determinato territorio e un loro inserimento, a regime, nella *governance* locale.

In tabella 1 si riporta un recente esempio di piano di emergenza ospedaliero al cui interno è considerato anche il rischio da eventi naturali.

CLASSIFICAZIONE DELLA GRAVITÀ DELL'EVENTO	CLASSIFICAZIONE DELLA TIPOLOGIA DI EVOLUZIONE DELL'EVENTO	MODALITÀ DI INTERVENTO
Esondazione, alluvione, frana EMERGENZA RILEVANTE	Trattasi di evento a RAPIDA EVOLUZIONE per eventi improvvisi e/o catastrofici che coinvolgono tutta o parte della struttura provocandone l'impraticabilità che compromette la sicurezza dei lavoratori, degenti/utenti	Il personale presente deve darne immediata comunicazione (numero telefonico di emergenza) al Coordinatore dell'Emergenza specificando la situazione, l'emergenza in atto, la gravità dell'evento e la necessità di intervento; questi, valutata la situazione, attiva il segnale d'allarme al fine di iniziare le procedure di messa in sicurezza dei degenti/utenti, visitatori e degli operatori
Sisma EMERGENZA RILEVANTE	Trattasi di evento a RAPIDA EVOLUZIONE per eventi improvvisi e/o catastrofici che coinvolgono tutta o parte della struttura provocandone l'impraticabilità che compromette la sicurezza dei lavoratori, degenti/utenti	Tutto il personale presente deve prepararsi a fronteggiare la possibilità di ulteriori scosse riparandosi ed avanzando sotto le architravi delle porte o in prossimità dei muri portanti; in relazione alla gravità dell'evento gli operatori devono attuare le operazioni di evacuazione dei degenti/utenti e dei visitatori, muovendosi con estrema prudenza ed avanzando lungo i muri. Una volta all'esterno devono allontanarsi dalla struttura e recarsi nel punto di raccolta

Tab.1 Linee guida Piano Emergenza strutture sanitarie Regione Lombardia - Rischio da eventi naturali (decreto 2174 del 15.03.2012)

Un piano di emergenza nasce dalla necessità di proteggere gli utenti dell'ospedale, dal personale, ai visitatori ai pazienti.

Tra gli aspetti più importanti di un piano di emergenza si ricordano: accordi preventivi tra ospedali e residenze sanitarie assistite per il trasferimento di pazienti, criteri e graduatorie per l'evacuazione dei pazienti; piani specifici per affrontare problematiche quali mancanza di acqua ed energia; sistemi per diffondere informazioni presso pazienti e visitatori, regole comportamentali per il personale in caso di emergenza, procedure per il recupero della funzionalità post evento.

Il piano richiede la partecipazione di gran parte del personale e tende a dare una risposta tempestiva ad emergenze improvvise. L'organizzazione della risposta prevede la definizione di ruoli e responsabilità dei diversi individui e gruppi coinvolti nel piano di emergenza.

Il piano stabilisce una sequenza di procedure da applicare, secondo tre diversi gradi di allarme: preallarme e verifica (primo grado); intervento per spegnere il fuoco (ad esempio, visto che la maggior parte di piani riguardano l'emergenza in caso di incendio) (secondo grado); evacuazione (terzo grado). Per le procedure esistono manuali appositamente predisposti.

Negli Stati Uniti (in particolare California) è disponibile, in tema di pianificazione ed organizzazione dell'attività d'emergenza, il metodo Hospital Emergency Incident Command System - HEICS (Sistema di comando dell'emergenza in ospedale)[9].

Tale metodologia consta di una struttura di gestione, responsabilità definite, un percorso gerarchico chiaro, canali per i rapporti sull'evoluzione dell'emergenza ed un glossario di uso comune per aiutare gli ospedali a comunicare tra loro e con altri soggetti coinvolti nell'emergenza. Importante è sottolineare che tutti gli ospedali usano lo stesso sistema base per la gestione dell'emergenza.

In particolare per il rischio sismico gli ospedali californiani utilizzano linee guida di preparazione, elaborate da un ufficio specifico della California, per i servizi in emergenza[10].

Gli standard italiani per la pianificazione dell'emergenza prendono in considerazione separatamente 3 tipi di scenari: afflusso massiccio di feriti; incidente interno; evacuazione dei pazienti.

Nel primo caso si assume che l'ospedale sia operativo mentre nel secondo si ipotizza che l'incidente sia limitato in una parte dell'ospedale stesso.

L'esperienza californiana porta a considerare nella pianificazione l'effetto combinato dell'afflusso esterno e dell'emergenza interna.

Si sottolinea infine che il piano ospedaliero definito di emergenza in realtà considera anche l'aspetto di vulnerabilità del complesso sanitario stesso. Pertanto, oltre ad essere fondamentale nella fase naturalmente di emergenza, esso può costituire uno strumento utile anche nella prevenzione perché va ad individuare nell'ambito del sistema ospedaliero, gli elementi più critici, cioè più vulnerabili, e che quindi possono essere messi preventivamente in sicurezza attraverso interventi di tipo strutturale.

[9] Un manuale in due volumi contiene maggiori dettagli sull'HEICS e sulle considerazioni che hanno portato al suo sviluppo. In particolare esso si articola in: una descrizione del sistema e dell'organizzazione dell'emergenza; schemi sintetici delle azioni di pertinenza di ogni ruolo (Job Action Sheets); modulistica; raccomandazioni per uniformità della terminologia; schemi di gestione dei pazienti; guide per l'organizzazione di esercitazioni nell'ambito dell'addestramento; esempi di strategie e procedure.

[10] Le linee guida (redatte nel 1998) riguardano: obiettivi dei piani di emergenza sismica; fasi del processo di pianificazione, come la formazione di un comitato di redazione del piano definizione dei problemi da affrontare, comunicazione ed applicazione del piano; pianificazione per la riduzione dei rischi; formazione ed addestramento; ricognizione dei danni; piani di evacuazione; gestione sanitaria; comunicazione; gestione delle camere operatorie; servizi sociali; coordinamento intra-ospedaliero; pulizie e soccorsi; pianificazioni delle riparazioni.

2.1 APPROCCIO METODOLOGICO PER LA SICUREZZA DEL SISTEMA OSPEDALIERO E CASO APPLICATIVO

L'impostazione metodologica approntata (Pirlone 2009) ha definito simulazioni di danno temuto per il sistema sanitario ed in particolare per il sistema ospedaliero, a partire dalla determinazione di indici di tipo quali-quantitativo di pericolosità, vulnerabilità ed esposizione.

L'evento considerato in tale studio è stato quello sismico; la metodologia ha comunque una valenza di tipo generale. L'approfondimento specifico che è stato effettuato in tale ricerca è stato rivolto alla grandezza esposizione, che non è stata determinata in un modo statico ma dinamico, andando a capire come cambiava la situazione nel complesso ospedaliero a seconda dello scorrere delle ore di una giornata. Per tale motivazione nell'ambito di tali scenari è stato introdotto il concetto di tempo, proprio della disciplina dell'Urbanistica temporale[11].

L'indice di esposizione ha pertanto tenuto conto della presenza della popolazione all'interno della componente ospedaliera nelle 24 ore di una stessa giornata, pervenendo ad un indice dinamico valutato cioè nel tempo (tale analisi è possibile a partire dal Piano degli orari o, visto la specificità delle diverse strutture, attraverso la realizzazione di analisi di offerta oraria).

Si ricorda che l'ospedale è uno dei pochi esposti ad essere, molto spesso, contemporaneamente sia struttura sensibile sia strategica, in quanto erogatrice di soccorso (soprattutto attraverso il pronto soccorso), che deve garantire una funzionalità h24 e che vede una affluenza di popolazione sempre diversa, in quanto ospita degenti, visite di parenti e servizi ambulatoriali.

La metodologia predisposta è stata applicata al comune di Cuneo.

Dagli scenari realizzati è emerso che il complesso ospedaliero di tale comune ha un indice di esposizione alto per il complesso S. Croce e medio per quello del Carle, e un indice di danno temuto, nel caso di evento sismico, medio-alto per il S. Croce (a seconda delle ore della giornata) ed alto per il Carle.

In figura 1 si riporta la rappresentazione di una carta di esposizione dinamica.

Gli scenari di danno sopra definiti dovrebbero essere considerati all'interno di nuovi piani ospedalieri, in modo da essere utilizzati sia per nella fase di prevenzione per la messa in sicurezza del sistema ospedaliero sia per la fase di emergenza.

Nello specifico si segnala che il complesso ospedaliero del S. Croce e del Carle di Cuneo rappresenta uno dei pochi ospedali ad essersi dotato di Piani di Emergenza nel caso di rischi antropici (incidenti stradali,…) o naturali (ad esempio quello idrogeologico).

Tali Piani non considerano però il rischio sismico e pertanto non è stato attuato quanto invece elaborato dal Dipartimento della Protezione Civile italiana a seguito della collaborazione attiva avuta con Applied Technology Council.

Nell'ospedale di Cuneo sono presenti i tre differenti strumenti descritti in precedenza: il Piano di Emergenza Interno PEI, il Piano di Evacuazione PEVAC e del Piano di Emergenza Intraospedaliero per il Massiccio Afflusso di Feriti PEIMAF.

Tali piani sono complementari, rispondono cioè a scopi diversi con modalità differenti, ma secondo un programma complessivo ed integrato. Ad esempio se l'accadimento è rappresentato da un incendio in ospedale, viene attuata l'attivazione del PEI; nel caso in cui viene registrato un numero elevato di intossicati da fumo è attivato il PEIMAF e quando si ha un'estensione dell'incendio stesso è messo in campo il PEVAC.

[11] Le politiche temporali sono azioni di e per la qualità delle condizioni urbane del vivere dei suoi cittadini, agiscono sugli aspetti orari delle funzioni urbane e del loro coordinamento e anche sugli aspetti fisici dei luoghi (Bonfiglioli 1999). Le politiche degli orari della città sono uno dei cardini delle politiche dei tempi…(Bonfiglioli 1994).

Inoltre se l'evento consiste in un incendio con conseguente evacuazione di un ospedale, viene attivato il PEIMAF nel secondo presidio ospedaliero.

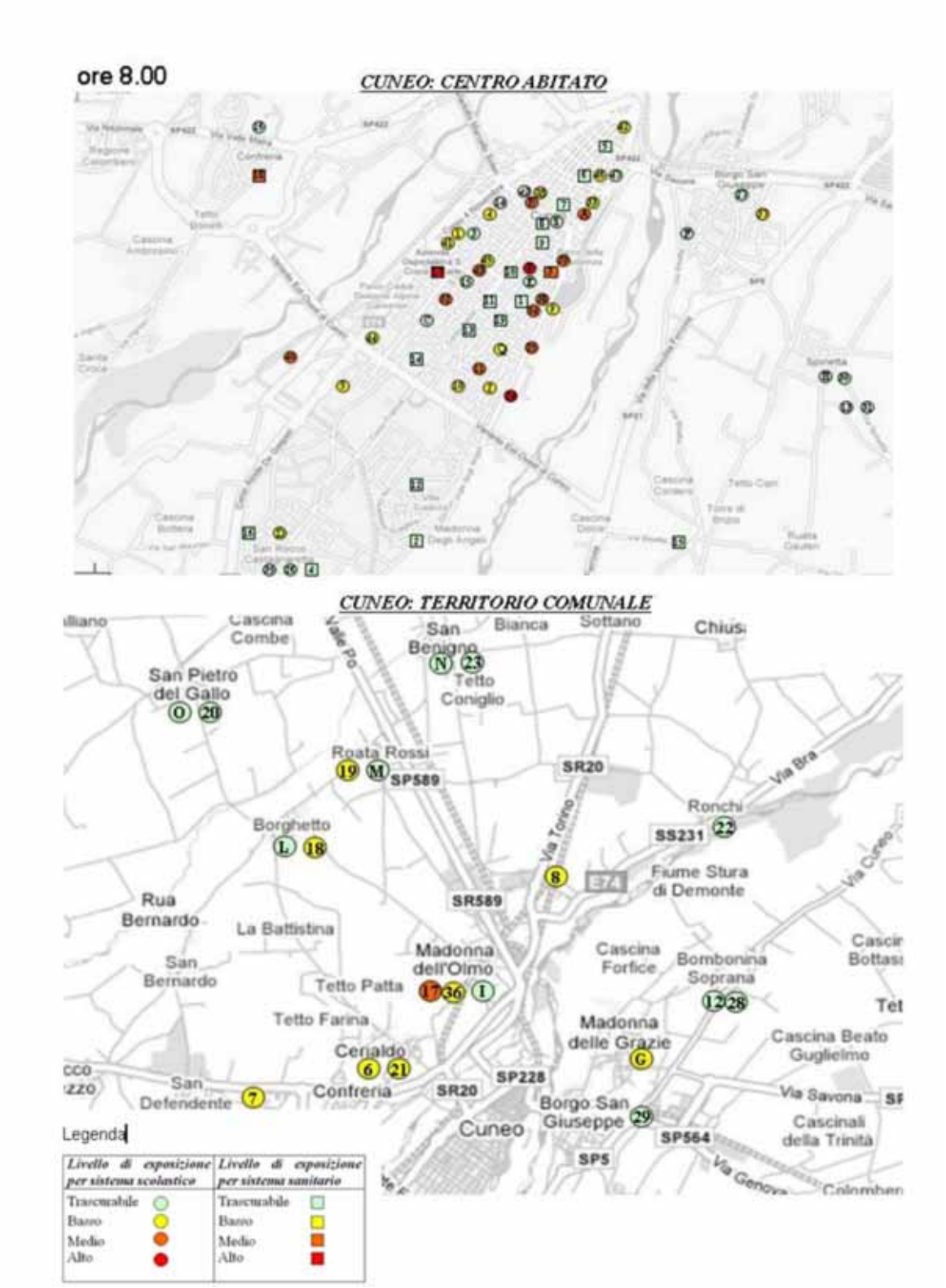

Fig. 1 Esempio di Carta di esposizione dinamica nel comune di Cuneo al variare delle 24 ore (giorno considerato: lunedì; sistemi funzionali analizzati: ospedaliero e scolastico)

Si sottolinea che i piani realizzati dall'ospedale di Cuneo sono dedicati esclusivamente alla fase dell'emergenza e che la pianificazione di quest'ultima[12], in tali strumenti, è concepita in modo da avere le seguenti caratteristiche:

- permettere la rapida localizzazione e la stima dell'evento;
- permettere il rapido attacco dell'evento e le operazioni ad esso collegate (eliminazione dei pericoli presenti);
- consentire la rapida messa in sicurezza dei pazienti e delle persone interessate dall'evento utilizzando aree sicure e luoghi di raccolta preventivamente individuati (attivando tempestivamente il Piano di Evacuazione e/o il Piano di massiccio afflusso di feriti);
- gestire un efficiente ed efficace coordinamento con i Vigili del Fuoco per l'estinzione totale dell'evento e la messa in sicurezza delle aree coinvolte (Fonte: Piano di Emergenza Interno PEI del complesso ospedaliero del S. Croce e Carle di Cuneo).

3 PROSPETTIVE DI SVILUPPO

Nell'ambito della governance italiana la tipologia di piano, descritta nei paragrafi precedenti e specifica per un particolare sistema funzionale (quello ospedaliero), costituisce un passo in avanti per la messa in sicurezza del territorio in quanto prevedendo determinate azioni e/o interventi, in tempo di pace e di emergenza, si contribuisce a rafforzare la resilienza dell'intero sistema urbano.

I piani vigenti, concepiti per le specifiche strutture ospedaliere, interagiscono infatti naturalmente con l'intero sistema urbano, in quanto coordinano o organizzano i soccorsi, in fase di emergenza, a livello complessivo; si pensi all'accoglienza dei feriti provenienti da diverse parti della città, al trasferimento di pazienti in altre sedi sanitarie urbane, ecc..

Pertanto, a riguardo, necessario sarebbe anche analizzare il tema dell'accessibilità dei diversi complessi ospedalieri, costruiti in anni passati per soddisfare esigenze demografiche e urbanistiche sicuramente diverse da quelle attuali, e che nel caso del verificarsi di eventi naturali diventa ancora più problematico…

Se importante è pensare alla fase di emergenza, fondamentale, è anche lavorare nell'ambito della prevenzione. In tal senso la positiva esperienza condotta per il complesso ospedaliero di Cuneo potrebbe essere integrata predisponendo piani dedicati anche alla prevenzione, sul modello del Dipartimento della Protezione Civile Italiana, comprensivi delle diverse tipologie di rischio naturale.

Se è vero che Cuneo come comune risulta essere esposto in misura lieve ad un evento sismico, vero è che nell'ambito della prevenzione un terremoto rappresenta l'evento non prevedibile più disastroso a livello territoriale.

Porre l'attenzione sul sistema ospedaliero, e metterlo in sicurezza, contribuisce ad aumentare il livello di sicurezza del sistema urbano in quanto, come già asserito, l'ospedale rappresenta una struttura sensibile ma nello stesso tempo strategica, costituendo l'unico esposto che deve fornire erogazione continua a servizio dell'intero territorio indipendentemente dal verificarsi o meno di un evento esterno.

[12] Il meccanismo dell'emergenza è codificato dalle seguenti procedure: procedura generale da adottare in caso di evento (solitamente incendio); azioni da intraprendere in caso di evento (incendio); attivazione squadra di primo intervento in grado di affrontare immediatamente l'incendio e coadiuvare il personale del reparto nell'eventuale evacuazione parziale; attivazione dell'unità di crisi in grado di prendere le decisioni circa la gestione dell'emergenza e l'eventuale evacuazione totale dell'Ospedale; attivazione dei tecnici reperibili agli ordini dell'unità di crisi con il compito di gestione, nell'area colpita, gli ascensori, i condotti dei gas medicali, l'energia elettrica, l'impianto telefonico, l'impianto termico e quello di ventilazione; comportamento nelle strutture complesse di rianimazione e terapia intensiva in caso di black out elettrico secondo le indicazioni della circolare regionale del Piemonte (fonte: Piano di Emergenza Interno PEI del complesso ospedaliero del S. Croce e Carle di Cuneo).

Necessario in tale ottica un collegamento organico tra questi strumenti specifici per un sistema funzionale e quelli di protezione civile[13] (Programmi di previsione e prevenzione e Piani di emergenza a livello provinciale[14]; Piani di emergenza a livello comunale15). Naturalmente fondamentale sarebbe, a regime, poter disporre di nuovi "Piani di pianificazione ed emergenza ospedaliera" che facessero parte integrante dei Piani di protezione civile comunali, dedicati non solo all'emergenza ma anche alla previsione, capaci di combinare l'analisi dei rischi per programmare la prevenzione e la protezione durante il tempo ordinario e le procedure di soccorso per il Piano di emergenza vero e proprio attraverso il quale gestire gli aiuti in caso di evento calamitoso.

In tal modo, attraverso la visione generale di un Piano di protezione civile comunale, i Piani di emergenza ospedalieri potrebbero rapportarsi correttamente con le altre strutture strategiche e con le principali reti a livello urbano (aspetto carente in oggi nei piani ospedalieri vigenti), contribuendo positivamente ad abbassare i livelli di rischio.

I Piani di protezione civile, così rivisitati, potrebbero rappresentare dei piani di settore dedicati ai rischi naturali e potrebbero, a loro volta, essere allegati ai piani urbanistici comunali al fine di diventare strumenti operativi di quelle strategie e politiche necessarie ad accrescere la resilienza urbana.

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[13] Tale struttura ha il compito di "tutelare la integrità della vita, i beni, gli insediamenti e l'ambiente dai danni o dal pericolo di danni derivanti da calamità naturali, da catastrofi e da altri eventi calamitosi". In tal senso infatti è da sottolineare che la Protezione Civile non si occupa solo delle diverse tipologie di rischi naturali, come viene evidenziato in particolare nel presente lavoro, ma anche di rischi antropici (incidenti rilevanti, terrorismo,...).
Per quanto riguarda le attività di Protezione civile, la L. 225/92, art.3, distingue tre diverse tipologie di attività:
- previsione, volte allo studio e all'individuazione delle cause dei fenomeni calamitosi, all'identificazione dei rischi e delle zone potenzialmente interessate;
- prevenzione, volte ad evitare o a minimizzare i danni conseguenti ad un evento calamitoso;
- gestione dell'emergenza, che comprendono sia gli interventi di prima assistenza alle popolazioni colpite da un evento, sia gli interventi di rimozione degli ostacoli per il ripristino di normali condizioni di vita (soccorso e superamento dell'emergenza).

[14] La Provincia (art. 13, L. 225/92) assume specificatamente compiti di rilevazione, raccolta ed elaborazione dei dati interessanti la Protezione Civile, di predisposizione e realizzazione del Programma Provinciale di Previsione e Prevenzione, in armonia con i programmi nazionali e regionali, mentre alla Prefettura viene affidato il compito di redigere il Piano Provinciale di Emergenza (art. 14). Ulteriore svolta in tale campo si ha con l'emanazione del D.Lgs. 112/98, che decentra altre funzioni dallo Stato alle Regioni e alle Province, ridistribuendo i compiti tra i vari Enti ed attribuendone di nuovi; la Provincia è investita pertanto anche del compito di redigere il Piano Provinciale di Emergenza, prima di competenza prefettizia.

[15] La Legge 225/92 assegna al Comune specifiche competenze in tutte le attività di Protezione Civile, con particolare riguardo alla fase di gestione dell'emergenza. Il D.Lgs. 112/98 rende obbligatorio il Piano comunale di protezione civile. Trattasi di un insieme di documenti da cui emergono a livello di singolo Comune: informazioni tematiche sul territorio (analisi territoriale); strumenti e dispositivi finalizzati all'organizzazione e alla disponibilità delle risorse; strumenti e dispositivi per le attività di pianificazione degli interventi (sulla base di scenari di rischio); competenze e processi decisionali (procedure di emergenza). Nello specifico il piano si articola in diversi documenti scritti e grafici (per esempio per la localizzazione delle aree di ammassamento, di accoglienza, di attesa, eventualmente anche privati... e per l'indicazione delle opere e degli interventi strutturali necessari in termini di prevenzione e di sostegno delle popolazioni...).

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IMAGES SOURCES

Tab. 1: Regione Lombardia (2012), Linee di indirizzo per la redazione del Piano di emergenza nelle strutture sanitarie.

Fig. 1: Pirlone, F. (2009), I rischi naturali nelle prassi ordinarie di pianificazione e gestione urbanistica. L'importanza della temporalità nella sicurezza del territorio, Alinea Editrice, Firenze

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TeMA
Journal of
Land Use, Mobility and Environment

TeMA 2 (2012) 101-116
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: 10.6092/1970-9870/921

review paper. received 9 June 2012, accepted 21 July 2012

www.tema.unina.it

TOWARDS RESILIENT CITIES

COMPARING APPROACHES/STRATEGIES

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ABSTRACT

The term “resilience” is used in many disciplines with different meanings. We will adopt the ecological concept of resilience, which epitomises the capacity of a system to adapt itself in response to the action of a force, achieving a state of equilibrium different from the original (White, 2011).
Since the end of the last century, with a significant increase over the last few years, resilience has featured as key concept in many technical, political papers and documents, and appears in many researches. Of all this recent and varied range of literature, our focus is on those texts that combine resilience with strategies, processes and models for resilient cities, communities and regions.
Starting from the resilience strategies developed as response for risks mitigation, the paper thus explores other approaches and experiences on cities resilience that have been conducted: the aim is to compare and identify innovation in the planning process towards risks mitigation.
In this paper we present a summary of the initial survey stage of our research, with three main aims:

- understanding the approaches to resilience developed so far and identifying which aspects these approaches share (or not);
- understanding which strategies are being proposed for resilient regions, cities or social-ecological systems;
- understanding whether proposed resilience strategies involve innovations in urban and regional development disciplines.

The aim is to understand whether the proposed concept of resilience, or rather strategies, constitute progress and contribute to innovation in the areas of urban planning and design in relation to risk mitigation.

KEYWORDS:
Resilience, Urban Planning, Risk Mitigation

1 ADOPTING RESILIENCE

The concept of resilience, and the term itself, is used in many disciplines (from engineering to the natural sciences, psychology and sociology) with meanings that are not always the same.

In the discipline of ecology, from which the agreed term used here is taken (and which, in a nutshell, epitomises the capacity of a system to adapt itself in response to the action of a force, achieving a state of equilibrium different from the one it originally had), resilience has been defined and explained in different way, and has evolved in line with the innovations that have occurred in that discipline (White 2011).

Generally speaking, we have seen this concept become widespread in recent years, often used as a key concept in many documents and books, at conferences and on websites. More recently, resilience has been used also when shaping development strategies for cities, and defining alternative development models for urban systems, local communities or social-ecological systems on a considerably bigger scale.

The concept of ecological resilience, as it relates to the development of territorial systems, was officially introduced into international politics and the European Union in 2005 when the document *Resilience and Sustainable Development: Building Adaptive Capacity in a World of Transformations*[1] was first presented.

The ongoing research presented here focuses on the concept of resilience with regard to the development of regions, cities and local communities.

While not claiming to be complete, in terms of the widespread disciplinary and political/social interest, this paper presents a summary of the first stage of the work carried out, and consists in a comparison of the wide-ranging literature published on the concept of resilience and cities (and/or resilience and regional systems).

The research, in relation to which this paper presents a summary of the initial survey stage, has three main aims:

1) Understanding the approaches to resilience developed so far, and identifying which aspects (concepts, strategies and so on) of these approaches are shared (or not shared);

2) Understanding which strategies are being proposed for resilient regions, cities or social-ecological systems (and pointing out the shared strategies);

3) Understanding whether the resilience strategies proposed involve innovations in f urban and regional development disciplinary fields.

The research aim is to comprehend whether the concept of resilience, or rather, whether the strategies of resilience proposed constitute progress and contribute to innovation in the areas of urban planning and design.

Three main families of literature have been identified from the recent literature promoting resilience as a key strategy. For each of these families the aim of the research – at this early stage – was to understand which particular concept and which aspects of resilience are used, which resilience strategies are proposed, how the term 'city' is defined and interpreted and, consequently, which are the key concepts related to strategies for resilient cities.

1.2 HOW CAN RESILIENCE BE DEFINED?

The concept of resilience has two main definitions involving different visions and approaches with regard to the concept of stability (Holling and Gunderson 2002). The most common established definition may be

[1] *Building Adaptive Capacity in a World of Transformations* (Background paper to WSSD) is a technical-scientific paper in support of the Swedish Government's Environmental and Scientific Advisory Council during the World Summit on Sustainable Development

called 'engineering resilience': in physics (and engineering), the resilience of a material is the property that enables it to resume its original shape after being deformed. This definition recalls the concepts of control, consistency and predictability.

The second definition, 'ecosystem resilience' is based on the concepts of persistence, change/unpredictability, adaptability and variability, emphasising conditions that are far from *aequilibrium*. Resilience is the property of complex systems to react to stress phenomena by activating response and adaptation strategies in order to restore the mechanisms by which they function. Resilient systems under stress react by regenerating themselves while maintaining the functionality and recognisability of the systems. Thus, resilience does not imply the restoration to an initial state, but the restoration of functionality through change and adaptation.

In ecology, resilience derives from functional strengthening through the various levels and hierarchies and from functional overlap between the levels. The vulnerability of the systems gradually increases as the sources of regeneration (diversity, redundancy, functional overlap and so on) and functional diversity are reduced (Odum 1963; Bettini 2004).

This article refers to the concept of ecosystem resilience, and all the papers and documents consulted refer to this agreed notion of resilience.

2 THE LITERATURE: FAMILIES AND APPROACHES

Since the end of the last century, and with a significant increase over the last few years, resilience as a key concept has featured in many technical and political papers and documents, and in a great deal of research that has been undertaken. The paper focuses on the texts that combine resilience with strategies, processes and models for the development of cities, communities and regions.

It is possible to identify three main families within the literature (to which can be added best practices, documents of intent and a large number of websites as research platforms, sharing of experience, networks of best practices and so on):

A) Resilience and sustainability: the concept of resilience is used as a way to gain the sustainability of the development of social-ecological systems.

B) Resilience and adaptation: the resilience is used as the key concept to the adaptation strategies with regard to climate change, natural resources reduction and the quality of local communities.

C) Resilience and territorial risks: resilience is used as a key concept for the innovation of territorial risk mitigation/management strategies (with the integration between the risk mitigation goals and the regional quality goals).

Assigning the contributions of the different authors to one of these three families has inevitably been forced in some cases. As we shall see, many concepts and strategies are common and shared, and, while the family of origin can still be identified, there is often intertwining and overlapping.

3 RESILIENCE AND SUSTAINABILITY

Although to do so is a gross simplification, it is possible to relate the first group of authors at The Resilience Alliance[2], a multidisciplinary network of researchers that brings together various universities and research

[2] The Resilience Alliance is a research organisation comprised of scientists and practitioners from many disciplines who collaborate to explore the dynamics of social-ecological systems. The body of knowledge developed by the RA, encompasses key concepts of resilience, adaptability and transformability and provides a foundation for sustainable development policy and practice, http://www.resalliance.org/.

centres promoting regional and local development policies and processes based on resilience. The family of texts is undoubtedly very large, and includes such authors as Carl Folke, Lance Gunderson, CS Buzz Holling, Elinor Ostrom, Johan Colding, Fikret Berkes, and numerous others.

Resilience is used as a key concept to achieve sustainable development. These days, sustainability has an established, common definition, or rather, several established institutional definitions[3]. While accepting the definition of sustainability as a given, the debate on the different routes to ensuring sustainable development is certainly more complex. The approach to complex systems and resilience is part of this debate.

In particular, the authors belonging to this school starkly oppose the approaches based on optimising the management of natural and social resources. More specifically, several authors (Folke, Berkes, Gunderson and others) stress that the optimisation is not a solution or the only solution: it is not possible to consider optimising the mechanisms of the way in which complex systems operate as a long-term strategy[4].

The concepts of efficiency and optimisation, are not negative in themselves, but absolutely necessary. They represent a loss of resilience and complexity if they are the only objectives or principles of reference for intervention policies and strategies.

It is possible to single out a substantial interdisciplinary core from the texts consistent with this approach, with most authors having a background in the natural and ecological sciences, and social and economic disciplines.

The common distinguishing features of a huge and complex range of authors, research and experiences, are:

- a sizeable theoretical output integrated with their application in different contexts;
- the central role of, and sharing of all experiences, texts and research on, the ecosystem approach, and its integration with the social dimension;
- a large scientific output (theoretical, methodological – modelling – and application) concerning the sustainable management of natural resources in which the sustainable management of natural resources is integrated with the social aspects of local communities;
- considerable attention to the development of local communities and regions in crisis.

Furthermore, it is important to point out that no specific significance can be found on the topic of the city, or rather urban design.

3.1 CONCEPTS OF ECOSYSTEM RESILIENCE

'Resilience, the capacity to lead to a continued existence by Incorporating change' (Folke, Colding and Berkes 2003, p.352)

Of the three families of authors, this is the one that chiefly integrates the concepts and principles related to ecosystem theories into strategies for the development of socio-ecological systems. The resilience strategies proposed are based on the concepts and properties of the ecosystems connected with resilience.

Diversity and stability

The diversity and 'creative' redundancy of functions are fundamental to ensure the mechanisms of resilience (Low, Ostrom, Simon and Wilson 2003).

Resilience, on a regional or complex scale is produced by the replication of processes on different scales. This apparent redundancy of similar functions replicated at different, interacting scales increases and

[3] While not wishing to deal here with the definition of sustainability, we would refer to sustainable development as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (1987 Brundtland Report, World Commission on Environment and Development (WCED)).

[4] The theoretical debate on the optimisation is developed by different authors (Low et al. 2003, Walker and Salt 2002, Gunderson and Holling 2002, and others).

guarantees complex systems a high level of resilience. While disturbance factors or crises are able to eliminate populations, or even entire ecosystems, the overall system is capable of reorganising itself due to the fact that functions similar to those lost can be found in other populations or ecosystems. The importance of diversity and redundancy for the functioning of natural systems has been studied and demonstrated, just as there are numerous studies on the effectiveness of redundancy for the smooth running of social systems: redundancy in public services, the presence of a large number of systems of governance, the strength and complexity of socio-political systems based on a redundancy and local management (Low, Ostrom, Simon and Wilson 2003).

Ecosystem organisation

Numerous empirical studies have identified a number of key concepts and mechanisms underlying complex natural systems, response systems to disturbances, and the structure and functioning of ecosystems.

Ecosystems do not have a single equilibrium with homeostatic controls to prevent them from deviating far from this, but multiple equilibria commonly define functionally different states. The normal movements of variation among the states maintain structure, resilience and diversity. In fact, non-linear characteristics of the processes of predation, reproduction, competition and the dynamics of nutrients create multiple equilibria.

Ecological organisation can be seen as a 'hierarchy' in which the hierarchical levels have their own different temporal and spatial attributes. The cycles of birth, growth, death and renewal transform and change hierarchies from a fixed or static state to a dynamic adaptive one.

Gunderson and Holling introduced the concept of *panarchy*[5] (in preference to hierarchy) to explain this concept and the interconnection between the different cycles and systems (with different complexity).

Cycles of adaptation

Complex systems are self-organised: self-organisation occurs when the properties of the macroscopic system that arise from the interactions between components are activated and influence the later stages of growth and the interaction processes themselves. It is the mechanisms of self-organisation that, by becoming activated, open up to multiple possible evolutionary pathways, and thereby maintain systems that have drifted far away from their equilibrium.

3.2 RESILIENCE STRATEGIES: LIFE IS FULL OF SURPRISES

On the basis of experiments and studies, different strategies have been devised for identifying a means to sustainability that embraces the dynamic nature of complex systems. The survival of social systems is more likely if the natural systems to which they linked are efficient and function properly (the interdependence between natural and social systems is a topic that has been widely debated).

'Ecological resilience has been defined as the magnitude of disturbance that can be experienced before a system moves into a different state and different set of controls. Social resilience has been defined as the ability of human communities to withstand external shocks to their social infrastructures, such as environmental variability or social, economic, and political upheavals. […]. The challenge is to anticipate

[5] Gunderson and Holling introduced the concept of Panarchy, or a cyclical and organisational trend in ecosystems comprising four phases: rapid growth (phase r), conservation (phase K), release (omega phase) and reorganisation (alpha phase). The adaptive cycle describes how an ecosystem self-organises, and how it changes and responds to external stresses and to changes in the world. A good example of the adaptive cycle in ecosystems are the cycles that characterise the North American forests, in which every 40-50 years parts of the forest (not all forests) catch fire naturally. The overall forest system consists in components and distribution areas of systems at different states in the evolutionary cycle. The cycles are not absolute, fixed and irrevocable, but an outline. In reality, both in natural ecosystems and social systems, there are transitions between the phases and between the conservation and reconstruction cycles.

change and shape it for sustainability in a manner that does not lead to loss of future options. It involves enhancing the capacity for self-organisation.' (Folke, Colding and Berkes 2003, p.354).

Learning to live with uncertainty and change

Precisely because changes and crises are part of the evolutionary processes of complex systems, one of the key strategies for maintaining and improving the mechanisms of resilience is specifically to cope with the phenomena of change rather than trying (or rather, struggling under the illusion) to remove the possible causes and phenomena of change.

For this reason, one of the strategies for increasing resilience and adaptability is to live with uncertainty and expect the unexpected, setting in motion courses of action that make it possible to accumulate experience. In this way, by implementing adaptation strategies, crises can be overcome and approximate the phenomena of surprise, keeping open a wide range of options and possibilities.

Feeding diversity for reorganisation and renewal

Increasing diversity is another strategy common to many studies and experiences. If it is by now well-established and known that diversity is an asset that must be cultivated in all systems (we might recall the policies for biodiversity, and in other areas, for governance), redundancy is a concept that has received less attention. Diversity and redundancy are the immediate sources for replacing functions that have been lost following a disturbance event, and form the 'stock' from which to draw adaptive responses with regard to a multiplicity of temporal and spatial dimensions.

Memory

In natural ecosystems, diversity and functional relationships are guided by mechanisms of ecological memory, which plays a role in putting together and spreading organisms and their interactions in space and time, and storing experience appropriated as environmental conditions fluctuate[6]. It is therefore not only the presence of diversity and redundancy that ensures increased resilience, but also the implementation of adaptive responses with regard to the phenomena of change.

Combining different types and systems of knowledge and creating opportunities for self-organisation

This concept is associated with the importance of bringing together and incorporating different forms of knowledge. This approach is even more important when applied to social systems: in risk management and community experiences that have occurred under extreme conditions (communities in geographic areas experiencing extremely difficult environmental conditions), it proved a key strategy to include the study of knowledge and local traditions in the cognitive phase in addition to scientific cognitive methods. In fact, traditional local knowledge encompasses the memory of responses implemented in order to adapt to environmental conditions and to changes.

3.3 CITY MODEL

The Urban Resilience program[7] is a research project started in 2007 with the aim of understanding what levels of stress can be absorbed by urban social-ecological systems without their structure and functionality mutating into less desirable forms. The research project does not explicitly provide a comparison with themes and instruments of local governance processes. The resilience-city model is based on four "systems":

[6] In the highly simplified landscapes of ecosystems, we see a loss of the mechanisms underlying ecological memory.

[7] CSIRO, Australia; Arizona State University, USA; Stockholm University, Sweden, Urban Resilience Research Prospectus Coordinatore *Brian Walker* Science Program Director and Chair, Board of Members The Resilience Alliance, February 2007 (go to link 1172764197_urbanresilienceresearchprospectusv7feb07.pdf)

the metabolic flows (that support the urban functions, human well-being and quality of life), the governance networks, the social dynamics and the built environment.

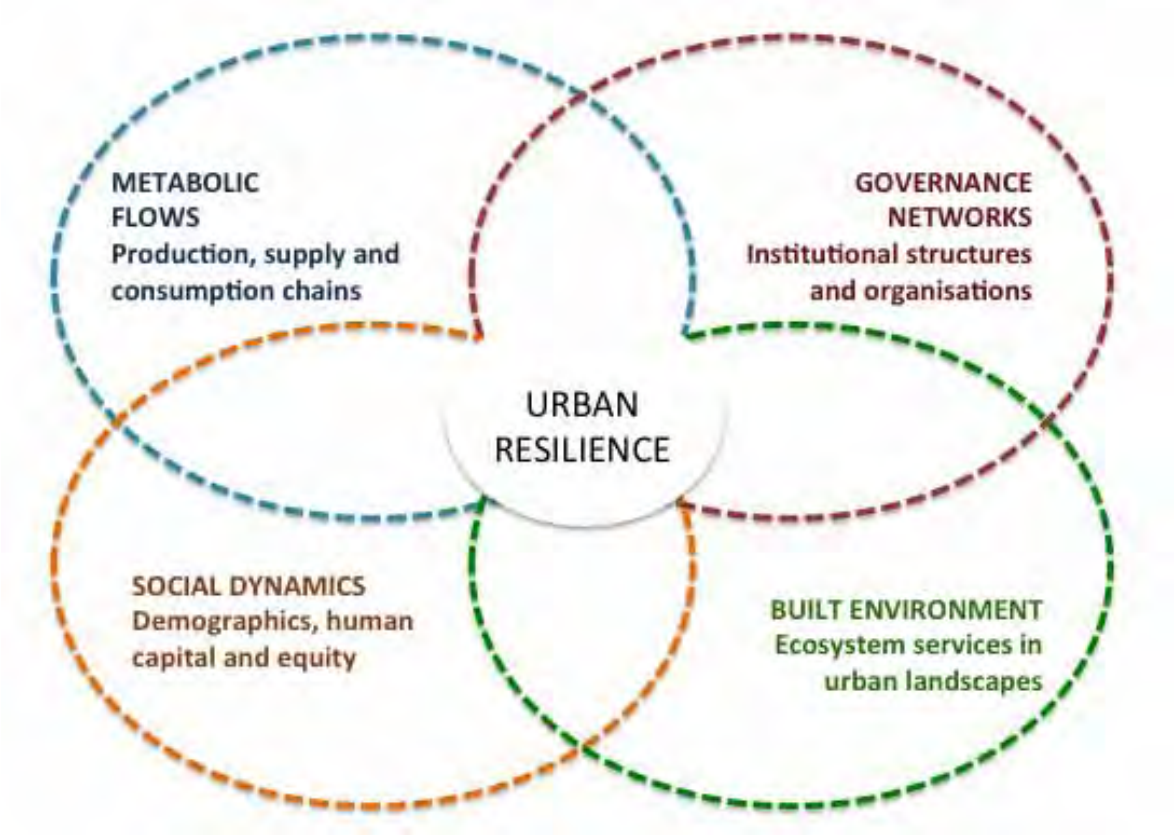

Fig. 1 The four components the overall urban system (adapted from http://www.resalliance.org)

4 RESILIENCE AND ADAPTATION

The amount of literature and documents related to climate change adaptation strategies and peak oil is enormous, including with regard to the relevance of the issue. The bodies and international organisations that deal with this issue are also many. For the purposes of this work, we have chosen from the wide range available texts that identify within resilience the concept on which adaptation strategies primarily related to urban and regional contexts may be built.

It is possible to identify two main groups: there are a number of texts on the resilience of urban areas or regions (such as those by Stephen Coyle or texts by authors such as Peter Newman, Peter Beatley, Heather Boyer) and many experiences, and a number of texts that refer to the initiatives carried out in English Transition Cities (Rob Hopkins and Shaun Chamberlin). Moreover, many documents by international institutions such as the World Health Organisation (WHO), the United Nations Environment Programme (UNEP), the UN and European Union documents of intent are included in this family.

One aspect common to these texts is that of using resilience as a key for coping with the important changes taking place, and for building adaptation strategies for climate change, the lack of – and fall-off in – natural resources (particularly oil), and energy crises.

This group of authors is particularly relevant to the lines of research because they focus on the development of cities, urban areas based on sustainable settlement models.

In terms of their core disciplines, there are some authors (whose works are very recognisable) who come from planning and urban design backgrounds, while others have a background in the natural sciences and economic and social sciences, and a few come from political and strategic sciences backgrounds.
The development scenario or model based on resilience strategies (resilient city) emerges as the most desirable and, in some texts (Newman), the only one.

4.1 CONCEPTS OF ECOSYSTEM RESILIENCE

In terms of using and referring to the concepts specifically related to resilience, the works focussing on cities and adaptation (e.g. Newman) do not expand upon theoretical references and/or close examination of the properties or principles of ecosystem resilience, while in the works related to transition cities, numerous concepts related to ecosystem resilience and properties are explicitly mentioned: diversity and redundancy, modularity and hierarchies/organisation and feedback processes. These principles are the basis for constructing processes, strategies and actions for resilient communities.
In general, it is possible to highlight how both the strategies and the instruments used in the texts, with the exception of the Transition Cities initiatives, can be attributed to principles, methods and tools already developed in the context of environmental and ecological planning. These texts are relevant from the viewpoint of innovation and the process models proposed but mainly refer to the concepts and principles already expounded within the debate on adaptation strategies. One element of innovation, from the point of view of the discipline of planning and urban design, is the change in principles, models and recognised experience at the level of urban systems.
The English Transition City initiatives (now spread throughout the world) are, however, very closely linked to the principles and concepts characteristic of resilience. These experiences, based on theoretical references set out in the texts, demonstrate highly innovative aspects focused, in particular, on the process, bottom-up policies and active participation and empowerment of local social communities.

4.2 RESILIENCE STRATEGIES

One element common to all the works of this family is their innovative approach and the attention they give to construction of the process, which includes both aspects of population involvement, and technical and operational aspects. Hopkins, in construction of the process, employs a number of concepts related to resilience theories (in particular, feedback processes). The main concepts of resilience referred to in the definition of strategies and actions (policies) for the transitions cities are: diversity (and creative redundancy), modularity (with particular reference to organisational networks and relationships as applied to the policies of governance), local-based (similar and related both to the vision of the complexity of urban regional systems, and to the importance of cognitive elements and bringing citizenship and local communities into effect), as well as the importance of choosing and implementing solutions appropriate to local contexts without generalising and defining methodologies to be reproduced in the same way in different contexts), and the concept of small (which refers to the balance between environmental, social and economic resources, and the type of development and their levels of consumption and use). Other important concepts that have characterised the transition city experiments are the central role of visioning (and a positive approach to changes and goals), social inclusion, and the capacity for awareness-raising and psychological insight.
In addition to the measures aimed at reducing emissions, at sustainable mobility (and others directed more towards environmental sustainability), there are:

– actions aimed at part of the community 'taking back' areas and regions or their living environment;

- integration and social inclusion measures;
- measures related to food supply chains and measures related to community living and environments on a human scale.

Participation is not only focused or concentrated on constructing the vision and strategic objectives, but it is the town as a whole that is the agent and party that implements the strategies for achieving shared goals and objectives.

Newman proposes, in the construction of strategies and measures for the resilient city, a number of evocative definitions or concepts evoked with reference to the city: Renewable Energy City, Carbon Neutral City, Distributed Dity, Photosynthetic City, Eco-Efficient City, Place-Based City, Sustainable Transport City. These key strategies contain, a number of principles deriving from the disciplinary debate on 'sustainable cities' (such as densification, sustainable mobility, and so on) and a number of strategies deriving from more engineering-based disciplines (such as the use of sustainable water management systems (LCD) and/or solutions for increasing energy efficiency).

4.3 CITY MODEL

This texts in this group, precisely because it includes various authors with a planning background, set out the structure or definition of urban systems (and their components), and planning actions explicitly related to the urban form. A general objective shared by these authors is the development of an action plans to make in the neighbourhoods, community or region more environmentally and economically healthy, habitable and resilient.

This group of authors (such as Coyle, Newman, Beatley and Boyer, for example), by greatly simplifying the models devised in the texts, separate out the built environment and other issues connected with networks or 'supporting systems'.

For example, Coyle proposes a model of the city (or urban system) consisting of the built environment and supporting systems. The built environment consists of the physical structures and organisation patterns of buildings, blocks, neighbourhoods, villages, towns, cities and regions. The supporting systems are: Transportation, Energy, Water, Natural environment, Food production, Agriculture, Solid waste, Economics.

A number of experiences with resilient cities (http://sustainablecitiescollective.com/) and experiments in urban transformation (http://www.resilientcity.org/) can be attributed to this group of authors.

5 RESILIENCE AND RISK

In the most innovative research and best practices aimed at the mitigation of territorial risks, the concept of resilience has assumed a central role in the construction of strategies that include within the objectives of reducing risks and hazards a plurality of goals aimed at territorial quality[8].

The concept of resilience in territorial risk management has now been established, certainly in scientific debate, for at least 15 years. Since that the topic of resilience has long been debated, there are also significant theoretical focal points in terms of interpretation, such as the relationship between resilience and vulnerability. As underlined Pelling *the idea of resiliency suggest a proactive stance towards risks. It has been discussed within ecological theory, system analysis and disaster studies* (Pelling 2003 p.7)

[8] See, for example, the many contributions relating to the research project on the sustainable development of the U.S. territories bordering the Gulf of Mexico, presented at the Venice Biennale, collected in the work by Eugenie L. Birch and Susan M. Wachter, Eds, 2006: Rebuilding Urban Places After Disaster: Lessons from Hurricane Katrina, University of Pennsylvania Press, Philadelphia; the best practices and researches devised by Pelling on the resilience of cities and urban systems, etc.).

	Conventional / High-carbon (CHC) community	Resilient low carbon (RLC) built environment
Urbanisation or development pattern	Dispersed uncontained growth Predominately auto-oriented urbanisation lacking clearly defined boundaries between the built and natural environment	Compact and bounded
Circulation pattern	Automobile oriented	Connected and multi - use
Land use patterns	Use-based zoning Control of uses with minimal power over the forms or sequence of urbanisation High density apartment sites abutting strip commercial development separated from single family subdivision by a multilane arterial	Form based zoning (as Flexibility in use)
Public space scale and form	Road way oriented, Public streets are scaled for automobile convenience, Little spatial enclosure for the public space, Parks and public space scaled to adjoining arterial or regional thoroughfares	Pedestrian scale and form, Multifunctional and connected
Building and landscape scale and form	Road way oriented	Pedestrian scale and form
	Conventional / High-carbon (CHC) community	**Resilient low carbon (RLC) built environment**
Transportation	Use of motor vehicles	Public transport, low/no carbon fuels and vehicles transportations demand-management technologies. Pedestrian cycling network
Energy	Conventional energy fossil fuel – generated	Renewable ad limited fossil fuel-generated electric power, improve the efficiency and the reduction of demand
Water	Conventional water supply system deliver water (potable and non – potable) via engineered hydrologic and hydraulic components Ron off and drainage based on conventional watershed or drainage basin management	Reduce the water demand, increasing the efficiency of performance of infrastructures, the storm water collection and discharge at local level (building, park, street..), the resilient storm water system at regional level Biological and recycling technologies for the waste water
Natural environment	The expansion of human activities into the natural environment ha reduced, fragmented ad isolated water habitats and other natural habitats	Improvement of natural habitats and biodiversity
Food production agriculture	Conventional food production consists largely of monolithic crop production (on petroleum-based fertilizer and other technological advances); conventional livestock production consumes 70% of all land used for agriculture worldwide, generates 18% of the world's greenhouse gas emissions	Sustainable agriculture and a regional supply food management
Solid waste	A minimal waste recycling or reduction The land filling and other high impact waste final destination	Sustainable solid waste system, recycling, zero waste approach (the production of products, the distribution, the recycling in use, the
Economic	The economic system focuses on increasing community prosperity by increasing the production distribution and consumption of good and services	Increasing the community prosperity through the production, distribution and consumption of goods and services that minimise or eliminate waste and non renewables

Tab. 1 Differences between Conventional/High-carbon (CHC) community and resilient low carbon (RLC) built environment (Coyle)

The concept of resilience was initially associated with (and opposed to) the concept of vulnerability: resilience was employed as the opposite of vulnerability and resilience strategies were therefore aimed at reducing the vulnerability of systems with regard to territorial risks. Subsequently, in the context of the scientific debate, resilience was associated with a wider vision and not just related to the reduction of vulnerability. From this point of view, the approach to resilience includes dynamic aspects (increasing the resilience of a system over time including theories of adaptation, not only at the time of reaction to disasters), aspects of scale and management of complex systems (reduction of the causes and determinants

of hazards and phenomena that increase the severity of disastrous events), socio-economic aspects (including both organisational and social aspects) (White 2010).
The conceptualisation of resilience in academia has been fuzzy and contested, and some lucidity is needed to understand this relatively new theoretical construct in relation to water and spatial planning. In recent texts, the study of resilience, while related to the issue of territorial risks (clear configuration of the aim) includes more general objectives: a more resilient system with regard to territorial risks is and must be, in general, an urban-territorial system characterised by higher overall environmental and social quality.

5.1 CONCEPTS OF ECOSYSTEM RESILIENCE

The concept of resilience used by many authors is that of ecosystem resilience. Resilience is understood as the capacity and ability, after a disaster, to emerge from stalemate in a condition that is not necessarily the same as the initial pre-existing condition. The capacity of a region to be resilient largely depends on the organisation and relationships that existed before the event: the more flexible the system, the quicker will be recovery to normality from the perspective of improvement and awareness.
If a community chooses to go on living despite the risk, then growth must be directed towards creating resilient cities capable of responding to the effects of a disaster. This type of approach, namely being aware of and cooperating with nature and not against it, can simultaneously achieve the goals of conservation and exploitation of natural resources without reducing the opportunities for growth (Burby 1998).
The integrated use of appropriate management tools and regional planning is needed to achieve a vision of resilient cities, reducing the intensity of growth in hazardous areas: by reducing the need to distort and obstruct natural processes, we will be able to reduce both the economic the social costs of vulnerable cities.

5.2 STRATEGIES

In the construction of strategies for territorial resilience against risks, there are many concepts characteristic of ecosystem resilience that are used as key principles:

- The homeostasis principle: systems are maintained by feedbacks between component parts which signal changes and enable learning. Resilience enhanced when feedbacks are transmitted effectively
- The omnivory principle: external shocks are mitigated by diversifying resource requirement and their means of delivery. Failures to source or distribute a resource can then be compensated for by alternatives.
- The high flux principle. The faster the movement of responses through a system the more resources will be available at any given to help cope with perturbation.
- The flatness principle. Overly hierarchical systems are less flexible and hence less able to cope with surprise and adjust behaviour. Top-heavy system will be less resilient
- The buffering principle: a system which has a capacity in excess of its need can draw on this capacity in times of need, and so is more resilient.
- The redundancy principle: a degree of overlapping function in a system permits to system to change by allowing vital functions to continue while formerly redundant elements take on new function. (Pelling 2003, p. 8).

Other authors (as Watson and Adams 2011) identify *the agenda of resilient design* that can be expressed by three key principles: multiple scales of impact, collaborative design and innovation in design, technology, and policy.
These strategies/principles are also contained in official documents of many bodies (as NOOA, FEMA and ONU agencies) set up to protect populations against risks: for example, the Federal Emergency Management

Agency (FEMA) has identified checklists for resilient cities/regions (related to flood plain management) or the document from the National Science and Technology Council Committee (Grand Challenges for disaster Reduction 2005, report for the White House office for science and technology) which contains actions to be implemented Towards resilient systems.
The concepts common to different authors for a risk-resilient system are: diffusion and diversity (redundant and diverse city), the rapid responses properties (efficient and strong city), the redundancy circuit (feedback and smart city); the storage capacity and the scale/hierarchy connection (independent, collaborative and adaptable city).

5.3 CITY MODEL

In general, the structure of the urban and regional systems proposed by the authors of this family is derived from the established methodologies and models of risk analysis and management. The local systems are broken down into subsystems and components (analysis by component: social, environmental, etc.) and into the relational components that exist between the subsystems (relational analysis: interactions between subsystems).

6 INITIAL CONCLUSIONS

The table shows a summarized comparison from this initial analysis of the literature on cities and resilience. In particular, the main disciplinary backgrounds, the scales or spatial dimensions under consideration (neighborhoods, regions, cities, etc.), the models of urban systems and the main concepts of ecosystem resilience referred to in the texts are specified for each family.
With regard to the concepts used, we are proposing a schematic summary which attributes the key concepts used by the authors of the three families researched. The schematic highlights where the key concepts are innovative in the field of planning and urban design and where these concepts can be found in the literature or are already in use.
The most innovative aspects and concepts common to the three families are:

- A strong link between physical, social and organisational elements;
- Strong relevance of local community and relevance to the social aspects;
- Focus and role of ecosystem services;
- Strong innovation in terms of the process;
- Relevance of the concept of process dynamics (and therefore of flexibility with respect to the dynamism of processes).

With regard to the contributions offered by the different families, it is possible to propose few more reflections.
Resilience and sustainability proposes innovative principles and strategies in the field of socio-ecological systems management, but does not appear to be strongly focused on urban and planning issues. Important strategies could derive from this family and be applied to urban design.
With regard to *Resilience and adaptation* family, the Transition cities experiences are very interesting in terms of innovation in the policies process and in term of strategic contents. The other experiences and proposals of this family are more focussed on adaptation strategies. The *resilience and risk family* developed since a long time a wide debate on resilience strategies aiming to the risk mitigation. The resilience strategies / principles related to the risk mitigation are more easily understandable by the general public: this because the population involved is usually more sensible to the themes of risk mitigation and prevention, and is thus more open to the adoption of innovative approaches, such as resilience.

	Resilience and sustainability	Resilience and adaptation		Resilience and risks
Disciplinary backgrounds	Natural sciences, biology, ecology, economy and social and political sciences	Planning, architecture, natural science, sociology		Engineering, Building architecture, planning, social science
Resilience definition	R. as the capacity to lead to a continued existence by Incorporating change'	**Planner approach** No definition of R.	**Transition cities** R. as the ability of complex system to absorb the stress using adaptation strategies	R. as the capacity and ability, after a disaster, to emerge from stalemate in a condition that is not necessarily the same as the initial pre-existing condition
Research and experiences Focus (scales and places)	- Theoretical / theoretical modelling - Development of local communities and regional development - Management of natural resources (linked to development of local community / regional development)	- Models / strategies applied to city / urban and metropolitan - Development of neighbourhoods and local communities		- Regional Development - Urban contexts - Projects focused on specific phenomena
Cities model (components)	- Social-ecological systems - Urban areas is the result of the interaction of four system (that have the same relevance): metabolic flows, governance networks, social dynamics, built environment.	**Planner approach** Cities system composed by the build env. supported by the supporting systems (Transportation, Energy, Water, Natural environment, Food production, agriculture, Solid waste, Economic)	**Transition cities** Community process of changing (not structured models)	- Cities/regional models are based on traditional risk analysis methods - City component physical, social and organizational
Resilience concepts used as key strategies	- Feeding diversity for reorganization and renewal - Interconnection between temporal and spatial scales varying - Recognition of the slow variables - Compact strong feedback - Adaptability, flexibility and innovation - Knowledge and communities	**Planner approach** No strong relation between resilience concepts and the strategies developed	**Transition cities** - diversity - modularity - local based - feedback - small	- Buffering - Core protection - Diffusion - Rapid responses - Redundancy circuit - Storage capacity - Waste nutrient recovery self-help
Resilience strategies (innovation for planning)	- Life is full of surprises - *Learning to live with uncertainty and change* - ***Feeding diversity for reorganisation and renewal*** - Combining different types and systems of knowledge and create opportunities for self-organization - Adaptability, flexibility and innovation based on feedback - **Memory**	No innovation strictly related to the resilience Newman proposes, strategies related to: Renewable Energy City, Carbon Neutral City, Distributed Dity, Photosynthetic City, Eco-Efficient City, Place-Based City, Sustainable Transport City.	- Diversity (and creative redundancy) - Modularity (organisational networks / and governance) - Local-based - Small - Balance between environmental, social and economic resources, and the type of development and their levels of consumption and use	- Redundancy & diversity - Efficiency & Strong (with the capacity to withstand events/external attacks of various kinds) - Independency & connections (ability to mutually support one other) - Adaptability - ability to learn from experience - Collaboration(multiple opportunities and incentives)

Tab. 2 Families of authors and summary of topics and approaches

Within the context of local governance processes, the concept of resilience affords possibilities and opportunities:

– Certainly the concept of resilience in itself contains significant possibilities, especially in the construction of scenarios and visions shared with local communities from a positive and optimistic perspective (Hopkins, Pelling). Issues such as the protection of environmental and ecosystem performance or the prevention of local risks can be translated not only into guidelines for constraints and safeguards, but as active construction projects for resilient territorial systems and communities.

Fig. 2 Schematic summary: strategic concepts, belonging and sharing (The scheme highlights (darker colour) where the key concepts are innovative in the field of urban planning/design and where these concepts can be already found or are already in use in the urban planning/design literature).

– Integrating the concepts of resilience into forward thinking capabilities for plans and programmes. Many benefits are derived from the efficient functioning of ecosystems, and, therefore, considering the services and benefits that derive from ecosystems as an integral part of the system of services and functions of local systems.

The following are some of the key strategies for resilient regions and cities that seem to be more innovative.

(Diversity and) redundancy: A resilient world promotes diversity in all its aspects and biological, landscape, social and economic forms. Diversity is a major source in terms of the options for our future. Diversity is a concept/principle already integrated in the planning polices/strategies. At the same time, if diversity implies the differentiation into elements and components, redundancy implies multiplicity of functions. Redundancy can also be approached through the principles of subsidiarity, understood as the interrelationship and repetition of a number of decision-making mechanisms including at the local scale. A resilient world has institutions that include some redundancy in the institutional structures and a degree of overlap between public and private in respect of access to ownership.

Recognition of slow variables: A resilient world must have policies focused on controlling threshold-related variables. By focusing on the slow variables that give shape to social-ecological systems and on the thresholds that remain , we have a better ability to manage the resilience of the system.

Adaptability, flexibility and innovation: A resilient world places the focus on learning, experimentation and the development of local rules, and embraces changes. One approach to resilience is to encourage new developments and innovations. In general, we aim for solutions to avoid change rather than find innovative solutions that mutate or assist the changes.

Knowledge and communities: a resilient world fosters social networks and flexible leadership. The resilience of social-ecological systems is closely connected with people's capacity to respond jointly and effectively to changes and disturbances.

Interconnection between spatial scales and time variables (already developed in urban design/planning): the issue of interconnection between different spatial scales and dimensions of time is certainly complex, and widely discussed in the field of urban planning and design. Studies on complex systems, however, tell us that in a resilient system, not everything is interconnected and dependent. There are relatively independent parts. The notion of over-interconnection, especially at intermediate hierarchical levels of hierarchy implies that once one part suffers stress, this shock reverberates throughout the whole system.

Solid strong feedback (already developed in urban design/planning): The feedback processes allow us to perceive the thresholds before crossing them. A resilient world has strong feedback (but not too strong). In this case there are very many references to the flexibility of decision-making processes and construction plan processes (Steiner but a great many others).

Future developments

Research paths include the following stages:

- reading up on and comparing the experiments carried out with regard to the three approaches identified (and making a comparison in terms of how efficient and innovative the methods and tools proposed are);
- identifying genuinely innovative aspects of resilience (extending the analysis not only to the theoretical aspects but also to the proposed measures, instruments and methods of analysis and action);
- reading (and comparing/classifying) websites and platforms (including their role, functions, effectiveness)
- identifying strategies to be integrated into the planning and urban design processes;
- applying key strategies and key principles to urban design and planning cases and processes.

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TeMA
Journal of
Land Use, Mobility and Environment

TeMA 2 (2012) 117-130
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: 10.6092/1970-9870/924

review paper. received 10 June 2012, accepted 20 July 2012

www.tema.unina.it

Strumenti di valutazione della resilienza urbana

Assessment tools of urban resilience

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ABSTRACT:
The objective of this work is to highlight the aspects related to the resilient capacity of a neoecosistema. Clarifying what does it means to speak about a resilient neoecosistema and which are the specific characters that make him capable of change and adaptation when facing an environmental, social or economic threat, it will be possible to understand the efficacy related to the model of urban development. From the individuation of perturbing factors of this capacity, it will be possible to generate a panel of the resilient capacity linked to three different ambits that represent the three characteristic elements of natural ecosystems: its physic structure, the persons and the interaction processes between them so we would be able to make explicit the specific characters of resilience distinguished from those of sustainability and urban quality.

KEYWORDS:
Neoecosistema, urban quality, urban resilience, quantitative evaluation,

1 AMBITO DI INVESTIGAZIONE

L'approfondimento si pone all'interno del dibattito dello "sviluppo urbano insostenibile" che ha portato con sé alcune problematiche legate a un'occupazione di suolo rilevante, una voracità energetica, la concentrazione di agenti inquinanti e il consumo di risorse non rinnovabili. Le città contemporanee soffrono, infatti, di un'impronta ecologica molto elevata e una crescita esponenziale della vulnerabilità di alcuni gruppi sociali (bambini, anziani...), relazionata all'aumento della povertà.

Questo perché i contesti urbani sono sempre più dipendenti da flussi energetici, alimentari, di materiali e di informazioni, che provengono da sistemi interscalari (area comunale, regionale, nazionale...), che rende molte delle realtà urbane incapaci di attivare un ciclo autorigenerante, dove anche i rifiuti prodotti risultino componenti utili per il mantenimento del sistema stesso.

Parlare delle realtà urbane come un insieme di flussi, pone la necessità di definire in modo chiaro cosa intendiamo per città e introdurre quindi l'idea di città come ecosistema naturale, come organismo vivente (Odum, 1988). Una definizione molto accurata è stata data da Magnaghi che definisce appunto l'ecosistema urbano come neoecosistema: «organismo vivente ad alta complessità […] in continua trasformazione, prodotto dall'incontro di eventi culturali e naturali e composto da luoghi dotati di identità, storia, carattere, struttura di lungo periodo» (Magnaghi, 2010).

Questa definizione pone l'accento sulla necessità di considerare la città non solo come un insieme di elementi intercambiabili, ma piuttosto come appunto un organismo (più o meno antropizzato) che vive, caratterizzato da una parte importante di capitale naturale e una altrettanto importante di capitale sociale (le persone). Questi elementi interagiscono tra di loro producendo processi metabolici, economici, produttivi, processi di socializzazione, partecipazione e sensibilizzazione. Queste interazioni mantengono il sistema vivo e capace di reagire e soprattutto recuperarsi di fronte a un trauma.

Sotto questa ottica risulta ancora più interessante l'ipotesi di Mc Donough di rivoluzionare i processi di produzione e progettazione dei beni in modo da eliminare il rifiuto, che diventerebbe invece materia utile ad un altro processo (Mc Donough, 2003). Se pensiamo di ampliare l'ambito d'interesse di tale rivoluzione ai flussi di informazioni (condivisione della conoscenza, acquisizione di capacità pratiche utili a alla comunità, come permacultura, artigianato etc) e non solo a quelli di energia e materia, si può pensare di dar vita a processi che siano in grado di creare un sistema dinamico, capace di modificarsi e sensibile ai cambiamenti esterni e inaspettati. Infatti, inglobando tutti gli elementi e i processi del neoecosistema, lo stesso, nel caso venga affettato da un fattore esterno, risulta capace di riorganizzarsi (da un punto di vista ambientale, sociale ed economico), con la possibilità di perdere uno o più elementi acquisendone un altro utile alla nuova riorganizzazione.

Il concetto di resilienza è strettamente collegato a quello di sufficienza nella misura di comprendere quale sia il limite tollerabile per il neoecosistema considerato. L'elemento importante della sufficienza è infatti la capacità di impiegare solo la quantità necessaria per garantire il benessere sia dell'individuo, come collettività, che del territorio che abita. Come scrive Sachs «mentre efficienza significa fare le cose nel modo giusto, sufficienza equivale a fare le cose giuste» (Sachs, 2007). Questo determina due questioni fondamentali: da una parte quale sia il limite, il livello di sufficienza e quanto sia importante un cambio di comportamento a livello individuale e collettivo. Infatti, il concetto di sufficienza da una parte è strettamente connesso con «la giusta misura, concepita come un sistema equo e come arte di vita» (Sachs, 2007) e pertanto dall'altra presuppone un «nuovo modo di rapportarsi con i beni e i servizi» (Sachs, 2007), senza cioè guardare solo alla quantità e all'efficienza della tecnologia, ma soprattutto alla qualità della vita e alla diminuzione del carico sul capitale naturale. Sicuramente l'efficienza nell'uso delle risorse, rimane un

elemento fondamentale nel dibattito, ma questa efficienza deve essere accompagnata e "gestita" da una prospettiva di sufficienza, rispetto al capitale naturale e sociale.

2 L'IMMAGINE DEL NEOECOSISTEMA RESILIENTE

Partendo dalla definizione della resilienza urbana come «(...) insieme di capacità adattative di un sistema urbano a fronte di fattori di stress e, in particolare, ai fenomeni di cambiamento climatico e scarsità energetica» (UNEP, 2005), un neoecosistema resiliente è in grado di « assorbire shock e/o perturbazioni senza subire alterazioni rilevanti nella sua organizzazione funzionale, nel suo assetto e nelle sue caratteristiche identitarie» (UNEP, 2005)

Data la definizione riteniamo interessante proporre una descrizione un po' più figurativa attraverso alcuni aggettivi e sostantivi che ne evidenziano i caratteri predominanti. Partendo quindi dalle caratteristiche strutturali dei sistemi complessi e aperti, sono poi state evidenziate le caratteristiche morfologiche urbane che descrivono le città contemporanee rispetto modelli differenti (compatte, diffuse), per poi terminare con l'approfondimento del concetto di qualità di vita relazionato ai contesti urbani.

I SISTEMI COMPLESSI

Come specificato nella parte introduttiva stiamo parlando di neoecosistemi e come ben sappiamo la maggior parte dei sistemi che ci circondano sono sistemi **complessi.** Dalla società, alla biosfera sino agli ecosistemi stessi che la compongono, e quindi appunto al neoecosistema. Ciò significa che i nostri neoecosistemi sono composti da differenti parti, interconnesse tra di loro e i cui legami creano delle informazioni addizionali che non sono visibili all'osservatore, se non nel momento in cui questa interazione di elementi e proprietà rende visibili nuove proprietà. In particolare un sistema complesso si caratterizza per un'interazione e una connessione forte tra le componenti, che significa che le differenti parti hanno la possibilità di auto-organizzarsi tra di loro per far fronte in modo rapido ed efficace ad un determinato shock e/o perturbazione.

Oggi i neoecosistemi stanno perdendo questa **capacità modulare** a causa della globalizzazione, che seppur permette di connettere parti del mondo molto lontane e con caratteri differenti, indebolisce la modularità a scala locale che è quella che permette di reagire in modo efficace e tempestivo in caso di trauma. Un esempio significativo sono le epidemie e contaminazioni di animali che si sono estese facilmente e in modo rapido per quasi tutto il globo (l'influenza aviaria, la mucca pazza, il pollo alla diossina). Se si pensa alla produzione alimentare, infatti, è molto facile visualizzare il problema: se ogni città consumasse i cibi prodotti nella propria comunità, provincia o regione d'appartenenza, qualsiasi contagio potrebbe essere controllato in modo molto rapido e non si diffonderebbe a scala globale. Questo non significa dover rinunciare alla connessione per intercambiare informazioni, che, come abbiamo visto in eventi recenti, quali il movimento studentesco in Messico (Yo soy 132) o la denominata "primavera araba", hanno consentito di dar loro voce e di mobilitare l'opinione pubblica su situazioni e avvenimenti che altrimenti avrebbero avuto uno spazio molto marginale.

Questo cambiamento di scala (dalla globale alla locale) introduce un tema estremamente importante: l'**autosufficienza** , che riprende il dibattito introdotto nel primo paragrafo tra efficienza e sufficienza. L'autosufficiente, infatti, significa bastarsi a se stesso, definizione ripresa molto bene dal detto popolare, utilizzato anche da Ikea spagnola: "non è più ricco colui che possiede di più, ma chi meno necessita". Trasportando il concetto al contesto urbano si fa riferimento in prima istanza al metabolismo e quindi alla possibilità di chiuderei cicli, di energia, acqua, materia, facendo in modo di diminuire in primo luogo la domanda e di non creare rifiuti che non possano essere riutilizzati in altri processi.

I SISTEMI STABILI E APERTI

Partendo dalla complessità del neoecositema abbiamo da una parte differenti elementi del sistema relazionati tra di loro, dove si cerca la coesione e la **stabilità** del sistema, dall'altra esiste un limite rispetto al quale è possibile che cresca il sistema stesso. Questo, infatti, è strettamente correlato con l'intorno con il quale scambia energia, materia e informazioni e allo stesso modo è soggetto a traumi, che possono modificare la conformazione di partenza, ma che, in un sistema stabile, riescono a fare in modo che le emergenze che sorgono siano inglobate nei cicli stessi.

Soffermandoci un momento sulla capacità del sistema urbano d'intercambiare materia, energia e informazioni con l'ambiente circostante, vediamo come, questo suo carattere che lo denomina come sistema **aperto,** gli consenta di mantenendosi in uno stato chiamato "uniforme", pur incorporando ed eliminando materia e costruendo e distruggendo elementi. Questo significa che modificando le condizioni di partenza o il processo, lo stato finale non per forza cambierà. Pertanto differenti condizioni iniziali e processi possono portare a uno stesso stato finale. Tale caratteristica deriva dal principio di equifinalità, per il quale in qualsiasi sistema chiuso, lo stato finale è inequivocabilmente determinato dalle condizioni iniziali (Von Bertalanffy, 2006). infatti da un punto di vista della termodinamica, i sistemi aperti riescono a mantenersi in uno stato di alta improbabilità statistica per ordine e organizzazione (Von Bertalanffy, 2006).

MODELLO COMPATTO/ MODELLO DIFFUSO

Altro carattere significativo dei neoecosistemi urbani è la **compattezza**. Si considera compatto un neoecosistema con una densità di abitanti medio/ alta, intorno ai 250/350 abitanti/ettaro, e con una trama del tessuto continua. Questo carattere, tipico delle città consolidate fa emergere alcuni caratteri interessanti di discussione: l'occupazione del suolo, la mobilità, la vegetazione, il carattere bioclimatico degli edifici, il consumo di energia e acqua e la coesione sociale.

Partendo dall'occupazione del suolo, uno studio molto interessante di Matthew Kahn, professore della University of California, pone in evidenza come nell'Unione Europea le aree suburbane consumino più del doppio del suolo della città principale, lasciando margine a pochi commenti da parte dei sostenitori del modello di espansione urbana diffusa.

Rispetto alla mobilità è possibile notare come il modello compatto sia caratterizzato da una rete viaria più densa e meglio organizzata, rispetto al modello diffuso. Questo significa che ci saranno meno strade (quindi meno occupazione di suolo), potranno essere meglio connesse, con più servizi di trasporto pubblico e di uso comunitario e compartito soprattutto di biciclette, ma anche di altri mezzi alternativi a quello privato. Le strade avranno dimensioni ridotte e quindi potrebbero portare problemi di congestione, ma se bene progettate risulteranno spazi maggiormente fruibili per il transito e anche la sosta delle persone. Allo stesso modo aumenta la prossimità ai servizi, alle attività e alle funzioni urbane, che unita a un'efficienza dei mezzi di trasporto pubblici ed alternatici (bikesharing, carsharing, affitto biciclette, motorini...) consente una riduzione dell'uso del mezzo privato, diminuendo il problema di congestione del traffico, dell'inquinamento dell'aria e del consumo energetico dei trasporti pubblici e privati. In merito Salvador Rueda fornisce alcuni dati della città di Barcellona molto significativi per marcare la differenza tra il modello compatto e diffuso: nel primo l'accessibilità si divide in 10% mezzo privato, 40% mezzo pubblico, 10% biciclette e 40% pedone, mentre nel diffuso 80% mezzo privato, 15% mezzo pubblico, 3 % bicicletta e 2% pedone (Rueda, 2012).

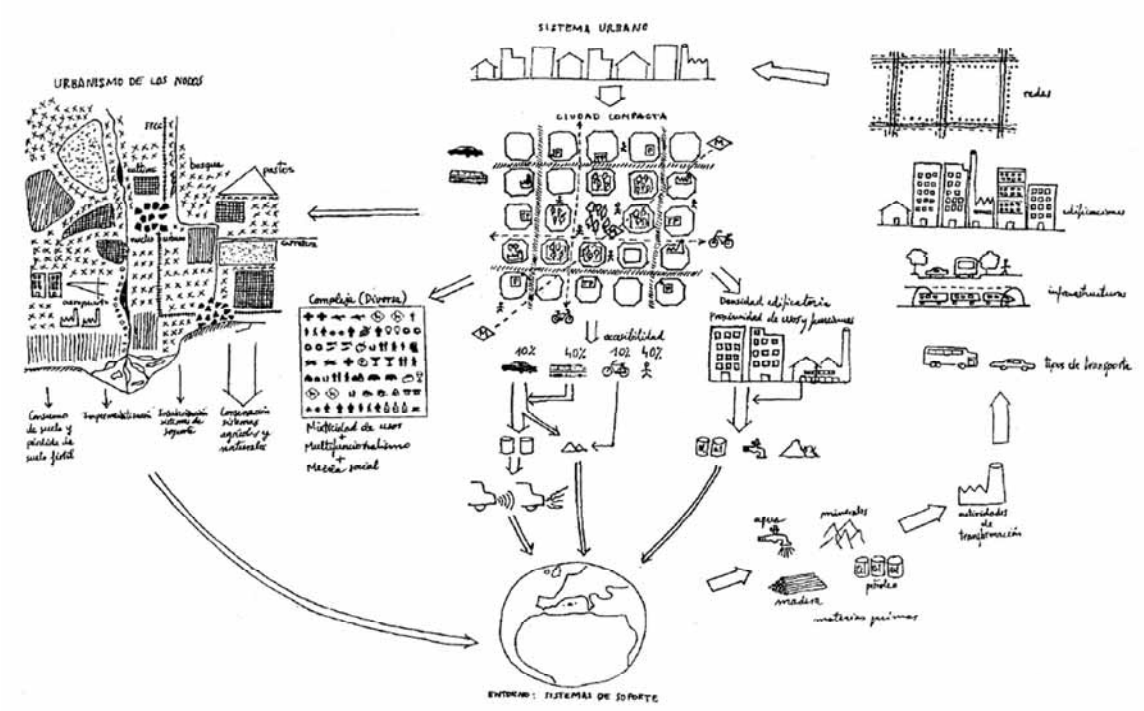

Fig. 1 Schematizzazione del modello della città compatta.

Il problema del verde urbano lascia maggior spazio di dibattito, in quanto se da una parte nel modello compatto lo spazio verde pubblico e privato è relegato a parchi urbani, orti, viali alberati il modello diffuso, occupando più suolo, diminuisce l'estensione dell'ecosistema naturale intorno alla città, consentendo però che ogni casa sia circondata da spazi verdi pubblici che si sommano spesso a quelli privati di ogni abitazione. Se analizziamo il problema ampliando la scala e quindi considerando il territorio che circonda la città troviamo esempi virtuosi (Vitoria- Gasteiz, Amburgo, Stoccolma) che mostrano come limitare l'occupazione di suolo consenta di contare su un anello verde che circonda il nucleo urbano. Inoltre una buona pianificazione del verde, degli spazi pubblici e delle aree abbandonate permette da una parte la mitigazione del microclima esterno e dall'altra la realizzazione di corridoi verdi che connettano gli spazi verdi interni alla città con quelli esterni. Questi ultimi consentono l'auto-mantenimento della biodiversità della fauna e della flora adeguato anche all'interno della città.

Parlando di consumo energetico e capacità passiva prima di tutto, riprendendo la definizione di Illich della sufficienza e dell'efficienza, dobbiamo mettere evidenzia che il problema deve essere portato ad una scala individuale, nella quale sia possibile abbassare il consumo in considerazione delle risorse locali a disposizione. A livello più generale comunque risulta molto significativa l'analisi di Gauzin Müller sui consumi delle case isolate e addossate (Gauzin Müller, 2002). Di fatto un edificio plurifamiliare di 8 case può consumare un 11% meno di riscaldamento di 8 alloggi unifamiliari addossate e il 32% in meno dello stesso numero di case isolate.

È vero comunque che le abitazioni isolate permettono una progettazione ottimale per quanto riguarda i caratteri bioclimatici legati all'orientamento, alle caratteristiche del sito e alla morfologia dell'edificio, mentre un neoecosistema denso non può garantire a tutti gli edifici, un ottimale contributo passivo. Per questo sarebbe opportuno che per ogni edificio fosse valutato una destinazione d'uso adeguata ai propri caratteri costruttivi e morfologici e insediativi. Inoltre il tema dei materiali costruttivi apre davvero un dibattito sulle potenzialità dell'architettura vernacolare rispetto ai nuovi componenti costruttivi che mirano a standard

sempre più alti di efficienza termica e acustica. Sicuramente un tessuto consolidato dà meno spazio alla nuova edificazione, ma molto di più alla riqualificazione energetica, quindi i benefici e limiti sempre si vanno a equilibrare. In generale poi parlando di consumi energetici, dobbiamo fare una nota riguardo ai prezzi dell'infrastrutturazione di base legata alla gestione dell'acqua, dell'energia, del ciclo produttivo, che risultano molto più contenuti nel modello compatto.
Ultimo elemento è la stretta relazione del modello compatto con un possibile aumento della coesione sociale, legata principalmente alla possibilità di incontro, condivisione e interazione con diversi gruppi sociali e con un mix di attività, servizi e organizzazione mediamente alta. Questo carattere pone in evidenza l'importanza di parlare di un neoecosistema diverso rispetto i molteplici elementi che lo compongono. La **diversità,** infatti, non si riferisce solamente alla quantità di elementi (capitale naturale e sociale) che compongono un determinato sistema, ma anche alle relazioni e interconnessioni che si creano tra gli elementi stessi e quindi alla diversità di funzioni, attività, relazioni, organizzazioni, e quindi di tutti i processi che interessano il neoecosistema e che lo rendono capace di differenziare le risposte davanti alle diverse perturbazioni/ shock che occorrono.

LA QUALITÁ DI VITA

Questo essere un luogo di connessioni, relazioni e non solo di elementi fisici, pone la necessità di considerare la capacità del neoecosistema di garantire una certa **qualità** spazi di relazione e della qualità di vita, che significa da una la riscoperta e la valorizzazione degli spazi pubblici, di relazione (piazzi, parchi, strade pedonali e alberate, orti, spazi comunitari) e di transizione tra l'interno e l'esterno (porticati, patii). In area mediterranee infatti gli spazi aperti, come quelli di transizione hanno sempre avuto un valore d'uso e di interazione sociale. Mutando le dinamiche urbane, la vita cittadina si è sempre più allontanata dalle strade e di conseguenza le strategie di controllo del confort termico alla scala urbana perdendo di vista la relazione con la qualità di vita degli individui che abitano le città e quindi, come questa mancanza di attenzione possa contribuire all'esclusione sociale.
Nell'analisi che Català e Angell fanno dei caratteri della qualità della vita e della soddisfazione dei cittadini (Angell 2007) è importante sottolineare quali siano i beni e servizi che il cittadino può incontrare a scala locale, rispetto alla necessità di ogni individuo. Da una parte pongono in evidenza gli elementi collegai alla morfologia e ai caratteri dell'edificato come degli spazi pubblici e ai servizi e alle opportunità offerte dalle strutture urbane, che chiamano sussistenza. Dall'altra, quelli legati a caratteri più sociali, come la riproduzione che pone l'accento sulla cura delle fasce deboli (donne, anziani e bambini), la sicurezza, sia negli spazi privati che in quelli pubblici, la cura dei malati, anziani e discapacità e l'affetto considerando la tolleranza, il rispetto e la solidarietà come beni della comunità. Infine, viene approfondito il tema di qualità di vita come accessibilità a diverse possibilità e servizi: l'accesso alle informazioni, la partecipazione rispetto ai canali messi a disposizione, l'accesso a spazi e attività ricreative e per il tempo libero, la possibilità di coltivare la propria spiritualità, creatività e espressione emozionale. Tutti questi sono resi possibili, da una buona dotazione sicuramente, ma anche dalla costruzione della libertà individuale, legata sia alla presenza di mezzi di trasporto e alla mobilità, come alla diversità di servizi e possibilità di ampliare e condividere la propria conoscenza. Infine molto interessante, la valutazione del senso d'identità come appartenenza a determinati luoghi e il riconoscimento in determinati atti culturali o d'incontro comunitario.
Tutti questi aspetti sono riassumibili dalla definizione di Lynch di «consonanza ambientale» (Lynch, 1981), come capacità del neoecosistema di rispondere non solo agli aspetti di comfort, ma anche alle esigenze psicofisiche umane e di vivibilità sociale. Esiste, infatti, una relazione forte tra i valori dell'uomo e la forma fisica della città, intendendo come forma della città «la struttura spaziale che ospita le attività delle persone,

il flusso di persone, di merci e informazioni che ne deriva e le configurazioni fisiche che intervengono a modificare lo spazio in modo » (Lynch, 1981).
Lynch individua 5 dimensioni prestazionali (performance) per giudicare la qualità della forma urbana e indicare aspetti su cui eventualmente intervenire. Le dimensioni prestazionali (performance) sono: *vitality*, capacità di un insediamento di garantire il benessere fisico, *sense*, capacità di favorire l'identificazione e l'orientamento, *fit*,capacità di accogliere agevolmente le attività, *access*, capacità di facilitare il raggiungimento di zone e nodi e control, la capacità di rendere possibile una cura e una gestione diretta dei luoghi da parte di chi e fa uso effettivamente. Questa lettura della città sottolinea come non sia siano solo importanti i caratteri specifici di un insediamento, ma anche (e soprattutto) le dinamiche che concorrono a modificarli.

Emerge quindi l'importanza di consolidare il legame con i luoghi che formano il territorio, elemento intrinseco nella stessa definizione di neoecosistema, che sottolinea l'importanza che i contesti urbani siano incontro di eventi culturali e naturali e quindi prendano in considerazione il capitale naturale e quello sociale dall'altra parte che siano composti da luoghi che siano significativi per la comunità, consentendo di creare una identità comunitaria forte tra gli individui e il territorio che vivono. Questo consente, infatti, di creare dei circuiti di retrazione corti, che significa acquisire la capacità di comprendere in tempi brevi e di rispondere in modo efficace a determinati cambiamenti che possono avvenire nel sistema. Un esempio chiarificatore è la provenienza dei prodotti materiali che troviamo in commercio. Comprare un mobile in legno di tropicale a Barcellona ha un peso significativo, ingestibile a scala locale: il consumo di energia per il trasporto, il problema della deforestazione di parti delle foreste tropicali, lo sfruttamento della manodopera. Tutti elementi, la cui ricaduta non può essere gestita all'interno dei confini urbani, provinciali o regionali, ma piuttosto globali. Un sistema ben localizzato, al contrario, permette all'individuo, alla comunità di vedere le conseguenze delle proprie azioni, i problemi legati al territorio o a ipotetici traumi che possono sorgere all'interno del sistema, e quindi tentare azioni puntuali ed efficacia, nel breve tempo.
Questo porta con sé un elemento fondamentale per il neoecosistema resiliente: la consapevolezza e la partecipazione da parte della comunità e pertanto il suo essere un ambiente creativo e quindi con uno slancio a produrre progetti innovativi che possano beneficiare tutta la comunità.

3 STRUMENTO DI VALUTAZIONE DELLA RESILIENZA URBANA

L'ipotesi di un pannello di indicatori capaci di valutare la resilienza urbana, parte dall'analisi di quelli che possono essere i fattori di perturbazione del neoecosistema, strettamente connessi con il problema del cambio climatico e la diminuzione di un livello sufficiente di benessere dell'individuo, ponendo appunto il problema a diverse scale, quella globale e quella locale quindi la sfera individuale e quella sociale/ comunitaria.
Pensando quindi alla problematica del cambio climatico, le minacce al neoecosistema, rispetto alla sua capacità resiliente, sono legate al capitale naturale e quindi alle risorse a disposizione e alla loro gestione. Da una parte, infatti, possiamo individuare l'esaurimento delle risorse e l'effetto serra, che incidono sul modello urbano con flussi, di prelievo e immissione nell'ambiente, di energia, acqua e di gestione della materia. Dall'altra invece, collegata a entrambe, è la perdita di biodiversità che invece inciderà sul modello di occupazione di suolo, sulla diversità biologica e sulla protezione delle specie.
Considerando invece la necessità di garantire un livello sufficiente di benessere, possiamo individuare come minacce la mancanza di dotazione dei servizi di base (educazione, sanità e residenza), una bassa qualità degli spazi urbani legata sia all'abitabilità degli stessi che alla mobilità. Per ultimo una bassa coesione sociale

che ha come ambiti di incidenza specifici la complessità delle attività quotidiane e di uso comunitario, la partecipazione comunitaria alle stesse come alla vita politica e comunitaria, i caratteri della popolazione e i processi produttivi, materiali e alimentari, considerandone tutti il ciclo di vita.
Nello specifico, nella tabella sotto sono stati evidenziati, per ogni ambito di incidenza delle minacce individuate, quali siano i caratteri relazionati alla capacità resiliente del neoecosistema, rispetto le tre componenti dello stesso: la struttura fisica e quindi il capitale naturale e quello antropizzato, il capitale umano che lo abita (individui) e le interazioni e connessioni tra gli stessi (processi).

	CAMBIO CLIMATICO		DIMINUZIONE BENESSERE INDIVIDUO	
COMPONENTI NEOECOSISTEMA	AMBITO DI INCIDENZA	ASPETTO DELLA RESILIENZA	AMBITO DI INCIDENZA	ASPETTO DELLA RESILIENZA
1. STRUTTURA FISICA	Modello energetico Modello gestione idrica Modello gestione ciclo materia Modello uso del suolo Biodiversità	Adattamento al modello di efficienza e al comporta-mento bioclimatico dei tessuti urbani (edifici e spazio pubblico)	Servizi Residenza Mobilità urbana Spazio pubblico Attività Popolazione Economia Partecipazione	Pianificazione urbanistica ecologica
2. PROCESSI DI FUNZIONAMENTO	Modello energetico Modello gestione idrica Modello gestione ciclo materia Modello uso del suolo Biodiversità	Miglioramento dell'efficienza (energetica e idrica) Materializzazione della gestione delle risorse Conservazione della biodiversità urbana	Servizi Residenza Mobilità urbana Spazio pubblico Attività Popolazione Economia Partecipazione	Capacità di autogestione (attività economiche e sociali) Desmaterializzazione dell'economia
3. INDIVIDUI	Modello energetico Modello gestione idrica Modello gestione ciclo materia Modello uso del suolo Biodiversità	Sensibilizzazione e riduzione della domanda	Servizi Residenza Mobilità urbana Spazio pubblico Attività Popolazione Economia Partecipazione	Abitabilità degli spazi urbani Sensibilizzazione Relazione individuo/ ambiente (rurale e urbano)

Tab.1 Relazione tra gli ambiti di incidenza delle minacce che possono affliggere un neoecosistema e i caratteri della resilienza.

Partendo quindi da quelli che sono i componenti essenziali del neoecosistema come ambiti generali, è stato costruito il pannello di indicatori, che ne valuta la capacità resiliente.

LA STRUTTURA FISICA
Il primo ambito considera le caratteristiche fisiche del sito, per comprendere se è presente una diversità di elementi adeguata a garantire la possibilità di adattamento a uno shock e/o perturbazione. L'analisi considera sia sugli elementi consolidati del tessuto che quelli invece adatti a nuove trasformazioni, riqualificazioni e rivitalizzazioni di aree non utilizzate (ex fabbriche, aree abbandonate, aree di espansione). Nello specifico sono stati individuati due sotto-ambiti di analisi: la struttura dell'edificato e degli spazi esterni

rispetto la capacità passiva legata alla morfologia del tessuto e all'occupazione del suolo, come specificato sotto.

Indicatore	Calcolo
A. Struttura edificato	
1. Aree non utilizzate	(aree non utilizzate/ tot. sup.)
2. Densità tessuto urbano	(vol. edificato/ tot sup.)
3. Densità abitanti	(abitanti/ tot sup.)
4. Tasso abitazioni libere	(abitazioni libere/ tot. abitazioni)
5. Fattore permeabilità suolo	(adimensionale) Σ (f_i * a_i) /A_t
6. Sup. spazio di relazione	(sup./ persona)
7. Densità alberi	(alberi/ ha tot.)
8. Densità delle strade	(lunghezza/ tot sup.)
9. Connettività	(inter. con. str./ tot. inter.)
10. Sup. per rigenerazione acqua	(sup. per rigenerazione/ sup. tot)
11. Sup. per gestione materia	(sup. per gestione/sup. tot)
B. Comportamento bioclimatico	
12. Fattore di forma	(sup. edificata/ vol. edificato)
13. Efficienza forma solare	(adim.) Σ (A_{ef}*S_f)/ A_{tot}
14. Efficienza forma vento	(adim.) $\Sigma(A_E*0,8+A_I*0,2)/A_{totI}$
15. Compattezza	(adim.) $V_t^{2/3}$/per*h+sup
16. Snellezza	(adim.) h/ $\sqrt{(S_o/\pi + h^2)}$
17. Porosità	(adim.) 0,094* $S^{3/2}$/ V_T
18. Addossamento	(adim.) S_{ad}/ S_{ad}+ S_{in}+ S_{pt}
18. Efficienza edificato	(edifici livello suff./ tot. edifici)
19. Car. bioclimatica strade	(% strade)
20. Proporzione delle strade	(% sup.)
21. Incidenza ombre nel contesto	(adim.)Σ [(A_{of} *s_f)/$A_{totSE/SO}$]
22. Incidenza protezione solare	(adim.) ΣA_i / A_{itot}
23. Incidenza vento invernale	(adim.) A_{pro}/ A_{est}
24. Incidenza vento estivo	(adim.) A_{est}- A_{pro}/ A_{est}

Tab.2 Indicatori relazionati al primo ambito: la struttura fisica

Come si vede nella tabella 2 un neoecosistema resiliente necessita una struttura compatta (3, 4, 5), dove sia possibile lavorare sulle aree inutilizzate (1, 2) per implementare una progettazione che abbia come obiettivo il miglioramento della biodiversità e la creazione di spazi adeguati e confortevoli di incontro e condivisione per la comunità. Dare quindi un valore nuovo a quelli che sono gli spazi di transizione e gli spazi aperti in quanto recettori di attività, relazioni, comunicazione e informazioni.

Dall'altra parte è stato posso l'accento sul comportamento bioclimatico del costruito, sia a scala di edificio e isolato (12-18) che a scala urbana (tessuto urbano) (19-24). Questo consente di individuare le fragilità all'interno del tessuto per orientare la pianificazione verso un miglioramento delle condizioni di partenza, che per un edificio potrebbe semplicemente dire un cambiamento di uso dei locali e per uno spazio esterno, una

progettazione del verde o una diversa organizzazione degli spazi di istanza e di transito in modo da utilizzare al meglio il soleggiamento e l'ombreggiamento e la ventilazione naturale dato dalla morfologia.
Infine, partendo dalle stesse considerazioni, è stato posto l'accento sulla relazione tra gli spazi edificati e pubblici, quali parchi, piazze, orti (6), come elementi di coesione, di relazione e condivisione da parte dell'individuo e della comunità
Quanto detto mostra un cambio di prospettiva rispetto la valutazione della sostenibilità. In questo senso la valutazione del controllo della crescita urbana è relazionata alla capacità ambientale considerata (1, 2, 3, 4) che significa non solo valutare la giusta densità per i flussi urbani, come nel modello sostenibile, ma anche e soprattutto fomentare la riqualificazione delle aree consolidate e non. In questo senso la gestione delle acque pluviali e marginali (10) e del ciclo della materia organica (11) diventa rilevante nel considerare i sistemi di rigenerazione naturale e che consentono la chiusura dei cicli di acqua e materia senza un'ulteriore perdita di energia (fitodepurazione, biodegradazione, rimozione di sostanza organica, stagni, orti urbani, raccolta porta a porta o altri tipi di raccolta dei rifiuti, corsi per il riuso si materiali per prodotti di artigianato, etc.).

I PROCESSI DI FUNZIONAMENTO
Il secondo ambito valuta i processi che nascono dalle interazioni tra il territorio e quindi la struttura fisica e le persone. Nei neoecosistemi esistono dei processi legati all'uso del capitale naturale, che a loro volta creano delle interazioni tra gli elementi fisici e le persone (complessità urbana). Inoltre risultano importanti, per il mantenimento di un buon livello di biodiversità all'interno del neoecosistema, tutti i processi di autogestione della flora e della fauna urbana, come si vede nella tabella sotto.

Indicatore	Calcolo
A. Metabolismo fisico	
1. Ciclo dell'acqua	(acqua rigenerata/ consumi tot.)
2. Ciclo dell'energia	(KWh rinnov. locali/ consumi tot.)
3. Ciclo dei rifiuti	(kg rifiuti ricic/kg riusati/tot)
4. Tasso prod. alimentaria locale	(cons. locale/ prod. attuale/ prod. tot.)
	(stili di vita/consumo loc./ prod. loc)
5. Modalità di spostamento	(n. con trasp. privato/ n.tot.)
6. Emissioni CO_2	(adim.) $\sum tCO_2$/tot.persone/365
7. Tasso produzione locale	(negozi prodotti locali/ tot. negozi)
8. Tasso uso materiali eco. /locali	(kg mat. eco-loc./ kg tot.)
B. Aspetti socio-economici	
9. Diversità urbana	(adim.) $\sum (P_i * \log^2 P_i)$
10. Densità attività associative	(n. attività associative/ n. tot.)
11. Occupazione locale	(n. persone impiegate loc./ tot. pers.)
12. Moneta locale	(moneta locale in circolazione/ tot.)
C. Biodiversità urbana	
13. Indice di diversità alberi	(adim.) $\sum P_i * \log^2 P_i$

14. Indice di funzionalità parchi	(dim.less)
15. Abbondanza di uccelli	(specie città/ specie provincia)

Tab.3 Indicatori relazionati al secondo ambito: i processi di funzionamento

La tabella 3 in particolare chiarifica il fatto che la scala di valutazione della resilienza sia quella locale, marcando l'importanza della consapevolezza da parte degli abitanti del proprio territorio e delle risorse dello stesso. Parlare di una crescita, uno sviluppo locale (senza o con limitata crescita) significa, infatti, pensare all'intersezione di diversi processi auto-sufficienti portati avanti da diverse culture, individui, soggetti economici e politici per un equilibrio dell'ecosistema.

In questo senso un aspetto rilevate è quello legato al metabolismo urbano dei cicli di materia (1, 3) ed energia (2), rispetto al quale risulta ancora più chiara la distinzione che facevamo nel primo paragrafo tra il concetto di efficienza e sufficienza. Primo passo per un metabolismo resiliente è la diminuzione dell'uso di risorse non necessarie, quindi la massima efficienza dei cicli e infine la eliminazione di rifiuti che non possano essere riutilizzati in altri, magari differenti, cicli produttivi. Il metabolismo sostenibile spesso spinge molto sull'efficienza dei cicli, dimenticandosi quanto sia importante il primo e l'ultimo passo. Questo è comprensibile, considerando che la diminuzione dell'uso di risorse, l'eliminazione dell'uso di materiali che non possono essere facilmente riciclati o riutilizzati e il riuso, riciclo dei rifiuti sono dinamiche che non possono essere controllate esclusivamente dall'alto, ma che comprendono un alto livello di partecipazione della comunità. Parlando di metabolismo urbano locale è necessario comprendere tutti i processi di produzione alimentare (4) e di oggetti di consumo (7, 8) e l'impatto di questi processi urbani sul livello d'inquinamento dell'ambiente (5, 6), dalla prime fasi di produzione alle ultime di vendita.

Pertanto un altro aspetto importante è l'implementazione della diversità delle attività comunitarie (9), l'incremento e il potenziamento dell'organizzazione e dell'autogestione comunitaria (10) e l'implementazione della gestione dei processi economici a livello locale e comunitario (11, 12). Allo stesso modo parlando però di biodiversità (13, 14, 15), diventa fondamentale il ruolo della fauna e della flora urbana, soprattutto legata alla possibilità che si possano mantenere all'interno del neoecosistema in modo autonomo, garantendo una mitigazione degli spazi esterni di relazione e la creazione di momenti di incontro e apprendimento per la popolazione (orti urbani).

L'INDIVIDUO

Infine l'ultimo ambito approfondisce un aspetto molto importante del neoecosistema, che è l'individuo, come parte di una comunità. Da una parte, infatti, si valuta la percezione di benessere dello stesso negli spazi esterni e la possibilità di accedere a un certo numero di attività e servizi differenti e dall'altra il livello di coesione. Questi elementi sottolineano la necessità che un neoecosistema resiliente sia in grado di garantire un adeguato livello di qualità di vita all'individuo e alla comunità che vi abita e che contribuisca a creare tale livello di benessere. Può sembrare un elemento secondario, se si considera la semplice definizione della resilienza come capacità di adattarsi, reagire e imparare in caso si trauma, in quanto è difficile vederlo come uno strumento concreto, come può essere l'orto urbano in caso di un trauma nella produzione alimentare.

Però, come abbiamo cercato di introdurre nel paragrafo precedente, nel rafforzamento (o creazione) di questa capacità, un posto rilevante lo copre il rapporto tra territorio e individuo e tra individui della stessa comunità.

Il primo è strettamente collegato alla "riscoperta" dell'uso di spazi pubblici esterni, spazi di transizione, di relazione. Questo significa lavorare per la qualità di questi spazi, da un punto di vista dell'abitabilità, e del riconoscimento del proprio territorio come un bene comune da comprendere tutelare e da cui imparare in modo da essere in grado di reagire in tempi brevi ai traumi che possono occorrere. La creazione di spazi

riconoscibili, sicuri, confortevoli e identitari consente anche di lavorare sui problemi di segregazione, vulnerabilità sociale e a tutti quegli aspetti collegati alla qualità della vita dell'individuo, come evidenziato nella tabella sottostante

Indicatore	Calcolo
A. Percezione della qualità degli spazi urbani	
1. Relazione tra pedone e auto	(% sup. viaria ped./% sup. carr.)
2. Comfort acustico	(m^2 con < 3dB/ m^2 tot.)
3. Comfort termico invernale	(m^2 con suff. Liv comfort/ m^2 tot.)
4. Comfort termico estivo	(m^2 con suff. Liv comfort/ m^2 tot.)
5. Comfort visivo	(m^2 con suff. Liv comfort/ m^2 tot.)
6. Esposizione a el. contaminanti	(pop. esposta/ pop. tot.)
7. Accessibilità	(m^2 con acc. suff. /m^2 tot.)
8. Percezione del verde urbano	(m^2 verde/ m^2 tot.)
9. Esposizione a rischi naturali	(pop. esposta/ pop. tot.)
10. Percezione di sicurezza	(pop. esposta/ pop. tot.)
11. Elementi identitari	(presenza di elementi identitari)
B. Accesso a servizi di base	
12. Servizi di base	(dotazione per tipologia/ dot. ottima)
13. Edilizia sociale	(edilizia sociale/ abitazioni tot.)
14. Prox. attività comunitarie	(popolazione coperta/ pop. tot)
15. Prox. spazi di relazione	(popolazione coperta/ pop. tot)
16. Prox. Vendita prodotti locali	(popolazione coperta/ pop. tot)
17. Prox. reti alternative	(popolazione coperta/ pop. tot)
18. Accesso a canali di informazione	(pop. con acces. suf./ pop. tot)
19. Livello politiche sensibilizzazione	(incentivi per tipo/ pop.)
20. Tasso riuso	(Kg materiali riusati/ kg. tot)
C. Coesione sociale	
21. Grado partecip. vita politica	(banda debole/ tot. pop.)
	(assoc. rappresnetative/ tot.)
22. Grado partecipazione attività	(pop. con part. suff./ tot.)
23. Tasso volontari	(n. volontari/ n. impiegati)
24. Capacità sociali	(n. giovani con cap. soc. suff. /tot.)
28. Popolazione per età	(adimensionale)
29. Popolazione straniera	(%)
30. Popolazione per genere	(%)
31. Pop. terzo grado studi	(%)
32. Tasso di istruzione insuff.	(adimensionale)
33. Indice di segregazione	(adimensionale)

Tab.4 Indicatori relazionati al terzo ambito: Gli individui

La tabella 4 mostra come la morfologia di un neoecosistema resiliente debba rispondere non solo ad aspetti di comfort, ma anche alle necessità psico-fisiche dell'individuo e a un buon livello di vitalità (Lynch, 1981), in quanto una persona ha bisogno di riconoscersi, vivere e muoversi nel proprio neoecosistema in modo facile.
Questo significa che, come il modello sostenibile, da una parte necessita spazi con microclimi che garantiscano il benessere dei fruitori (1-8), con una accessibilità (12, 13, 14) e prossimità (15, 16, 17) adeguata ai servizi di base e alle attività comunitarie. Dall'altra considera, come parte della qualità della vita, il raggiungimento di un livello adeguato di sicurezza (9,10), la presenza di elementi identitari (11) e un buon livello di sensibilizzazione da parte della comunità e dell'amministrazione pubblica (18, 19, 20)
Gli indicatori di mix sociale hanno una stretta relazione con la vulnerabilità sociale. Da una parte l'invecchiamento della popolazione (28) riduce la parte di popolazione produttiva e aumenta la percentuale di popolazione dipendente, dall'altra il problema della segregazione culturale, religiosa, di età e di genere (29, 30, 31, 32, 33) ha bisogno di un intervento sociale per prevenire eventi di esclusione ed emarginazione. Oltre a queste problematiche, sviluppate anche dal modello sostenibile, sono introdotte quelle delle partecipazione della comunità e della capacità sociale. Come spiegato in precedenza, infatti, il livello di partecipazione alla vita politica della comunità (21, 22) aiuta a creare o potenziare la consapevolezza delle problematiche e delle potenzialità del proprio territorio a livello individuale e comunitario (23).

4 CONCLUSIONI

L'approfondimento ha voluto evidenziare i caratteri essenziali e peculiari del neoecosistema resiliente, ponendo in evidenza il fatto che il concetto di resilienza non è legato esclusivamente al mantenimento (per le generazioni presenti e future) delle risorse naturali, come quello di sostenibilità, ma anche alla trasmissione di tali risorse. Ciò significa che un neoecosistema resiliente può perdere risorse naturali, acquisendo però la capacità di compensarle con altre in grado di compiere le stesse funzioni.
Questo mostra la necessità di attuare un passaggio dal concetto di sostenibilità, oggi per lo più legato all'immagine di modello efficiente, a quello di resilienza urbana, strettamente connesso al concetto di sufficienza e quindi di capacità limite. Infatti, un neoecosistema resiliente soddisfa i caratteri di sostenibilità espressi nell'obiettivo di mantenere il capitale naturale nel tempo. Partendo da questo è necessario però fare un passo ulteriore: valutare e incrementare i caratteri di modularità, diversità e retroattività de neoecosistema, che gli consentano di reagire, adattarsi e apprendere di fronte ad un'alterazione.

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FONTI DELLE IMMAGINI

Fig. prima pagina: Decorazione di un muro dell'orto Xino, Barcellona. Fonte: Francesco Scognamiglio e Anna De Nicola

Fig. 1: Salvador Rueda (2012), El urbanismo Ecológico, Agència d'Ecologia Urbana de Barcelona, Barcelona

Tabb. 1, 2, 3, 4: Rielaborazione propria

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TeMA
Journal of
Land Use, Mobility and Environment

TeMA 2 (2012) 131-146
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: 10.6092/1970-9870/911

review paper. received 6 June 2012, accepted 19 July 2012

www.tema.unina.it

SPATIAL RESILIENCE OF OUTDOOR DOMESTIC SPACE IN MOZAMBIQUE

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ABSTRACT

Historically, the people of Mozambique have faced oppression and social spatial segregation and responded in a way that has reinforced rather than dismantled their traditional values. Since pre-colonial times, the population's strategy for escaping from environmental and foreign political disruption has been to reinvent tradition, based on the principles of resilience, resistance and self-reliance. The development of decentralised human settlements, involving the appropriation of land for domestic space and the self-organisation of neighbourhoods, were strategies to protect communities from adversity and secure collective self-reliance.

Following Mozambique's conversion to globalization, the post-colonial 'cement city' is now the core of neo-liberalism, as a node of the global economy, where foreign donors and international market economy control national political economy, exacerbating the premise of the negation of self-sufficiency that continues to evolve resiliently at its margins. The adoption of a neo-liberal model of development during the 1990s, completely bypasses the realities of Mozambican society. This paper argues that the strategy of self-production of space regarding the household/Outdoor Domestic Space unit, which existed previously as a resistance strategy, first of all against colonialism and secondly, against the statist definition of socialism, thirdly, has become a successful strategy for survival, as the building block of the decentralised Agrocity, in the face of a global economy which totally neglects both the people and the land.

KEYWORDS:
Outdoor Domestic Space; Urban Resilience; Political Ecology; Decentralised Urbanisation; Mozambique

1 SPATIAL RESILIENCE, RESISTANCE AND SELF-RELIANCE: THE HISTORICAL LEGACY

The city is both a spatial product of civilisation and a spatial product of nature in the sense that man is part of nature's processes. Moving away from the conventional argument that population growth and urban sprawl are a source of multiple problems, the notion of 'city' in this paper emphasises a symbiotic social connection with nature. The decentralised and resilient nature of the case study provides evidence that the informal city can play a vital role in ecological development by contributing towards local economic growth, ecological improvement, adaptation to climate change, enhanced social identity and individual self-esteem, mitigation of urban poverty, ecosystems and conservation of resources, amongst other factors. The collective decentralised practices of the dominant Mozambique cityscape prove that the city itself is central to creating opportunities both for human development and natural regeneration, which generate benefits beyond municipal boundaries. As a result, a city that expands by self-regenerating its own growing natural ecosystem not only improves the quality of the urban environment but also reduces human pressure on natural resources in peri-urban areas.

Historically, the people of Mozambique have faced oppression and social spatial segregation and responded in a way that has reinforced rather than dismantled their traditional values. Since pre-colonial times, the population's strategy for escaping from environmental and foreign political disruption has been to reinterpret and reinvent tradition, based on the principles of resilience, resistance and self-reliance. The spatial resistance and resilience expressed through the development of decentralised human settlements, involving the appropriation of land for domestic space and the self-organisation of neighbourhoods, were strategies designed to protect the population from successive adversities. During colonial oppression, they were used to counter discrimination, forced labour and taxation, and later, as a reaction to and a rejection of the post-independence Frelimo militarist national development agenda, and recently to halt the Guebuza government's increasingly intolerable food and energy prices[1]. Following this tradition of popular spatial insurgency and the post-independence urban boom, the Mozambican city has gained more substance and autonomy to enable itself to create the conditions for urban survival and improved welfare in times of hardship.

The future of Mozambique's urbanisation would benefit from acknowledging and reinforcing the potential developed by people living in informal neighbourhoods, which has proved more advanced and effective than neo-colonial planning approaches as a means of effectively meeting the real needs of the population and helping them deal with urban challenges. The existing ODS practices found in the case study of Dondo are considered crucial to the emergence of an alternative urban development paradigm based on self-organised urban space. The extent to which ODS is shaping a ruralised urban form challenges the imported post-modern urbanism top-down approaches to the relationship between the expanding informal city, the growing urban population and the deteriorating environment which, instead of improving urban life, exacerbate social inequality, spatial segregation and urban poverty. Based on this scenario, in which the vast majority of the urban population rely on family subsistence production using ODS, I suggest that through awareness, recognition and collaborative processes, the spontaneous urban expansion of informal settlements arising from spatial resistance, resilience and self-reliance, contributes not only to a legitimate and more sustainable form of urban development but also to a positive environmental change through which society recreates itself in a way that effectively builds a sustainable living environment.

[1] This refers to the 1-2 Sept. 2010 'Maputo Food Riots'.

What is initially a social response to crisis inherently becomes a response to environmental challenges too, if the balance between humanity and nature is precondition for survival, although this response may not always improve the environment at all or may even make it worse[2]. Nevertheless, the evidence from this research still reinforces the argument of recent literature that self-organising social systems are very efficient (Allen, 1997). Through resilience, decentralised urban space not only has the ability to return to its previous equilibrium in the face of shocks, but can also reinvent a new state of equilibrium. Continued crises in Mozambique have made social systems resilient enough on a basic survival level. Yet, during this process they have gone one step further to move beyond simple survival and create a new dynamic form of equilibrium that is ready to respond to present and future challenges, gradually moving towards a new kind of equilibrium in the relationship between humanity and nature.

2 THE PRE-CAPITALIST DOMESTIC SETTLEMENT'S SYMBIOTIC RELATION WITH NATURE

The Great Zimbabwe State was a very hierarchical society that prospered from domestic and collective cultivation of land, mining and trade of surplus with foreigners on the coast of Mozambique. Over about 1,000 years the state developed to reach a peak population of 35,000 to 40,000 inhabitants before it was abandoned in AD 1500 (Rita-Ferreira, 1999). The decline of the Great Zimbabwe State was apparently caused by environmental constraints associated with overexploitation of the surrounding resources and the tsetse fly, which collapsed the fragile political and social balance (Garlake, 1973). More aware of urbanisation, the impact of cultivation on resources and the effects of successive floods and droughts on urbanisation, the Monomotapa State learned lessons and minimised these effects by establishing itself in the region through a network of settlements instead of a single larger one, and by relying on intercropping collective farms combined with hunting, cattle raising, mining and trade activities. The possible reasons for the decline of the Monomotapa State are not related to the environment itself, but to socio-economic and political factors in which the Portuguese played a decisive role[3]. Although it was a highly centralised state it proved resilient to a certain extent, notwithstanding the predatory actions of foreign intrusion. Within this segregated settlement structures, the community at the base coexisted through highly resilient self-organisation to secure livelihoods in the face of imposed hardship (Newitt, 1987). Away from the Monomotapa regime, there were dispersed family kinship-based societies that lived from subsistence agriculture and cattle raising. The traditional swidden agriculture of the small family communities scattered around the territory was not environmentally disruptive but in those days was actually quite evocative of a close knowledge of nature's living systems. Through spatial resilience and resistance, this innate symbiotic relation with nature has endured until today in the marginalised neighbourhoods of the Mozambican dualistic city.

[2] In the case of Lagos, the use of self organisation and adaptation to solve the problem of waste by creating artificial islands resulted income source from waste recycling but in the pollution of the lagoon and damage to the entire ecosystem ('Welcome to Lagos', BBC, 2010)

[3] Rita-Ferreira (1999) considers that the great transformations that occurred during the pre-colonial period in the present-day territory of Mozambique were the result of (a) environmental factors – soils, rainy seasons, droughts, vegetation, diseases, etc.; (b) the introduction of American and Asian edible plants; (c) contact with foreign cultures through trade; and (d) migration flows caused by economic and demographic factors.

3 ECOLOGICAL TRANSFORMATION OF URBANISATION UNDER CHANGING REGIMES

3.1. COLONIALISM

The process of land alienation and occupation firstly through the *feiras*[4], then the *prazo*-system[5] and later the International Charter Companies involved the uncontrolled use of land, people and resources, and inaugurated a period of massive exploitation through subversive practices. Firstly, the colonial cities and towns created urban environmental health problems in the neighbourhoods, given the sudden high population concentration and lack of sanitation, inadequate water supply and lack of waste management. Later, and gradually, knowing they could only rely on themselves, the communities in the 'reeds' neighbourhoods were forced to organise in a way that enabled them to be as resistant and self reliant as possible, by reinventing traditional knowledge[6].

3.2. POST-INDEPENDENCE

The post-independence nationalisation of land, the departure of Portuguese residents and the destabilization war with Renamo led to a very accelerated rate of urban growth from a massive rural exodus to the cities and towns of Mozambique, which led to a dramatic deterioration in urban environmental health conditions and put pressure on the surrounding land resources (Raposo, 1988). Frelimo's rural development policies of extensive and intensive collective state farming and nationalisation and collective lifestyles in the Communal Villages developed a form of socialism which in practice was closer to a form of collectivism. The State Farms led to the deterioration of the environment and the impoverishment of the population in rural areas. Since the official rural development programme was insufficient to feed the cities and was seriously compromised by the pressure from the Renamo forces attacking from the countryside and destroying the linking infrastructures, the peripheral resources rapidly became depleted. The growing economic and general paralysis during the war years spread hunger to both rural and urban areas, leading to the continuation of urban farming, both in the neighbourhoods and the 'cement city' (Sheldon, 1999). A series of floods and long droughts increased the already severe impoverishment of the population at national level due to internal and external factors, creating stagnation in agriculture and urban collapse. This gave rise to collective and resilient forms of self-organisation.

4 THE POLITICAL ECOLOGY OF SPATIAL RESILIENCE

Outdoor Domestic Space is a multifaceted space that refers to the external space surrounding the built house and which, in the case of Mozambique, is where daily life takes place, involving strong social, ecological and productive functions. Under successive periods of political economy oppression and environmental adversity, the Outdoor Domestic Space has been adapted and refined to ensure collective self-reliance. Shaping a green and ruralised urbanisation at the margins of the Mozambican post-colonial

[4] Portuguese word for "market" or "fair". Feiras were trade centres built temporarily and distributed into inner land along the rivers for dissemination of Portuguese trade seeking land and trade dominance which was reinforced by the Portuguese Jesuits in the 16th century.

[5] *Prazo, Emprazamento* or *Terras da Corôa* was the first Portuguese colonization strategy in Africa in the 16th century and consisted in the lease of large land areas in the Zambezi river valley to Portuguese and Goan colonizers under a semi-feudal estates system.

[6] E.g. since the men's wages were inadequate and women were not absorbed into the labour market, urban farming by women became widespread in the neighbourhoods' ODSs and open spaces within the city (Sheldon, 2003 and Guedes, 1971).

dualistic city, which I call the Agrocity, the Outdoor Domestic Space is resilient because it is able to adjust domestic space as a strategy to secure livelihoods, provide urban food, commerce and services, maintain vital kinship relationships and produce a comfortable and clean microclimate across the spontaneous neighbourhoods (see Figure 1). This spatial resilience is the feature underlying the self-organisation of neighbourhoods with a new way of overcoming alienation from nature, which suggest the continuance of an innate relationship between society, the human habitat and nature.

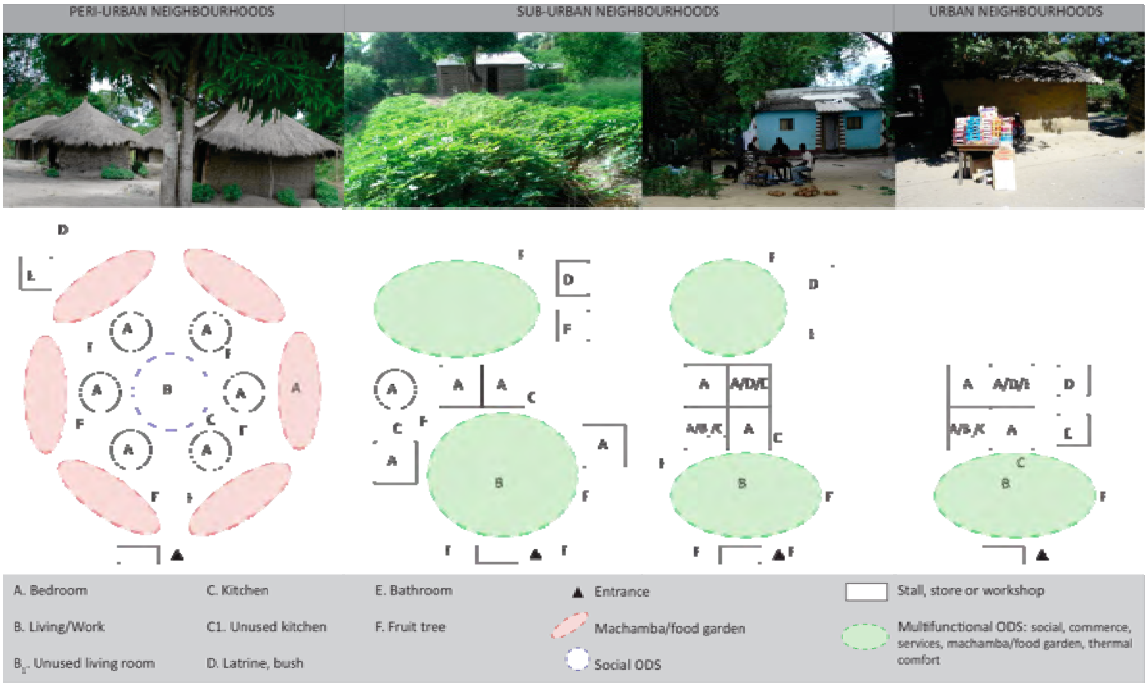

Fig. 1: Outdoor Domestic Space transformation and livelihoods self-organisation in the spontaneous neighbourhoods of Dondo Municipality

Outdoor Domestic Space is considered here as the individual building block or cell unit in the wider whole, the Agrocity, whose definition is explored in terms of the details of the larger operative system, its dynamics and overall implications (socio-cultural, economic, ecological and institutional). The cell is resilient and incorporates both modern and traditional knowledge, providing the basis for the resilience of the wider system – the human habitat - to shocks. Historically, the human habitat, as a space for production and human concentration, has been viewed as a source of conflict, reaching its peak during capitalism. In contrast, this case study demonstrates that other forms of human settlement and production are possible – the use of ODS, the production process and the neighbourhood self organisation are themselves expressions of the material-energy exchange in the relationship between society and nature. The Agrocity dissipates social differentiation and power relations, promoting inclusion through collaborative networking. I analyze the Agrocity metabolism as a self-regulatory system (Lovelock 1979, Girardet 1996) both separate and derived from technocratic post-Modernist (colonial and neo-colonial) urban models connected to wider processes of political and economic historical change.

Following its failures during the post-independence period and rejecting oppression from either left or right wing authoritarian regimes, socialism in Mozambique is now reinventing itself from below in a more genuine and legitimate fashion with apparently greater chances of success. Likewise, the current global political and

economic crisis, peaking oil and climate change resulting from the ongoing breakdown of the capitalist system are creating the opportunity for revolutionary change.

4.1. RESILIENCE OF THE HOUSE UNIT

It has been reported that in pre-colonial cities, the home also served as a workplace (see Figures 2 and 3) and a gateway to the outside world (O'Connor, 1983). An analysis of the evolution of the Mozambican house from the traditional *muti*[7] to the agro and business-based ODS in the neighbourhoods of Dondo, reveals how significantly outdoors domestic life has been adapted into a survival and production tool. Traditional domestic space strategically becomes a productive advantage by providing shelter, food and income based on creatively adapting ancient family economic traditions that favour kinship, networking, diversity and flexibility. Whilst the built house has undergone several changes in terms of quantity, size, technology and style to keep pace with constantly changing challenges, the ODS has become even more important in daily life than in the past.

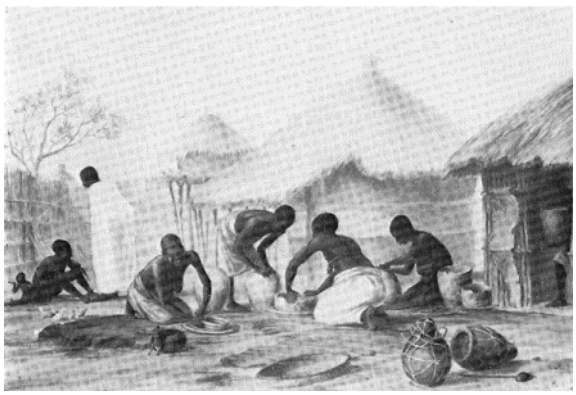

Fig. 2 and 3: Spinning, pottery manufacture (left); and Outdoor domestic production and making pots (right)

With the massive exodus of rural people escaping Renamo attacks in the countryside, informal settlements spread from the city centres outwards and became vast and densely populated, requiring rapid adaptation to urban conditions, such as the lack of space for the traditional large domestic area. On arrival in the city, temporary shelters were built using traditional materials such as reed or recycled city waste materials until a more permanent wattle and daub, cement block and corrugated zinc, or wood and corrugated zinc house could be built (Guedes, 1971). Although space was scarce and the plots closer to the central services in the 'cement city' were much smaller than those in the villages, when food became scarce, urban cultivation on any available piece of land, even roof terraces and balconies, proliferated (Guedes, 1971). This settlement pattern endured as a reaction to the poor urban food supply, food prices and urban poverty, given that high unemployment rates reinforced the self-organisation of the traditional subsistence family economy practiced by most of the Mozambican urban population to ensure subsistence in many innovative ways.

Facing the phenomena of gradual modernisation, the house type, materials, technology and use of space as well as livelihoods, community organisation and management of natural resources have been subject to a

[7] A large domestic settlement or hamlet of several house units large enough to be small villages. The muti reflect forms of life and production in harmony with its natural surroundings: location, space use, building technologies and materials, forms of production and use of near resources are based on subsistence family-based production.

process of self transformation and rediscovery. This is the result of a set of changing factors, including: (a) growing modernised tastes, due to many foreign influences through history, urban migration, media and proximity to modern house models; (b) a general desire for 'Western-style progress' directly associated with the stigma traditionally equated with backwardness; (c) increased purchasing power to build costly modern houses and buy large modern items of furniture; (d) less time (and will) to collect natural materials and carry out traditional house maintenance due to changing lifestyles; (e) the scarcity of natural building materials in the city and their rising prices on the urban markets, together with the abundance of recycled or gradually more affordable industrial building materials; and (f) the fact that houses with right angles are easily built and are more adaptable to different building materials and technologies, (and to modern furniture) leading to the gradual replacement of the traditional circular *maticado* Mozambican house with a quadrangular or rectangular design (Bruschi et al. 2005, Raposo 1988, Veríssimo 2010). However, this 'modernisation' is more obvious in Maputo than in the rest of the national cityscape, which is composed of medium and small cities where, according to fieldwork and statistical data, the prevailing built environment and skyline in the neighbourhoods apparently remains traditionally built and green (see Figure 4) (INE, 2007).

Fig. 4: Bare and plastered maticado houses (left); and decorated wall in earthen plaster 'matope' with corrugated zinc roof (right)

People living in the informal settlements in Mozambique are as poor as urban residents in the poorest cities in the world and also lack adequate infrastructures and services to ensure proper standards of urban life. However, excluding the denser cities like Maputo and Matola metropolitan area and Beira, in medium-sized cities of Mozambique such as Dondo there may be neighbourhoods without a 'slum' environment, since they feel surprisingly like intimate, cosy ruralised cities, apparently resultant from adapting the family subsistence agriculture tradition to the urban context. Therefore, I find it more appropriate to call these informal settlements as 'neighbourhoods' rather than as 'squatter settlements', 'slums' or even 'low-income settlements', mainly because (1) houses are traditionally adapted to the local climate and are environmentally friendly, comfortable and relatively well maintained because they are a means of livelihood security and the greatest asset people have; (2) the few but gradually increasing cement houses seem to deteriorate more rapidly because the finishings and maintenance are expensive, meaning that they are usually left unfinished, and also require costly materials and skilled labour; (3) abundant vegetation and trees grow throughout the neighbourhoods providing shade and a good, cool environment; (4) large plots for domestic farming reduce the density of the conventional urban built environment, improving the urban atmosphere. In denser residential areas that show early signs of overcrowding and neighbourhoods with

factories obviously have poorer environmental conditions. These factories in Dondo are, on the one hand, a negative presence imposed on the neighbourhoods' residents and, on the other hand, a source of opportunities, i.e. jobs, cheap access to materials and useful waste (e.g. wood, sawdust, cement and asbestos plates that are used as building materials and for crafts, furniture, cheap domestic fuel, etc). However, the self-organised urban community management tries to minimise their negative effects with vegetation and tree planting, street cleaning, maintenance of open drains, improvised bridges over drains, buffer areas and so forth (Veríssimo, 2010).

The levels of ODS transformation also depends on the varying intensity of the following two variables: the scarcity of the natural resource base and access to alternative building materials. Scarce and overpriced traditional building materials increase the vulnerability of minority social groups such as the disabled, the elderly, widows and the poorest households, who face greater difficulty in carrying out necessary regular maintenance work on the house which would otherwise collapse after being exposed to the elements for a certain period of time, especially during rainy season. In more densely populated cities such as Maputo or Beira, away from bush areas, the poorest in the population manage to build their houses from waste materials, although these are equally unstable and unhealthy, whilst others buy cheap recycled and new materials such as flattened paraffin tins, corrugated zinc and asbestos plates, to build more permanent houses (INE, 2007). As long as there are regenerative ways of maintaining a local supply of natural materials within the neighbourhoods without compromising resources in peri-urban areas, and some households can still afford and are interested in 'upgraded housing'[8], the majority of the urban population will continue to build and live in an ecologically safe built environment. If the natural resource base is preserved in peri-urban areas and reproduced in urban areas in a way that ensures positive natural regeneration levels, its products may be available sustainably to all. The continuation or even optimisation of affordable and self-built construction technology may improve the self-reliance, security and well-being of urban communities. This could also accumulate environmental and health benefits through the use of lightweight natural materials which, in addition to being naturally degradable, have a low thermal mass, hold in little heat and cool easily at night. In contrast, zinc and asbestos roofing, cement blocks and concrete are heat conductors, do not cool down easily and are highly carcinogenic. There is a local perception that, for the reasons stated above, houses built using modern materials represent a superior and more dignified standard of living and that traditionally built houses therefore imply a 'poor' standard that people aim to reject, even if superficially[9]. It is necessary to find ways to reaffirm not only the cultural but the overall validity of natural traditional materials, so that they are appreciated and preserved instead of being viewed as a sign of poverty or backwardness. Despite the assumption that housing in informal settlements are always built with recycled or new modern materials, this case study demonstrates that spontaneous neighbourhoods may renew themselves by making use of traditional building technology using natural materials in a sustainable manner.

Whatever direction the house in the neighbourhoods of cities in Mozambique may take in the future, field findings indicate that the traditional use of Outdoor Domestic Space might continue to evolve as a productive tool to ensure secure livelihoods based on agriculture, commerce and services (see Table 1). Findings suggest that the factors encouraging the growing productive use of ODS include: (1) the legacy of pre-

[8] An 'upgraded house' is locally perceived as a more durable house structure built with cement and concrete structures and a zinc or asbestos roof, that usually remains unfinished, leading to a number of building pathologies that are commonly associated with malaria and air-borne diseases.

[9] According to fieldwork, this 'house upgrading' does not involve improvements regarding sanitation, space, ventilation or any other factors that might improve comfort and well-being.

NEIGHBOURHOODS	*Exclusive (sole) source of ..*		*Complementary (significant) source of ..*		*Supplementary (back up) source of ..*		*Only as a source of fruit and not a source of income*	
	Food	Income	Food	Income	Food	Income	Food	Income
NHAMAYABWE 32 households	-	26	12	3	12	-	7	-
MAFARINHA 25 households	-	19	8	4	6	-	11	1
THUNDANE 3 households	1	-	2	3	-	-	2	-
TOTAL 60 households	1	45	22	10	18	-	18	1

Tab.1: Households Dependency Level on ODS for Livelihoods: food security and income

colonial agro-based cities based on family relations and mutual aid - household and community self-organisation; (2) colonial social spatial segregation which enforced the continuation and adaptation of decentralised traditional forms of housing, use of space and an agro-based family subsistence economy; (3) the present restricted opportunities for wage-earning, which have led to the updating of new self-organised family income strategies; (4) medium-sized cities and low-density urban growth patterns which allow for spacious house plots that facilitate urban domestic farming and family businesses, as well as environmentally regenerative urban community self management; (5) the innate connection with nature due to the population's continuing high dependence on a natural resource base and the knowledge of ecological systems from uninterrupted agro-based experience; (6) the legacy of domestic urban food production dating from pre-colonial and colonial urbanisation: cultivation on domestic terraces in the Monomotapa cities and the domestic cultivated ODS of colonial and post-independence neighbourhoods due to the poor urban food supply, many food crises, natural disasters, unemployment and very low wages.

Colonially imposed land alienation, forced labour, abusive taxation, displacement of people and racially discriminatory laws led the population to settle in scattered remote areas as the only means of escaping oppression. Later, with industrialisation from the 1950s onwards, the reverse shift towards the city gradually increased, marking the earliest stage in the 'reed' city neighbourhoods and the emergence of dualistic urbanisation in Mozambique.

4.2. RESILIENCE TO NATURAL DISASTER AND CLIMATE CHANGE

The variable climate, involving periods of heavy rain followed by periods of drought, is a natural phenomenon in Mozambique. Since the hunter-gatherer and agro-pastoral societies of pre-colonial times, people have learned to cope with nature's lifecycles and the severity of extreme weather conditions by intercropping combined with flexible and diverse production modes. These were used extensively in the Monomotapa State, and nomadically in the pre-capitalist agro-based family domestic settlements. The transformation to a state and market system did not prevent the majority of the population, as in Dondo for example, from resorting to their ancient knowledge of natural living systems to adapt to new scenarios – domestic farming combined with urban-based income strategies through a modified use of Outdoor Domestic Space and modes of production based on flexibility and diversity.

Nevertheless, current levels of climate variability have become more extreme, increasing the population's vulnerability to floods, drought and heat waves and undermining their ability to adapt in order to deal with the growing impact. Although Africa is the continent with the lowest ozone depleting gas emissions, it is highly prone to the actions of climate change (Boko et al. 2007, African Development Bank 2007). According to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, (1) agriculture production and food security are severely threatened by climate change, with small-scale producers being the worst affected; (2) climate change is also expected to increase pressure on water availability and quality; (3) several ecosystems are changing at a faster rate than expected, particularly in Southern Africa; (4) the rise in sea level creates larger flood-prone areas in low-lying land, therefore increasing the socio-economic and physical vulnerability of cities, particularly in East African coastal areas; (5) disease vectors are changing – the spatial and temporal transmission of malaria, dengue fever, meningitis, cholera and diseases caused by climate change undermine human health (African Development Bank 2007).

In Mozambique the important agricultural sector is affected by the climate, involving major economic impacts, whilst the dependence of the population on natural resources and agriculture, the general poverty, poor infrastructures, low capital, limited municipal resources and environmental degradation are also factors that increase the country's vulnerability to climate change. This is the reason why attention must be paid to emergent resilient sustainable practices, since they are better equipped to deal with severe and unexpected catastrophes.

5 SUSTAINABLE URBAN METABOLISM

The urban metabolism approach involves the creation of cycles, or loops, in the system to enable the footprint and waste of the city to be reduced by addressing aspects of the city perceived as hazardous. Obviously, in terms of livelihoods, the population essentially concentrates its efforts on protection against those hazards. However, since the urban metabolism can be approached from a top-down or bottom-up manner, there are, on the one hand, the centrally planned, highly technocentric 'ecocities' driven by neoliberal centralised control systems, such as the Tangshan Caofeidian in China and Masdar Abu Dhabi in the United Arab Emirates (Joss, 2010). On the other hand, the emergent decentralised cities developed by the people to ensure the security, survival and progress of the community, such as Dondo. The technocentric top-down approach does not cope effectively with the problems associated with urban degradation because it cannot be widely distributed and transplanted. The only way it can be effective is through a decentralised system which is more resilient to shocks and is self regenerative[10], as in Dondo where the indigenous improvised system reacts to the partial collapse of the central system by reconstituting itself from its individual cell, whereas in the central approach[11] if the centre collapses, the whole system falls apart.

The resilience of the metabolism is what enables the Agrocity to adapt to new adverse scenarios. It is a metabolism which evolves like a living organism with properties, components and dynamic relationships. However, the emergent properties of the Agrocity cannot be fully deduced from the individual cell, the

[10] As in the starfish model, a metaphor for decentralised systems, in which, like a starfish the decentralised open system has no head, i.e. no ruler or central intelligence, which instead is spread throughout the system. When cut, it replicates itself in each limb, i.e. the system is self regenerated (Brafman and Beckstrom, 2006).

[11] According to Barfman and Beckstrom, the centralised system is the spider which has a central body with legs - when the head is cut off it dies (Ibid., 2006).

household-ODS, because it is not self-contained and interacts dynamically with other components. The urban metabolism of the Agrocity may be defined as a fluid, complex and dynamic framework that is self-organised on the principles of resilience, resistance and self reliance, and is sustainable because its functioning implies the creation of feedback loops in which products are no longer waste, but energy for the self-regenerating living system. These feedback loops may be negative, causing entropy of the system, visible in the form of environmental hazards[12], or positive, when hazards are converted into energy by the metabolism.

Usually, and partly in the case of Dondo, the environmental transformation to which cities are exposed is related to uncontrolled industrial waste in residential areas, and capitalist exploitation of natural resources such as the intensive cut down of trees by the forestry industry, which may generate environmental problems related to (a) consumption of resources that changes the natural surroundings and endangers the population's natural resource base, and (b) the production of waste in the form of pollution that affects all life forms. This affects local food security and welfare, since livelihoods are highly reliant on land resources for food, fuel and materials. Likewise, people are usually either forced to consider settling in more remote and better-preserved natural areas or moving further into the urban neighbourhoods for waged work. Lacking infrastructures, and being close to factories and other hazardous locations produce environmental problems inside the neighbourhoods that threat human welfare. Common features of denser neighbourhood environments may easily lead to the following problems: (a) the spread of biological pathogens (air, water, food, soil, animals, insects or other disease vectors and carriers); (b) contact with chemical pollutants (unmanaged toxic industrial waste, poor sanitation, and open fires); (c) the absence of scarce and distant hazards such as fires, floods and drought (Hardoy et al., 2001). Yet, the population living in the neighbourhoods of the Agrocity, in the real case of Dondo and also as a hypothesis, are less vulnerable to

Fig. 5: Thermal comfort, environmental upgrading and food security. Top from left to right: Trees and greenery provide a healthy urban environment and minimize lacking infrastructure; Streets are safe and pleasant places for playing, strolling, rest and chat; Primary school teacher cycles back home. Bottom: fruit and shade trees, food growing and poultry at the ODS.

[12] Environmental hazards are associated with degradation of the rural environment and urban environmental problems, with impacts o human health, the natural resource base, local ecosystems and global life-support systems. Although this threatens the majority of urban livelihoods, the system is able to cope with adversity by reducing its impacts.

Fig. 6: Self-organising resilient and autonomous livelihoods. Top from left to right: This household sells sodas, cell phone credit and SIM cards, the husband is a prophet and traditional healer at their ODS; A carpenter works from his ODS where he raises goats, chickens and also cultivates cassava and fruit trees; A movie and TV 'saloon' charging entrance at ODS. Bottom from left to right: A carpenter displays his work at his door front while accross the street someone sells cooking oil; door front stalls (cell phone credit and snacks) under a shade are a great place for gathering; Domestic grocery stall at ODS facing street; Selling building materials and used steel pieces for melting at door front facing busy street.

Fig. 7: Urban inclusion, security and community urban management. Top from left to right: Chatting on the way to work in the neighbourhoods; Children play freely in the neighbourhood's streets along with neighbours chatting; Teaching her daughter a new hair style under a mango tree shade while drinking lemonade at their ODS. Bottom: Streets are collectively maintained clean.

these impacts because they collectively manage domestic waste, sanitation, street cleaning, and drains maintenance, as well as planting dense vegetation in the Outdoor Domestic Space to produce food, income, fresh air and a pleasant environment in an attempt to minimise the negative impacts of being poorly served with basic infrastructures (see Figure 5). The neighbourhood community is also self organised at Outdoor Domestic Space level to provide urban normal amenities and services such as health care, child care, public safety, religion, hostels, taverns, nightclubs, cinema, carpentry, groceries, etc, for the population, as in any other ordinary city driving social inclusion and a sense of local identity and community (see Figures 6 and 7). When a negative feedback loop occurs in the urban metabolism, caused by environmental or political and economic pressures, the communities in rural areas, local ecosystems and natural resources become affected by (a) greater urban dependency on the natural land in peri-urban areas for food, fuel and building

	OUTDOOR DOMESTIC SPACE (ODS)	AGROCITY
Social	. Individual and collective satisfaction and improved self-esteem . Poverty alleviation . Health upgrading . Integration of vulnerable groups through domestic work, social and business networking, kinship relations and economic participation . Self-employment . Safety and security in food and fuel production (household-community-city) . Recreational and educational farming	. Urban communities food and fuel security . Food sovereignty from sustainable urban farming . Security of livelihoods and social inclusion . Safe, productive and sustainable urban growth
Economic	. Generation of household cash income . Negotiated municipal taxation . Encouragement of entrepreneurship and urban work . Participation in economic system through commerce and services provision . Food supplier to city food system . Reduced need for imported food . Contribute to macro-economic development	. City food supply . Participation in local economy . Informal markets growth . Household income and entrepreneurship
Political	. Improved level of infrastructure and services provision . Participatory urban policies and plans . Partnership for urban environmental management . Information and support to minimize health risks from ODS . Micro-credit support	. Support, partnerships and community engagement in collaborative governance
Ecological	. Urban farming and biodiversity productivity . Waste composting . Natural pest control . Small energy emissions . Reuse of solid waste for composting and water for irrigation . Direct positive impact from the house space . Greening improve micro climate conditions . Improved soil nutrient cycling . Conservation of soil, water, biodiversity and landscape . Flood control . Low energy intensity food and other produced products . Energy conservation involved in conventional market food (transport, cooling and packaging) . Reduced interest in harvesting natural resources . Reduced need to cultivate in forest areas . Urban income reduce pressure on resources . Preservation of natural habitats and biodiversity . Continuation of cultural traditions	. City production of natural resource base . City management of waste . Richer urban ecosystems . Reduced urban waste and pollution . Improved public health . Protection of peri-urban areas (forest, waterbeds, farmland, etc) . Resource base conservation by local reproduction

Tab. 2: Socio-Economic, Political and Ecological Potential Characteristics of ODS-AGROCITY Closed Metabolism

materials; (b) intensive extraction of raw materials for local industry; (c) rapid urban sprawl; and (d) increased urban waste. Given that the Agrocity is an urban metabolism that 'mimics' nature in the sense that it is part of it, it is therefore supposed to integrate into its cycles and processes in a mutually beneficial manner. When exposed to entropy within the system, the resilient property of the metabolism enables the Agrocity to reverse the damaging effects and regenerate its living systems by a positive feedback loop to ensure that life is preserved. Today, the food consumed in Dondo is largely produced inside the neighbourhoods, which benefits the natural ecosystems through clearance for cultivation purposes, although the urban food supply is still partly dependent on rural production and imported products.

The devastation caused by the forestry industry and the increasing scarcity of firewood near the neighbourhoods implies travelling further for collection and charcoal production, rising market prices, rural people driven further away to better-preserved areas and greater deforestation and soil erosion. Natural resources are fundamental to commercial and subsistence activities and their degradation compromises the majority of the population's welfare and their capacity to become involved in local economic development. Therefore, the system has to be autonomous. The urban system in Dondo has been responding positively by increasing urban food production in the ODS and open spaces within the neighbourhoods developed in an environmentally safe way, as well as planting trees and vegetation, not only for a clean and comfortable environment but also for fuel and building materials, which are available sustainably, to increase local self-reliance. The availability of bamboo, wood, reed, thatch and clay inside the neighbourhoods allows residents to continue building resistant, comfortable, low-input, traditional housing that is adapted to the climate, in pleasant neighbourhoods that are also close to the formal services in the 'cement city' (see Table 1). If this could be intensified, the regenerative capacity of the urban metabolism could improve life both for society and nature.

6 THE RESILIENT AGROCITY METABOLISM

Man confronts the material nature as one of he own forces. He sets in motion arms and legs, head and hands, the natural forces of his body, in order to appropriate the material of nature in a form suitable for his own needs. By thus acting through this motion on the nature which is outside him and changing it, he at the same time changes his own nature.

Karl Marx cited in Schmidt 1971: 77-78

The whole Agrocity, as an open dynamic system, evolves from the dynamic interaction of the ODS cell with other components within the system as a whole. Metabolism was socially and ecologically defined by Karl Marx as 'It is not the *unity* of living and active humanity with the natural, inorganic conditions of their metabolic exchange with nature, and hence their appropriation of nature, which requires explanation or is the result of a historic process, but rather the *separation* between these inorganic conditions of human existence and this active existence, a separation which is completely posited only in relation of wage labour and capital.' (Marx 1973: 201) in order to explain the dialectics of society and nature through labour as a natural process in which humanity not only participates, but belongs. Likewise, the Agrocity includes a metabolic process with a 'complex system' organization: it is made up of sub-units (the spontaneous neighbourhoods) composed of individual cells or basic units (the Outdoor Domestic Space) and evolves through spatial production by a decentralized society. The Agrocity is therefore self-organised on two levels: the first level is the individual cell - the Outdoor Domestic Space building block, which is internally self-

organised by the household and resilient in the sense that when perturbation occurs on the overall system it manages to survive, and the second level is the interaction between similar cells to form the neighbourhood which the Agrocity system sub-units. Since the ODS cell connects easily to other components of the system, the Agrocity self-organisation within the neighbourhood sub-units may expand to other levels, such as the 'cement city' and urban-rural linkages, as well as other elements from the external environment. So, there is interaction between the household at the ODS and other components within the Agrocity. In an analogous way, at a global scale the Agrocity interacts with other components as a part of the wider system, which is emerging ecosocialism.

This paper deals with this particular Agrocity as found in Dondo case study, but there are other similar emergent formations elsewhere which interact both locally and globally. Although the conditions of the ensemble cannot be predicted by the individual cell, the paper is focused on understanding and explaining the behaviour of the Outdoor Domestic Space individual cell and the process of local interaction between the ODS and other diverse components that generates local relationships. Exploring further the Agrocity built by the society of ecosocialism, the Agrocity becomes the individual cell of the emergent process of ecosocialism as a whole, which is analogous to the way in this study ODS shapes the Agrocity. Understanding one particular building block that explains the process of self-organisation of ODS cells and the way they form neighbourhoods contributes to understanding the Agrocity and hypothetically its important processes to understand a new ecodevelopment/ecosocialism.

Summing-up, resilience is the main feature of the Agrocity metabolism, arising out of internal and external changes to its system after it has reached a state of disorder, to enable it to regain its balance. Through resilience, society is able to restore sufficient order to the system to allow it to continue satisfying demand whilst avoiding hardship for the whole system, as for example it was the case with the transformation of domestic space in Mozambique when people escaped to the city during the war. The positive system dynamics depend on the wide and rapid distributive capacity of resilience within its component parts. This feature is crucial in securing the balance of the urban system in terms of food security, clean water, repositioning resources and so forth during crisis events, and this proves that resilience is linked to the innate relationship between the human habitat and nature.

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Fig. 1: Outdoor Domestic Space transformation and livelihoods self-organisation in the spontaneous neighbourhoods of Dondo Municipality (source: Veríssimo, 2010); Fig. 2: Spinning, pottery manufacture (source: Sinclair, 1987, pp. 116); Fig. 3: Outdoor domestic production and making pots (source: Newit, 1973, pp. 285); Fig. 4-7 and Tab. 1-2: (source: Veríssimo, 2008 and 2010)

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TeMA
Journal of
Land Use, Mobility and Environment

TeMA 2 (2012) 147-158
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: 10.6092/1970-9870/940

review paper. received 10 April 2012, accepted 14 July 2012

www.tema.unina.it

ENHANCING RESILIENCE

OF LONDON BY LEARNING FROM EXPERIENCES

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ABSTRACT

The concept of resilience was introduced at the beginning of the 70s to indicate the capability of natural systems to absorb perturbations, preserving their structure and keeping the system functioning. The paper considers London as an example to a resilient city by focusing on some remarkable disasters in the history of London, such as the Great Fire in 1666, the Air Raids during the World War 2, 18 December 1987 King's Cross Fire, Terrorist Attack to the London Tube network on July 7, 2005, flooding in 1928 and 1953 Storm Surge. The paper starts by giving short descriptions of these disasters and continues by discussing the lessons learned. In this paper, the concept of resilience has been studied in three phases: prepare for, respond to and recover from a disaster. Besides, actions that have to be taken according to these three phases are going to be explored in detail. In conclusion, the notable effects of the mentioned disasters on structural and non-structural mitigation tools are revealed by considering resilience of London.

KEYWORDS:
Resilience, flood risk, disaster risk management

London, which is one of the biggest cities in the world since the 19th century, has proved being resilient to natural and man-made disasters several times. Since London was settled in A.D. 50, the city had experienced many disasters (Withington 2010, 3), some of which destroyed almost the entire city and some other gave partial damage. Wars, invasions, terrorism, fires, floods, epidemics, wild weather, fog, accidents such as train crashes or explosions and also financial disasters occurred in the history of London. Following each disaster, London recovered and evolved according to the needs of its inhabitants and adapted to the changing environment.

In this paper, some of the notable disasters, which shape today's London's structural and non-structural mitigation measures to disasters, such as emergency management system, have been analysed by considering the lessons learned and their effects on the present system. The focus is on the Great Fire of 1666, the air raids during the World War 2, 18 December 1987 Kings Cross Fire, the terrorist attack to tube network on the 7th of July 2005, 1928 flooding and 1953 storm surge. The first two examples, the Great Fire 1666 and the blitz during World War 2 provided the opportunity to shape the London's physical structure again. On the other hand, Kings Cross Fire and July 2005 terrorist attacks revealed the strategic, operational and systemic problems encountered during a disaster on the transportation system. Moreover, 6 January 1928 flooding and 1953 East Coast Surge floods are chosen as they had noteworthy effects on the structural and non-structural defences to flooding in London. Campanella (2006, 143) states that a city is as resilient as its citizens, so it can be said that the common characteristic of all these examples is that each time both London and the citizens of London had proved their significant resilience.

1 1666 GREAT FIRE

In 1666, London was the biggest city in the UK with its estimated 500.000 population. Great fire of London lasted 5 days and destroyed more than 436 acres of urban land. Moreover, one in every three houses was destroyed by fire and around 70.000 people became homeless, which was the 14% of total population (Withington 2010, 71). The great fire of London led to improve fire regulations and "rebuilding of London Act 1666" had been issued. The 1666 act regulated the rebuilding and authorised to widen the roads, the types and organization of buildings by locating a Fire Court. Act helped to organise the density of buildings according to the width of the streets. According to the Act, all buildings must be in brick or stone. The act also grouped the buildings that are permitted in four categories:

- on the smaller streets: cellar, two floors high with an attic on by-lanes;
- on larger streets: one more storey than the first category;
- on main roads: two more storeys than the first category.

Mansions with fewer restrictions than the other three but still restricted to four storeys plus cellar and attic.[1]

Sir Christopher Wren prepared the new plan of London according to the act. In the new plan, central streets provide connections between main locations, while narrower streets divide residual areas in grid shape.[2] Organizing widths and orientation of the streets according to the facilities and density of the buildings had ensured effective mobility in the city. Moreover, dividing the city into four districts in accordance to the fire regulations was an attempt that improved resilience of the city in case of a fire incident. In each district, there were «800 buckets and 50 ladders, as well as shovels, pick axes and hand-held squirts». People also were informed about the fire-fighting equipment and how to quell a chimney fire etc. (Withington 2010, 75). Moreover, fire insurance concept aroused, as many businesspeople bankrupted due to the fire. First

[1] http://london.allinfo-about.com/features/rebuilding.html (Stephen Inwood, A History of London) (30.04.2012).
[2] RIBA Library Drawings and Archives Collections, http://www.architecture.com/LibraryDrawingsAndPhotographs/OnlineWorkshops/UrbanAdventures/01Wren.aspx (30.04.2012).

insurances were offered in 1680, by promising clients «the services of watermen as fire-fighters, or the rebuilding of their premises if these efforts failed to serve them», which is the way of emerging professional fire fighting in London (Withington 2010, 75-76).

The Great Fire of London is a significant disaster in London's history, because a much safer city was achieved by rebuilding according to the new rules defined by the "rebuilding of London act 1666" after the incident, which destroyed almost the entire city, and additionally, this disaster led to start professional fire fighting in London (Withington 2010, 76).

2 THE WORLD WAR 2 AND AIR RAIDS

In the Second World War, the causalities of air raids were more serious than the First World War. In the Second World War, in 1940, the transportation system was the main target and especially road network, the docks and railroads were bombed with an air raid. As fire engines were short in supply, different modes of transportation, such as taxis and private cars were used to carry mobile fire pumps to extinguish the fire (Withington 2010, 27). Furthermore, people were out of water, gas, electricity, food and basic services, even if their home stands. Moreover, sewage breached and contaminated water. Buses were used to evacuate people to rest centres in safer places. However, in the confusion, some of these buses could not find their way and could not arrive at safer places and rest centres. Regarding the tube network, people, who got stuck in London, used nearly 80 tube stations as shelters (Withington 2010, 27). Even though tube stations could seen as the best shelter place, they were actually hit by the bombs and hundreds of people died there. In the first six weeks of the air raids, more than 6.000 people were killed and 10.000 injured. 16.000 houses destroyed, 60.000 seriously damaged and 300.000 people needed re-housing (Withington 2010, 28).

The London blitz provided the reason to plan and reconstruct the city again, as it happened after the Great fire. Patrick Abercrombie prepared "the county of London plan in 1943", which states the deficiencies of London, such as «traffic congestion, depressed housing, inadequacy and maldistribution of open spaces» (Forshaw and Abercrombie 1943, 3) and provides ideas and plans for the development of the city. Due to the obsolete housing stock and declined quality of urban life, large numbers of Londoners migrated to the suburbs after the war. In the 40s, according to Abercrombie, London was just like a collection of villages and they need to be connected by new arterial and sub-arterial highways hierarchically. To solve the housing and traffic congestion problems, recover the population sprawl and define the edges of London (Hall 1989, 36), Patrick Abercrombie's plan for London's development was prepared between 1942 and 1944. The intention of this plan was to surround London with a green belt and regroup the population in the new or enlarged towns offering also workplaces (Parker 1999; Hall 1989; 1993). According to Hall (1989, 44), Abercrombie's plan was an interpretation of Howard's garden cities but in a bigger scale. By implementing the Abercrombie's plan, the population moved beyond the green belt successfully and the physical sprawl of the city stopped.

3 18 NOVEMBER 1987 KING'S CROSS FIRE

The fire at the King's Cross was initially a minor accident which turned into a disaster. It could have had different results, if the employees had known how to distinguish a fire, and how to evacuate people. A small fire has noticed under one of the escalators by one of the staff. However, staff did not know the evacuation procedure, he could not handle the situation, so they called first the Police, and when the Police arrived at the station and saw the situation, they decided to call the fire brigade. Additional time has been lost due to communication problems, as the radio did not work in the underground. When Police decided to evacuate the station, they were sending customers up by escalators, where the fire is, because they thought that it

was the only way to go out. When the fire brigades arrived, together with the staff and Police, they stopped the people coming up from the escalators, put them back onto the trains, and did not let the following trains stop at the platforms. Just three minutes after the fire brigades arrived at the station, a huge explosion occurred at the station (Withington 2010, 100-103).

This chain of events indicates some vital points. First of all, un-trained underground staff was a shortcoming in this event, as only four of the staff on twenty-three staff on duty received training in evacuation/fire drills (Withington 2010, 104-106). Even though there were fire-fighting equipment all over the station, the staff was not able to use them. Secondly, communication was one of the main problems as radio did not work in the underground and the only way to communicate was landline or word of mouth. The supervisor of the station was in his room that was far from the fire and the only way to communicate with him was his internal phone, and he was informed about the fire twelve minutes after its first discovery. Although, fire brigades and British Police officers had radios, they were working only on the surface level (Withington 2010, 104-106).

In this accident, more than 200 fire brigades were involved, 31 people died and more than 50 people were injured. Although, there had been about 400 fires in the London underground between 1956 and 1987 (Withington 2010, 98), the obligation of doing drills was introduced after this terrific fire at the King's Cross tube station to make sure people knew what to do in times of emergency[3].

4 TERRORIST ATTACK TO THE TUBE NETWORK ON 7 JULY 2005

In 2005, the terrorist bombs hitting the tube indicated what worked effectively and revealed the defects to be improved for better performance. When the bomb exploded at 8:51am, it took time for the officers to understand what had happened. The first thing that was seen was a massive loss of electrical power on the northern side of the Circle line. Two years before this event, there was power lost on the underground and a dramatic incident occurred as a result on the 23rd of August 2003 when many people were trapped in the tunnels and trains. Due to this accident anytime a new problem occurred, people tended to perceive that problem, similar to the one they experienced before. Therefore, as the reports were saying that there was no electrical power, the initial assumption of the authorities was that one of the electric providers blew causing all this noise. Within about ten minutes, further reports showed that the situation was more serious and different from the first assumption. By 9:15 am, it was decided to evacuate the tube network and the code amber[4] was ordered to re-ensure employees, public and further trains from any risk.

The employees were out of the network between 8:51 and 9:15, as there was a drivers' stop next to the scene. Many people went to help the people stuck on trains and charged right into the tunnels where the bomb exploded. It took the emergency services a while to arrive at the scene. The employees of the underground went to those tunnels immediately and used what they had learned in previous training to do what they could.

Some important lessons were learned from these incidents that need to be pointed out. First, management cannot intervene fast enough, as it takes too long to understand what is happening. Therefore, the most important thing is to train people ready to respond, as they are the most valuable resource and immediate response. Therefore, it is crucial to train people and make sure that they know what to do. Just two weeks before the terrorist attack, the London Underground had run a drill at Tower of Hill station. As they had trained, people did response very well. Additionally, they run table-top exercises with the emergency service

[3] The information gathered by conducting an interview with the former boss of London Underground, July 2011.
[4] Code amber is the code to evacuate network and control under circumstances.

a couple of times a year. All these exercises paid off, because employees of the London Underground were already in the incident scene and they were the first responders.

There was one thing about the reaction of people at the bombsites. When the code amber was ordered, which was to evacuate the network by taking each train into a platform and getting people out, it was happening in the middle of the morning peak and there were people on trains all over the network. Thus, customers did not know what is going on. Trains were stopped, and people were made to get out of stations. They might never have been in that station before and those people were out on the street. 250.000 people were in the network in that time, and hundreds and thousands of people evacuated within an hour.

Communication in the underground system has improved after the terrorist attack. Before that, there was no inner operability and the existing communication system had failed in previous accidents. After this event, efficient means of communication were put in place. Today, there is a radio system, by which one can talk to anyone else both in the tunnels and the various underground levels. Moreover, the emergency services have channels on this radio system and they can talk to their own people.

Another lesson learned regards the shortcoming of exaggerated focus of protocols. According to the previous arrangements, once an accident occurs, the Metropolitan police get the “gold control.” The London underground is under their authority. The Metropolitan police are responsible also for communicating with the public. Informing people was not the responsibility of the underground authority. However, the Underground Authority realized that it was a mistake, as their employees were looking for information about the incident. The Underground Authority thought that not giving the information to their employees would create distrust in the network. So, the Underground Authority shared the available information with their employee, thinking that otherwise employee would think authorities hide some information while their life are at stake. After the attack, to keep the trust of their employees, the London Underground Authority changed this protocol and decided that in case of accident, no information will be withhold to the employees and tell everything that they know and not know, taking the risk that the information might become public.

Another limitation was that, there were no storage of medical supplies in the underground to deal with the situation and it took long for the emergency services to bring it there. One of the changes applied after the attack was putting more storage of medical supplies across the underground system, and very large supplies at strategic locations in the zone one, where it is most likely that an emergency may happen.

One other lesson that is learned from this experience was the importance of drills for multiple incidents at the same time. The London underground used to do drills, but both the strategic planning and the emergency planning of drill scenarios were always about dealing with a single incident. A drill was never planned for multiple incidents at the same time. London Underground personnel could deal with an incident but dealing with three of them at the same time was quite challenging, especially when their knowledge was deficient. As a result, having multiple attacks changed the scenario planning for future training.

At the incident scene, the employees of underground were grouped in three and the tasks had divided in these teams. The first team continued focusing on getting relief and dealing with the immediate incident. Another team was put together to deal with the planning and create new service patterns, like shuttle systems on both sides. Besides, there was a third team to focus on the immediate restoration of services at the bomb side, which was heavily engineering based. In this respect, the tunnels were inspected and blown up trains extracted. The primary aim was to bring the system back and organize the services again to continue functioning. The underground system started operating the next day in the morning.

A customer service program to informing people about any situation had been started before the terrorist attack and was accelerated after the incident. Now, drivers are talking on the P.A. constantly to inform public about any problem. For example, when there is a delay, drivers inform about the reason of delay.

5 6 JANUARY 1928 FLOODING

1928 flooding along the Thames and its branches was a combination of melting snow, deep depression, heavy rain and spring tide (Holford 1976, 97). The 6th of January, the height of the water at the Southend was 1.5 meters more than forecasted, and in the central London, 1.8 meters higher than predicted and 0.3 meters more than formerly recorded level. The areas flooded were Battersea, Poplar, Greenwich, embankments at Temple station, Old Palace Yard, Westminster, Tate Gallery, Lots Power station, Wandsworth Gas Works, Blackwall Tunnel (Holford 1976, 97-98). Flooding made homeless more than 4000 people (Holford 1976, 99). This event showed the insufficiency of the walls along the Thames and their height has risen after the event. Increasing the height of the walls cannot be an efficient and effective solution, and it cannot be done constantly. Should the wall be raised, this has to be done along the entire length of the wall. This operation is getting more costly and less efficient each time, because it involves also alteration of wharves, approaching roads and sometimes demolishing properties (Holford 1976, 100).

The 1928 flooding led to improvements in the forecasting and warning systems for flooding. In terms of forecasting, a research program was started by the Meteorological Office and the Liverpool Observatory and Tidal Institute for studying storm surges. Regarding to alerts, a warning system for London was installed by using the danger level at Southend as a threshold. Lastly, the idea of building a barrier on the Thames River had discussed again after a similar storm in 1897 (Holford 1976, 100).

6 EAST COAST SURGE FLOODS, 1 FEBRUARY 1953

East Coast Surge flood is called also as North Sea Storm Surge and affected not only in England but also in the Netherlands and Belgium. The effects of this storm surge was more serious in the Netherlands than in the other two countries. The economic damage (1953 values) of this event was 1.5 billion guilders in the Netherlands and 50 million pounds in the UK (Jonkman and Kelman 2005, 2). Moreover, in the Netherlands 200.000 hectares area inundated, in the UK 40.000 hectares and in Belgium 10.000 hectares (Jonkman and Kelman 2005, 2). Because of this incident, nowadays, the Netherlands has the most effective and efficient structural and non-structural mechanisms for flooding in Europe.

The causalities in the UK mainly depended on being not able to forecast the event. The event occurred unexpectedly and without warning. Fatalities were higher in the sea towns in Canvey Island, Jaywick and Lynn where the buildings were of low quality, as, people started living in those kind of temporary and low quality buildings shortly after the war (Jonkman and Kelman 2005, 6). Main causalities were among elderly people. At Canvey Island 42 out of 58, at Jaywick 28 out of 34, and at Lynn all 14 fatalities were older than 60 (Jonkman and Kelman 2005, 5-6).

Met Office indicated that the surge expanded from Tilbury to Docklands and caused damages on Docks, oil refineries, factories, cement works, gas works and electricity generating stations. Additionally, 100 metres sea walls were destroyed, and, more than 1000 houses were flooded[5].

The shortcomings the forecasting and warning systems in the UK became evident during this disaster. People were unaware of their own vulnerability to storm surges and being without electricity and communication systems increased the number of causalities. Sea defences collapsed, and this situation led

[5] Met Office: Great weather events: the UK east coast floods of 1953, http://www.metlink.org/pdf/teachers/1953_east_coast_floods.pdf.

to question the maintenance degree of the structural defences and their reliability (Jonkman and Kelman 2005, 8-9).

7 LESSONS LEARNED

EVENT	DESCRIPTION	DEFICIENCIES SHORTCOMINGS	EFFECTS ON STRUCTURAL PATTERN	EFFECTS ON NON-STRUCTURAL PATTERN
1666 Great Fire	Lasted 5 days and 436 acres burned. 70.000 people became homeless (14% of London's total population).	Timber houses, narrow streets, not having sufficient equipment to extinguish fire.	A grid plan prepared for rebuilding the city of London. "Rebuilding of London Act" issued, and all the buildings rebuild by brick or stone. Moreover, the act grouped the buildings in four categories and height of the buildings had arranged according to the width of the street.	Fire regulations had improved, and the event led to initiate professional fire fighting. The rebuilding act divide the city into four districts and sufficient fire fighting equipment had provided for each district. People had informed about how to use the equipment to extinguish fire.
Air Raids during the World War 2	More than 6.000 people were killed, 10.000 people injured, 16.000 houses damaged, 60.000 houses seriously damaged, 300.000 people needed re-housing.	Fire engines were short in supply. Evacuation of people was not successful. Shelters were in shortage.	The plan of Abercrombie was prepared to reconstruct the city again. Docks were never fully repaired after the blitz and they were the regeneration areas during 80s.	
1987 King's Cross Fire	31 people died, 50 people were injured, 200 fire brigades had been involved.	Not having trained underground staff and communication problem.	Timber escalators were removed.	Doing drills has become obligatory for the employees of the Tfl.
2005 Terrorist Attack to the Tube Network	Multiple attacks on the tube network.	It took time to understand the real issue, as communication was a problem. Being disciplined about following the protocol. Not having medical supplies in the underground. Employees knew what to do, because they were doing drills twice a year, however they never practiced a drill for multiple accidents.	Stores of medical supplies were put across the system and very large supplies at the strategic locations in the zone one. Inner operable radio system had built, know it is possible to talk to anyone no matter in the tunnel or not.	To keep the trust with their employees, underground has changed their protocol and decided to communicate their employees and tell everything they know and do not know. Having multiple attacks changed the scenario planning for drills.
January 1928, Flood	The water was 1.8 meters higher than predicted in the central London and 0.3 meters more than formerly recorded level.	Not having a proper forecasting and warning system. Not having sufficient structural tools to prevent flooding.	The height of the walls along the Thames had risen.	Improvements on the forecasting and warning system: a research program for forecasting was started, and a warning system for London was established.
East Coast Surge Flood 1953	More than 420 people died, 32.000 people were affected, and economic damage was 50.000 million pounds (1953 values).	The forecasting and warning systems were the shortcomings of this event. The maintenance degree and reliability of structural defences were other problems.	Thames Barrier had been built. Structural defences had been improved.	Flood forecasting, monitoring and warning systems have been improved. Emergency management system has come to today's level.

Tab.1 Retrospective view of risk

After the Great Fire, a plan was prepared to rebuild the city by considering mitigation of fire risk first time in London's history. Moreover, after the WW2, a plan had been prepared by the team of Sir Patrick Abercrombie to rebuild the city and to improve the existing deficiencies lasted since the beginning of the 19th century. This plan has given London its current shape. In addition, the Docks, which were severely damaged during the blitz, was subject to regeneration and economic revival in the 80s, and today the area consists of residential and financial activities.

Furthermore, the fire at the King's Cross underground station revealed the deficiencies of communication and un-trained underground staff in case of an emergency. After this event, getting involved in drills has become obligatory for the underground staff. However, communication system had not improved until the terrorist attack in 2005. Terrorist attacks on the 7th of July 2005, revealed the strategic, operational and systemic problems encountered during a disaster on the transportation system. Foremost problem in this example was communication between the staff in the tunnels and the people who were outside and trying to understand the real issue. As, employees of Tfl were doing drills since the King's Cross fire, they knew what to do in case of an emergency, and this was one of the biggest advantages in this event. After the incident, a radio system has been installed and communication is not a problem anymore.

Regarding to flooding, after the flood event in 1928 the focus was on the deficiency of structural mitigation tools. Besides, attention was given also to building forecasting and warning systems by conducting a research program for forecasting and by establishing a warning system for London. However, in 1953, a surge flood hit the southern part of the country including London, and this event showed that the forecasting and warning systems, which were established more than two decades ago, were not successful. After the event, having a barrier on the Thames had been considered again, and the construction of the barrier started in the 70s forecasting and warning systems have been improved and reached to today's level.

Table 1 indicates that each incident helped to improve structural and/or non-structural risk mitigation and/or management tools in the aftermath of the event. It also proved that seeing deficiencies of a system was not enough to improve it, sufficient resources must be provided as well. For example, the consequences of not having a proper communication system during an incident were seen in the King's Cross Fire. However, the communication system has improved only after the terrorist attack in 2005, 18 years after the King's Cross Fire. There is the similar situation for the construction of the Thames barrier. Since the 19th century, the need of having a barrier on the Thames was known, however the construction started only in the 70s.

8 ENHANCING RESILIENCE OF LONDON

The concept of resilience was introduced at the beginning of the 70s to indicate the capability of natural systems to absorb perturbations, preserve their structure and keep the system functioning. The characteristics of a person or group in terms of their capacity to anticipate, cope with, resist and recover from the impacts of natural hazard (Blakie et al. 2004). In ARMONIA project (2006; Walker at al. 2011, 17) 'resilience' is defined as «the capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to restore or maintain an expectable level of functioning and structure». Godschalk (2005, 58) indicates «acting beforehand to mitigate the impact of a natural hazard is far more effective than picking up the pieces afterwards». Godschalk suggests investing in mitigation before the next disaster (2005, 58), however, in some of the examples in the case of London, such as Great Fire or King's Cross Fire the strategy was to invest in mitigation after the last but before the next disaster.

Furthermore, in this paper enhancing resilience capacities of a community in general can be considered in three phases. These phases are: "prepare for a disaster", "respond to a disaster" and "recovery and reconstruction after a disaster" (Table 2).

PREPARE FOR A DISASTER		RESPOND TO A DISASTER		RECOVERY AND RECONSTRUCTION AFTER A DISASTER	
MITIGATION MEASURES		EARLY WARNING	DURING EMERGENCY		
Limiting exposure to hazard	Restricting development within hazard zone	Forecasting flood	Defining first respondents and training them	Physical	Assessment of loss and damages
	Selecting development areas outside the hazard zone	Monitoring flood	An integrated system		Repairing and reconstructing the built environment
	Land acquisition	Disseminating warning to public by translation of scientific information coming from forecasting & monitoring	Emergency drills with large public involvement		Availability of partial relocation programs during reconstruction for the most critical situations
	Land use ordinances	Training public on how to respond to warnings and how to act during emergencies	Maintaining and mobilizing stand by people, materials and financial resources		Building codes and retrofitting for new construction
	Density restrictions	Establishing a community network	Continuing long-term training of both emergency personnel and also public		Availability to incorporate recovery/resilience measures in future urban redevelopment plans
	Community relocation	Defining responsibilities and capabilities of institutions clearly			Sharing reconstruction plans among stakeholders
	Having disaster management plans	Warning industries, plants and hazardous facilities			Existence of skilled workers for reconstruction activities
					Geographical and economic importance of potentially affected settlements
Dimi-nishing direct and indirect impacts of hazard	Sea walls	Evacuation of public		Infra-structure	Mapping damage
	Leaves	Mobilizing material and emergency personnel			Quick survey on damaged parts
	Dams				Using spare materials for repair
	Fire breaks				Availability of personnel for repair work
	Quarantine				Existence of protocols to proceed with repairs requiring interlifelines intervention
	Strongly built environment to resists physical forces of hazards				
Sharing the losses	Insurances			Eco-nomic	Insurance coverage
	Relief funds				Dependence of economic actors on loss of environmental perils
	Personal savings				Access to funds
	Restoring pre-disaster situation, financial and medical services				Degree of diversification and capacity to spread risk
	Facilitating permanent return of residents				Providing work for those who lost their work
				Social	Healing injured and traumatized community
					Bringing together separated families
					Identifying dead
				Institu-tions	Liability
					Transparency in funds
					Ability to learn from past events

Tab. 2 Enhancing resilience capacity of communities for flood hazard risk in London

First phase, “prepare for a disaster” includes mitigation measures, such as limiting the exposure to hazard and diminishing direct, indirect impacts of hazard and sharing the losses. First, as for limiting the exposure to hazard, the development within hazard zone has to be restricted, and new development areas must be

selected outside the hazard zone. Moreover, land acquisition, land use ordinances, density restriction, community relocation and having disaster management plans are the other measures to limit the exposure in the hazard zone. Second, to mitigate the risk of hazard both direct and indirect impacts of a possible hazard have to be diminished by developing strongly built environment to resist physical forces of hazard and by building sea walls, leaves, fire breaks, quarantine, dams or barriers as in the London case. The third issue as for mitigating measures is sharing the losses by insurances, relief funds, personal savings, financial and medical services and indeed facilitating permanent return of residents who left the city shortly after occurrence a disaster.

Moreover, in the respond phase to a disaster there are early warning and emergency management aspects. The success of early warning depends on the success of the procedures coming before disseminating the early warning, such as forecasting and monitoring hazard. Monitoring hazard is a continuous activity to forecast possible hazards and understand its severity and duration. The quality of monitoring and forecasting could help to increase the warning lead-time. Therefore, people can be warned and informed about the existing risk to take the essential precautions before the occurrence of a hazard. While disseminating warning, the language of warning has to be transformed from scientific language which consists technical terms to the one that can be understood clearly by public.

Recovery after a disaster can be studied by considering the city in physical, infrastructural, economic, social and institutional systems. To recover the physical structure, first loss and damages have to be assessed before starting and reconstructing the built environment. In some cases, assessment and repairing works are done simultaneously to start operating the system as soon as possible. This can be possible in small and close systems, as it has seen in the example of terrorist attack to the London tube network in June 2005. However, it cannot be feasible in large-scale disasters. Before repairing also new building codes for new construction of the built environment has issued by the authorities.

If the previously mentioned disasters are considered within the structure of Table 2, the Great Fire in 1666 and reconstruction after air raids are good examples to increase resilience of a city by improving the physical conditions and taking precautions in the pre-disaster phase. In the latter example, after the World War 2, the physical deficiencies and unhealthy structure of the city healed by restricting density in the central London, controlling urban sprawl and traffic congestion and improving the quality of the physical environment. Furthermore, after the Great Fire, the city planned again by taking into account land-use ordinances, restricting the density and development, organizing height of the buildings according to the width of the streets and preparing disaster management plans in case of fire. Private insurance companies have established first time in the history to insure especially businesses in case of a fire incident. In addition, there are also two issues, which corresponded to the response phase of a disaster. First, public were trained on how to behave during a fire incident, how to extinguish fire and how to clean their chimneys. Second, in addition to improving fire regulations, professional fire brigade units were initiated with the name of watermen.

Moreover, after the 1987 King's Cross Fire, doing drills became obligatory for the entire underground staff and as it was seen in the 2005 Terrorist attacks, the underground personnel knew what to do and dealt with the situation very well as being the first respondents to the incident. However, communication has been improved after the 2005 terrorist attacks. 2005 Terrorist attacks also proved that the underground system is also resilient to such a multiple attack in terms of recovering after the incident. Regarding to the infrastructure, first, the damage has mapped by a quick survey on the damaged parts of the network. The resources and existing personnel were available for conducting repairing work, while some of the staff were still responding to the incident.

1928 flooding and 1953 Storm Surge event are the two examples which led to improve resilience by focusing on preparation and respond phases. As for the preparation, height of the see walls have increased, barriers such as Thames and Barking were constructed. For being able to respond to disaster, forecasting, monitoring and warning systems have been improved and warning networks have been established.

To sum, in the London case the ability to learn from failures and improving the system according to lessons learnt definitely increase resilience of the system. In addition, in the course of the time structural and non-structural mitigation have been improved reaching today's advanced level. In general, on one hand, the city is becoming more resilient by improving the system in all three phases, on the other hand, the exposure was increasing and formerly floodplain areas were becoming the attraction point for development after the construction of the Thames Barrier. Today, the barriers and embankments have protected the area according to the 1 in 1000 year flood event. However, during the construction of these defences, climate change and sea level rise have not been considered. Although flood hazard probability is changing due to climate change and sea level rise, the main reason of increasing flood risk in London is the *post-defence development* (Parker 1995, 341) and increased ownership of goods and property in the floodplain (Parker et al. 1987; Green and Penning-Rowsell 1989, cited in Parker 1995, 342). The post-defence development after the construction of the Thames Barrier in the 80s, such as increasing number of population, buildings, companies and firms, and extended infrastructure in the floodplain, led to increase exposure to hazards. Moreover, more businesses have been established and more infrastructures have been constructed in the area. By developments in the area, investment on transportation has also increased to connect the area both to London (DLR-Docklands Light Rail) and to the rest of the world (City Airport). Although the area is well connected to London, because of lack of redundancy of rail and road networks, any disruption on the existing transportation system in the area could lead to isolate the area from the rest of the city. Furthermore, having any disruption on these infrastructures in case of an incident could create not only direct damages but also indirect damages have increased due to increasing number of businesses, infrastructure and demand on traffic in the area (Parker 1995, 342). Though the probability of risk is low, due to increasing exposure and investments in the area, the consequences of an incident would be very high and costly.

Acknowledgements The author acknowledges and thanks with gratitude to the members of the Flood Hazard Research Centre at Middlesex University for their excellent help and support during the author's research period in London. Moreover, the author is grateful to Prof. Scira Menoni for her support in all the time of the research.

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TeMA Journal of Land Use, Mobility and Environment

TeMA 2 (2012) 159-175
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: 10.6092/1970-9870/912

review paper. received 12 March 2012, accepted 10 April 2012

www.tema.unina.it

URBAN RESILIENCE AND ECOSYSTEM SERVICES: HOW CAN BE INTEGRATED IN THE CASE OF ISTANBUL - SULTANBEYLI DISTRICT?

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ABSTRACT

As estimated by UN, in 2030, 95 % of population growth will result from urban areas while a few metropolitan areas of rapidly growing developing countries will absorb much of this growth. Due to the accelerated urban growth and uncontrolled urban dispersion through naturally significant areas, sustainable urban growth management becomes a critical urban development policy for the global agenda.
Istanbul has been attracting much of the internal migration with a dramatic urban growth process since 1950s and Istanbul Province, with over 12 million people in 2010, is the most populated city of Turkey. Sultanbeyli, as a unique case for informal housing development in Istanbul, expanded like mushrooming after 1980's and located itself on the largest drinking water source of Istanbul: the Omerli Watershed. The population of the Sultanbeyli District grew from 82,298 (1990 census) to 272,758 people (2007 census) (TUIK, 1990;2007): more than threefold increase in less than two decades with consequent environmental degradation, uncontrolled ground water pumping, lack of drinking and waste water infrastructures. These factors endanger the well-being of the environment and of the society. On the other hand, the serious poverty problem is the main concern in Sultanbeyli for urban resilience (UR) which can be defined as the degree to which cities are able to tolerate alteration before reorganizing around a new set of structures and processes and which can be measured by how well a city can simultaneously balance ecosystem services (ES) and human functions (Resilience Alliance, 2007).
This paper aims to discuss how to integrate ecosystem services and resilience theory which will be essential to resolve the problems reflected by social, economic and administrative characteristics of the Sultanbeyli District to enhance its urban resilience capacity in Istanbul.

KEYWORDS:

Ecosystem services (ES), urban resilience (UR), informal housing, Istanbul, Sultanbeyli.

1 AN INTRODUCTION TO RESILIENCE THEORY

Seeking a reform or a radical rethinking of the development concept, it is obvious that changes are compulsory in both goals and methods. The simple view of development suggests an upward climb, which is common to all countries but with different stages. Once the traditional development thinking has been challenged, a new concept – such as sustainable development, started to find wider interest. In 1987, the World Commission on Environment and Development attempted to formulate the concept of sustainable development as the study of the conflicts between environment and development ends. As this concept had been introduced in a larger discussion, there were generally three aspects (social, economic, environmental) that had been recognized; sustainability vs. un-sustainability: this lasts in itself is easier to recognize and compelling to action through the necessary policies (Haris, 2000). Klein, Nicholls and Thomalla (2003) state that over the past thirty years, there is an increasing recognition across the disciplines as human and ecological systems are interlinked and their resilience (therefore sustainability) relates to the functioning and interaction of the systems rather than to the stability of their components or the ability to preserve or return to some equilibrium circumstances.

Urbanization causes changes on land uses and habitats which are often subject to complex interactions among patterns, processes and natural systems in urban areas, and influenced intensely by all of ecological, social and economic drivers. On the other hand, rapid changes in urban activities and land uses affect the capacity of urban ecosystems to continue their functions and ecosystem services (ES) sustaining the quality of life. Therefore building resilience might be important particularly in the areas experiencing rapid population and urbanization change (Berkes et al. 2008; CSIRO, 2007).

According to spatial, administrative/institutional and temporal perspectives, cities may change more or less suddenly. The occurrence of vulnerability reduces resilience and increases the exposure of urban systems to the risks of oddities of uncertainty and unexpectedness. This perspective shows a multi-level look of the resilience of an urban system conceived as the role of *metabolic flows* in sustaining urban functions, wellness and quality of life; *governance networks* and the ability of society to learn, adapt and reorganize itself to face urban challenges; the *social dynamics* of community and citizens, as users of services, consumers of products, etc., and their relationship with and within the *built environment*, defining the physical patterns of urban space interactions (CSIRO, 2007). The *Metabolic flows* concerns the production, supply and consumption chains in an ecosystem, transcending the boundaries of the city. This is directly linked with the capacity of producing energy, goods, and services to be sufficient for the wellness and the life-quality of the whole community. On the other hand, production systems' interconnection, interdependency, diversity and efficiency are meaningful to test their own resilience. *Governance networks* are composed of institutions and organizations leading and managing urban settlements. The relations among them affect the regional, national and international levels. Governance relates to the management of finance, services (sewer, water, education, etc.) and emergency services (police and fire departments). *Social dynamics* include such as the features of demography, human capital and inequity characteristics of the population. Finally, *built environment* category represents ecologic and urban landscapes, and habitats. Ideologies, policies, building laws and transportation, affect the way the built environment may develop (Normandin et al. 2009). Urban resilience (UR) derives from the intersection of these areas.

Urbanization is both a social phenomenon and a physical transformation of landscapes through intense use of ecological processes around the globe and it totally dominates complex systems made up of resource flows such as food, energy, water, waste, as well as flows of people and goods. However, many rapidly growing cities of developing countries have not reached the same growth in socio-economic opportunity as developed countries. In other words, the socio-economic roles of ecosystem services in the wider development context should be factored into urban resilience strategies (Schäffler, 2010h), especially in developing countries. Turkey, like other developing countries, suffers from extensive pressures on natural resources due to rapid population increase and urbanization dynamics around metropolitan attraction nodes. The case of Istanbul sets a unique example with a population growth around 600% and a growth in built up areas 700% approximately since the 1950s. Today, Istanbul, with more than 12 million people, is still one of the most attractive internal migration nodes in Turkey. Diverse service facilities of governmental and private institutions, employment opportunities, cultural and historical background have been stimulating thousands of people from different rural parts of the country. As a result of rapid growth in population and urban dispersion, there has been significant pressure on ecological life support systems of the region. Since the 1980s especially, Istanbul experienced a considerable urban development in or neighbouring areas to drinking water sources. Therefore, there has been rapid environmental degradation in watershed areas by the impact of urbanization, especially by informally developed areas (Tezer, 2005).

Drinking water is provided by seven watersheds in Istanbul and the Omerli Watershed is the most important since it supplies more than 1/3 of drinking water demand of the province. However, the watershed has been experiencing dramatic population growth and informal settlement dispersion. Informal settlements, such as Sultanbeyli District, spreaded around after 1980's with lack of building and infrastructure quality in the peripheral areas of Istanbul with additional degrading effects on the environment and natural resources (Firat, 2004; IMP, 2007). In this study, social vulnerabilities are seen as the major triggers of change in ecosystem services and also as main threats for resilience in Sultanbeyli's ecosystems. In this case, the integration of ecosystem services with resilience theory becomes essential to enlighten the conflicts reflected by social, economic and political characteristics of the Sultanbeyli District.

Since the Sultanbeyli District is located on the long-range protection zone of the Omerli Watershed (Tezer et al. 2011(a)) and accommodates densely constructed informal residential buildings, the provision of the socio-economic resilience and the integration of the ES into the urban resilience theory are essential. In general terms, the benefits of the integration of ES which are rationally in line with the resilience theory, can be classified as follows:

- Multi-dimensional land use
- Better integration of socio-ecological systems
- Better identification of land-management thresholds
- Better coordination, cooperation and governance
- Provision of information production and sharing
- Encouraging sustainable activities
- Improving adaptive governance systems
- Provision of financial resources

These perspectives will be evaluated in the case of Sultanbeyli District which has significant importance as representing unique example for the resilience of the Omerli Watershed and Istanbul.

2 INTEGRATING ECOSYSTEM SERVICES AND RESILIENCE THEORY

"Resilience", as a concept, emerged from ecology between the 1960s and early 1970s. Ecologist C.S. Holling introduced resilience as the capacity to endure within a condition despite the changes and assumed that "resilience determines the persistence of the relationships within a system and measures the ability of these systems to absorb changes of state variables, driving variables, and parameters, and persist still" (Folke, 2006 quoted Holling, 1973). While Folke et.al. (2002) defines resilience as the capacity of a system to absorb shocks and to maintain its functionality at the same time. So resilience provides the mechanisms to renew and reorganize its functioning, when there is a change. Moreover, Brand and Jax (2007) propose resilience as a boundary object in the sense that it incorporates the capacity of social-ecological systems to cope with, adapt to, and shape change and learn to live with uncertainty and surprise. Basically, urban resilience is a multi-dimensional concept which basically focuses on the achievement of the changes where urban settlements exposed to.

The attention this term receives is the response to a widespread sense of uncertainty and insecurity and a strain to find formulas for adaptation and survival (Müler, 2011). Resilience as a concept firstly appeared in the work of the ecologist C.S. Holling. According to Holling (1973), resilience is "a measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables." In 1986, Holling (1986) refines this definition as "the ability of a system to maintain its structure and patterns of behavior in the face of disturbance." In the late 1980s, the ecological vision of resilience involved the interactions between people and the environment in order to measure the complexity of community-environment interactions, and the changes they bring (Maguire and Cartwright, 2008), then in the 1990s several scholars adopted this approach as an important tool to measure sustainability.

A key conclusion is that the definition may vary according to the use that is done of it. Plodinec (2009) classifies resilience into four categories;

Being vs. Becoming: Many definitions of resilience begin with "the ability to . . . ," as an inner quality of the subject. Others view resilience as a process.
Adaptation vs. Resistance: Most of the definitions focus on the adaptability to adverse events.

Trajectory: A more ecological approach studies if an adverse event brings an actual change in the socio-ecosystem without evaluating whether the change is an improvement or not.
Predictability: This approach is used to predict how positively the subject will react and regain functionality compared to others.

Finally, these definitions can be taken in comparison according to of what is similar to resilience. As an example, resilience and resistance are often considered as similar, but they are not. Resistance should be the provision of protective structures in order to make systems not significantly harmed by natural hazards; while, resilience has more in common with the term 'adaptation. The process of adaptation may help to achieve resilience, but it can't be substituted with resilience (Surjan, Sharma and Shaw, 2011).

Vulnerability can be understood as the features of resilience to tackle with for being resilient. The social and ecological systems lose their resilience and become vulnerable to change, when the change couldn't be absorbed, adapted or transformed. Therefore, in vulnerable systems, even small changes may be devastating in results; while, in a resilient system change has the option to produce opportunity for development and sustaining of the system. When considerable transformation is unavoidable, resilient systems already contain the components needed for renewal and reorganization. Briefly, they can cope, adapt, or reorganize without sacrificing the provision of ecosystem's services. Given its origins in ecology, it is not surprising that most resilience scholars have historically been interested in empirical analyses of non-urban areas (e.g., shallow lakes, production forests, and small-scale agriculture), and have devoted less attention to the specifically human and social elements of human-dominated systems, such as cities. In fact, several elements of resilience theory are highly relevant to cities (Ernston et al. 2009). A resilience perspective recognizes that communities are diverse and have ecological, social and psychological dimensions (CSIRO, 2007). Resilience is associated with diversity of species, of human opportunity, and of economic options maintaining and encouraging both adaptation and learning (Folke et al. 2002).

Now the general approach of resilience for urban development related sectors is quickly expanding and including the following: mitigation and adaptation to climate change (Satterthwaite et al. 2007; Dodman, Ayers and Huq, 2009; Deppisch and Hasibovic, 2011), disaster planning, management and recovery (Goldstein, 2009; Vale and Campanella, 2005; Godschalk, 2003; Berke and Smith, 2009; Normandin, Therrien and Tanguay, 2009), energy and environmental security (Coaffee, 2008), urban design (Colding, 2007; Pickett et al. 2004), resilience as socio-ecological systems (Berkes, Folke and Colding, 1998; Adger, 2000; Folke, Colding and Berkes, 2003; Adger et al. 2005; Walker, Holling, Carpenter and Kinzing, 2004; Folke, 2006; Walker and Salt, 2006; Ernstson, 2008), urban resilience (Folke et. al. 2002; Alberti et al. 2003; Pickett, Cadenasso and Grove, 2004; Campanella, 2006; Gleeson, 2008; Maguire and Cartwright, 2008; Ernstson et al. 2009; Newman, Beatley, and Boyer, 2009; Deppisch and Schaerffer, 2010; Lin, 2006) and urban planning (Fleischhauer, 2008; Wilkinson, Porter and Colding, 2010; Scotti-Petrillo and Prosperi, 2011; Schrenk, Neuschmid and Patti, 2011; Wilkinson, 2011). The extended use of resilience allows the treatment of the issues raised by Holling (1986) about renewal, innovation and reorganization in system development and how they interact across scales (Gunderson and Holling, 2002; Folke et al. 2010).

The resilience of an area provides the idea about the management of social-ecological systems. Thus, in order to build resilience for social and ecological sustainability, firstly it is essential to explain the relation between the humans and the nature. People are the most significant part of the urban system. They, respond and react, get involved and interact with urban ecosystems (Pickett et al. 2004). Human activities modify the states, landscapes and the functions of the ecosystems, consume terrestrial environments for providing life-support systems and affect the sustainability of human society. Therefore, the "land use system" can be considered as the "coupled human-environment systems" or the "social-ecological systems" (SESs) (Lin, 2006). In the coupled human-environment systems, or SESs, natural and social systems play a dynamic role. The social-ecological systems act as strongly coupled, complex and evolving integrated systems (Folke et al. 2002). Human communities may show a great capability to face changes and adapt themselves if analysed only through the social dimension, but such adaptability may weight on the capacity of ecosystems to sustain the fitting, and generate gaps and discrepancies in the resilience of a social–ecological system. On the other hand, considering the ecological approach as a sole basis for decision-making for sustainability, may lead to too narrow and wrong perspectives. That is why it is necessary to work on resilience which stresses linked social–ecological systems (Folke, 2006).

Management of resilience-building is versatile and open to learning. It attends to slowly-changing, fundamental variables that create memory, heritage, diversity, and innovative capacity in both social and ecological features of the system. It also keeps and fosters the diverse necessary elements to reshape and adapt to new, unexpected, and ever-changing circumstances. Therefore, it increases the range of surprises with which a socio-economic system may cope (Folke et al. 2002).

3 SULTANBEYLI DISTRICT: AN INFORMALLY DEVELOPED QUARTER OF ISTANBUL

Sultanbeyli was established as a small village in 1950s for the immigrants coming from Bulgaria; however, today it extends over 3000 hectares area with a population over 282.000 people (Figure 1 and Figure 2). In 1954, a 750 ha area was acquired for residential development and Sultanbeyli received formal "village" status by the Government in 1957. Old village pattern of the settlement represents the planned character as different from the recent informal developments. According to different researches, the most important driving forces for the change in Sultanbeyli were the availability of cheap land, existence of the most important highway (TEM) passing through the district and intensive internal migration originated from different rural regions in Turkey (Hurfikir, 1994; Isik and Pinarcioglu, 2001). The District sustained its village status until the beginning of 1980's and became "municipality" with the impact of population increase and settlement expansion in 1987. In the meantime, 1350 ha of State Property forest area was taken out of "forest land status" (as 2B-degraded forest status) by the Directorate of Istanbul Environment and Forestry Department in the same year, as a result of illegal urban development expansion. 2B- degraded forest lands that lost forest characters are assessed by cadastral applications regarding to 2/B of 6831 No. Forest Law that was realized according to 1744, 2896, and 3302 numbered additional laws (Tezer et al. 2001(b)). In Sultanbeyli District 440 of total 695 hectares land disqualified from forest were transformed to built-up areas. This process encouraged to degrade forest areas in the form of shrinking and transforming to built-up areas continuously. Today, although land expansion is not continuing as fast as previously but population is still increasing in considerable ratios (Figure 2) (Tezer et al. 2001(b)).

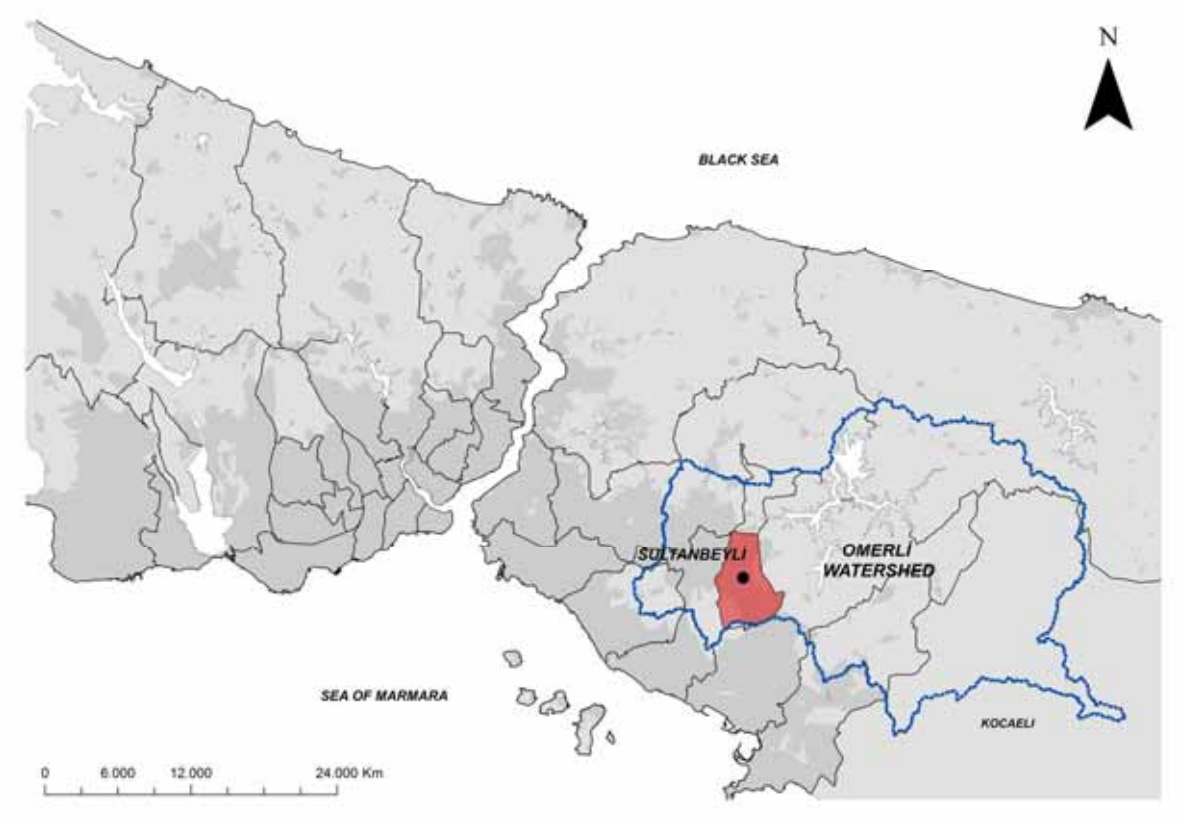

Fig. 1 Location of Sultanbeyli and Omerli Watershed in Istanbul (Tezer et al. 2001(b))

The irrigation pool, which is located on the southern central part of the District, with its 4.7 hectares area is an essential domestic and drinking water supply for Sultanbeyli and Pendik (IPDEF, 2007). Additionally, the north-eastern and south-western parts of the District are covered by forests and heath-lands and the Aydos Forest located near Sultanbeyli represents one of the most important forest ecosystems in the region. The flora of Aydos Mountain is enormously rich with Mediterranean, European-Siberian and Southeast Balkans species and it contains many rare and endemic plant species [Ozhatay and Keskin, 2007; Tezer et al. 2008; Ozhatay et al. 2005).

Between 1987 and 2005, transformation of almost 2000 hectares of land into built-up areas caused dramatic changes in the distribution of cultivated areas, bare-lands and other key ecological units in the Sultanbeyli District. Figure 2 and Table 1 show land cover changes of ecological units and built-up areas between 1987-2005. It is clearly visible that built-up areas represent a sharp increase while forests, woodlands, cultivated areas and bare-lands are simultaneously decreasing (Tezer et al. 2011(b)).

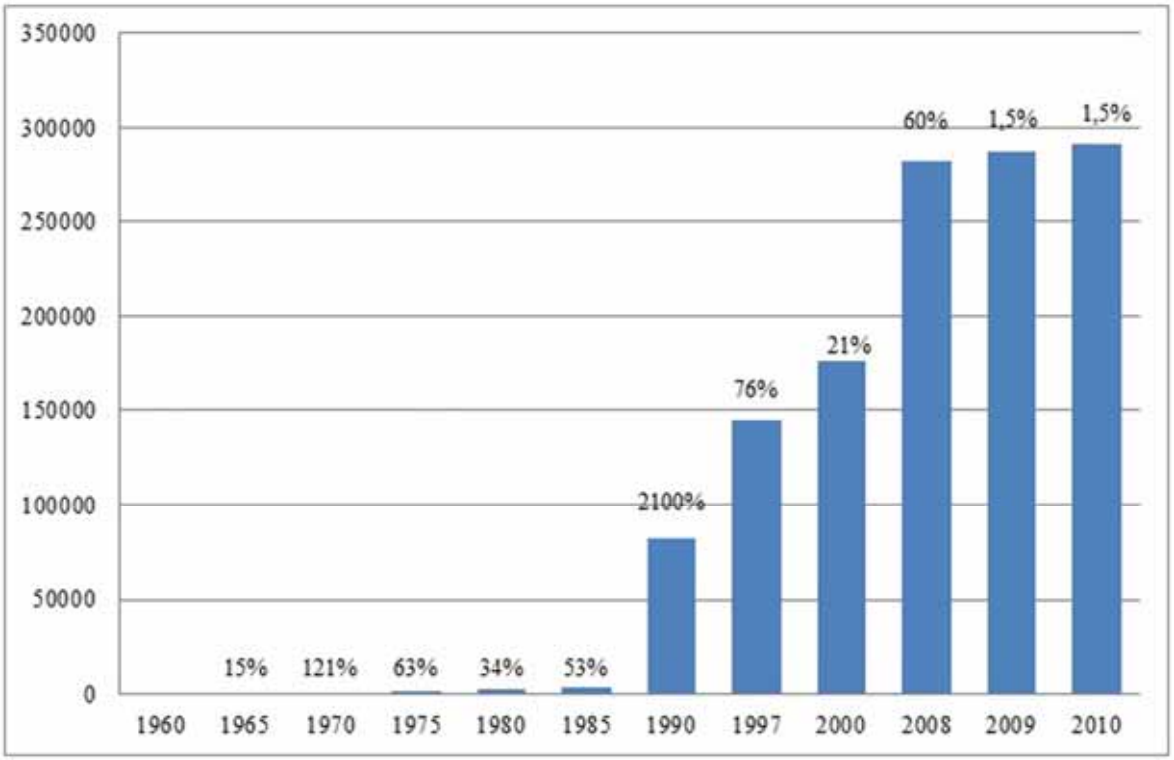

Fig. 2 Distribution of ecological units and built-up areas in 1987, 1995, 2005 (Tezer et al. 2011(b))

GROUP OF ECOLOGICAL UNITS	YEAR 1987 (Ha)	YEAR 1997 (Ha)	YEAR 2005 (Ha)	RATE OF INCREASE OR DECREASE IN LAND AREAS OF ECOLOGICAL UNITS AND BUILT-UP AREAS BETWEEN 1987-2005
Wetlands and surface waters	8	5	14	75% increased
Forests, Woodlands, Heath lands and Rocks	713	642	583	18% decreased
Cultivated Areas and Bare lands	2712	1836	852	68% decreased
Built-up Areas	67	1017	2051	2961% increased
TOTAL		3500 Ha		

Tab. 1 Changes in land area of ecological units and built-up areas in 1987, 1995, 2005 (Tezer et al. 2011(b))

Property right is another important issue leading to land degradations in Sultanbeyli. According to the land ownership distribution map given in Figure 3, 633 hectare of land belongs to the Treasury, 583 hectare of forest area is managed by the Ministry of Environment and Forestry and the rest of the area consists of private and shared properties. In 2005, in the Sultanbeyli District, 361 hectares of land belonging to the Treasury was occupied by illegal developments (Tezer et al. 2011(b)).

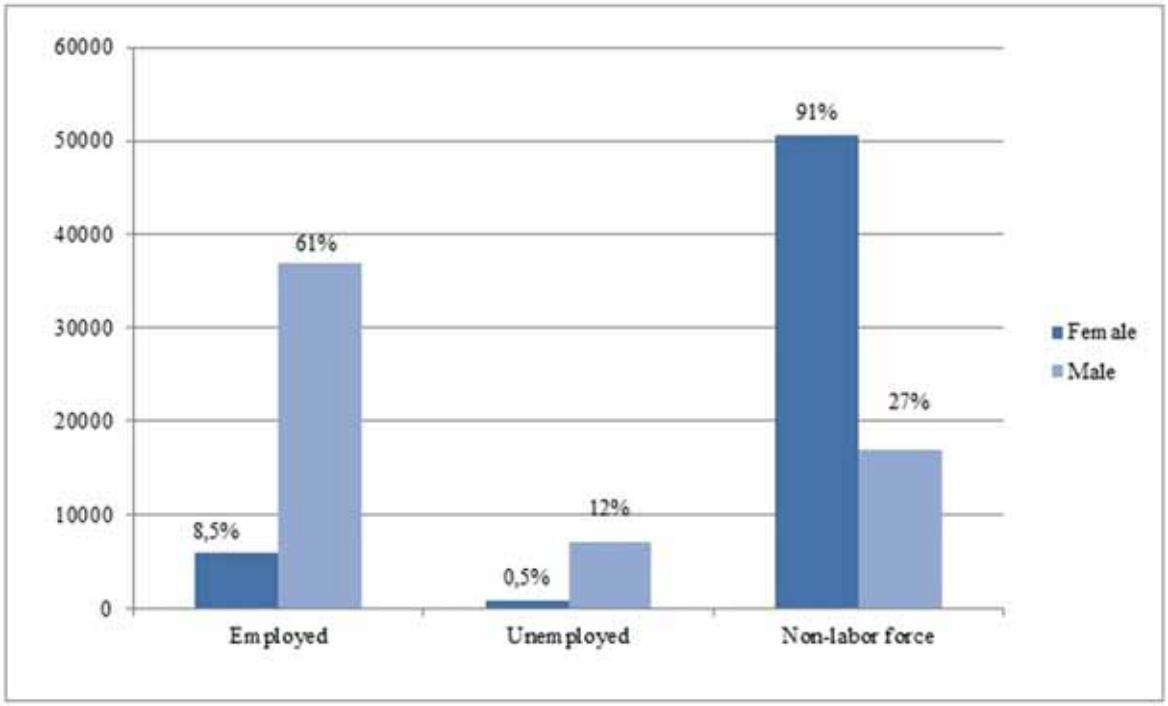

Fig. 3 Land use and ownership pattern in Sultanbeyli 2005 (Tezer et al. 2011(b))

The physical structure of Sultanbeyli developed as a result of the lack of control on land-management together with the ever starting and unfinished construction sites. In some periods, informal constructions were even encouraged with some legal tools such as building amnesties and Local Rehabilitation Plans. Consequently, the informal districts such as Sultanbeyli were legalized in every general election periods to persuade people who live in those areas for their political support. However, the quality of living standards, social services and infrastructures were way below the standards and out of control. Although the former examples of informal constructions and squatters (*gecekondus* in Turkish) in Istanbul were built for sheltering purposes only, the latter ones however, were much beyond than this as the ones in Sultanbeyli District. Latter *gecekondus* were different from the earlier ones with their multi-storey, concrete and not being "built over-night" characteristics. On the other hand, dense built-up pattern, lack of infrastructure systems and public facilities and more importantly the way of land occupation processes were the common features of these two types of informal building examples. These factors accelerated risks on ecological units and socio-cultural environment (Tezer et al. 2011(b)).

During the late 1980's, when the construction process of *gecekondus* accelerated, the majority of the buildings were unfinished: left without facade-plasters and unfinished-roofs recalling extra stores to be built in the future. In recent years, although they were looking like more 'complete', unfortunately the majority of these buildings had no engineering service and control during their construction processes. This building stock has another concern regarding to the earthquake risk with lack of required vertical and horizontal facilities for the strength of buildings (Tezer et al. 2011(b)).

Fig. 4 Population growth in Sultanbeyli (TUIK, 2010)

On the other hand, if we quest these changes we can find the overlap of extraordinary population growth and irregularity as a cause. As Figure 4 indicates sharply, the second half of the 1980's was the turning point for population increase in Sultanbeyli. Sultanbeyli's social profile formed with mostly immigrants from Black Sea and Eastern Anatolian Regions of Turkey. As Isik and Pinarcioglu (2001) state, there were three generations of immigration waves which are classified as;

-First generation: 1970's-1983 from outside of Istanbul-Black Sea Region,
-Second generation: 1984-1993 from Istanbul-outside of Turkey (foreigners) and central Anatolia region,
-Third generation: after 1994 from southeast Anatolia and eastern Anatolia region.

Internal migration waves have an important effect on the dynamics of social-economic structure in the peripheral settlements of Istanbul. First effect is the selection of Sultanbeyli as a settlement with the connections of people from the same part of the country as country-fellow (*hemseri*) and establishment of communion (*cemaat*) relationships. Secondly, development of income groups of districts with the effects of immigration waves (Isik and Pinarcioglu, 2001). Isik and Pinarcioglu argue that these migration waves have divided in sharp contrast the social structure of Sultanbeyli District as high income groups and low income groups. High income groups have their own homes and rental homes and they have solidarity networks like country-fellow and communion relationships. They have regular income, live in unqualified structures and environment but they have a chance for making their life conditions better. Low income groups who do not have regular income, they have to rent unqualified residential buildings and don't have the opportunity of solidarity networks as the others. Accordingly, low income groups who have difficulties for reaching qualified living conditions as education, working, security etc., are the most vulnerable groups of social structure.

Rapid population growth reflects a population structure with young profile constituting roughly the half of the total population. 44% of the population needs education and other basic public services which are insufficient amount and the quality in the District. Age structure of the population indicates that the rate of population below 15 years old (age limit for employment) constitutes more than 1/3 of the population in Sultanbeyli. In addition to young population characteristic, the majority of the population have not got qualified education background for employment and unfortunately only 1 % of the population have university degree. The majority of the population is constituted by children and young-adults (TUIK).

On the other side, unqualified education status and employment characteristics of population elucidate the developments on informal construction sector and the rents on urban-land becomes the first source of

income in Sultanbeyli (Isik and Pinarcioglu, 2001). In general, the participation of labour force especially for females is very low (Figure 5).

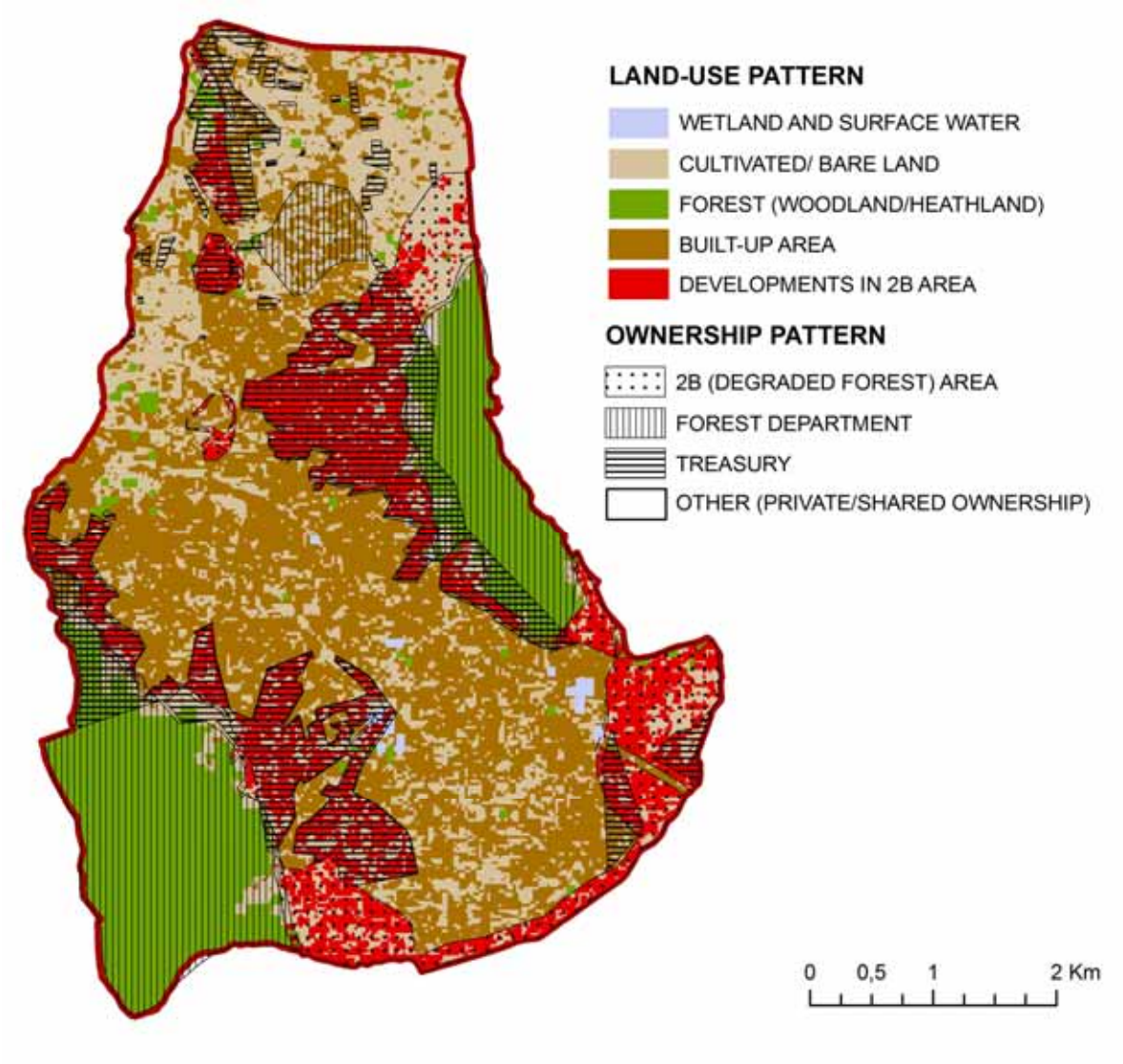

Fig. 5 Employment characteristics of Sultanbeyli (TUIK, 2000)

Therefore, irregular housing sector becomes the main driver of social, spatial and economic structuring of Sultanbeyli District. Cheap, unknown or governmentally owned lands accelerate informal housing developments with the contribution of socio-economic and socio-cultural characteristics of population. Unfortunately, these developments adversely effects ecosystems in Sultanbeyli and all together is not improving social capacity and impeding to strengthen the socio-ecological resilience capacity in the District.

As it was stated, in this research, social vulnerabilities are considered as the major drivers of change on ecosystem services and also main threats to the resilience of ecosystems in Sultanbeyli. Avoiding social vulnerabilities and providing social resilience is a way of understanding the dynamic systems of interaction between people and the environment.

Besides the obstacles of population profile, the inadequacy of social services and facilities, decelerates social integration of fragmented social structure and slows down communication and information flow within the community. It is remarkable that irregular housing settlements are the basic causes of social vulnerabilities, and the social vulnerabilities of the irregular/informal housing areas in Sultanbeyli can be grouped as follows;

-High rates of unemployment and marginal sector,
-High birth rates,

-High dependency ratio,
-Low rates of literacy,
-Low rates of participation to compulsory education,
-Low income rates,
-Socio-economic and cultural differences of the society in the Omerli Watershed area,
-High rates of young but non-qualified population,
-Continuous migration.

Table 2 summarizes the ecological, structural, social, economic and urban planning characteristics of the vulnerabilities in Sultanbeyli. In order to achieve socio-ecological resilience in the district, those vulnerabilities should be obviated.

ECOLOGICAL	- Risks on the sustainability of the ecosystem services by;
	  - *Degradation of natural habitats (especially forests and heath-lands),*
	  - *Illegal developments in riparian corridors,*
	  - *Contamination of water sources,*
	  - *Inefficient use of water sources,*
	  - *Uncontrolled use of surface and underground water sources.*
	- Risk of losing and/or transferring socio-ecological knowledge as a consequence of lack of relevant space to practice

STRUCTURAL	- Irregular/informal housing areas constructed by the immigrants. - Lack of engineering support/demand on the construction of houses, - Low cost and low quality housing which are vulnerable to natural hazards, - Lack of infrastructure and facilities, - Uncontrolled and unplanned developments, - Unhealthy and unsafe living conditions
SOCIAL	- Uncontrolled population growth, - Low rates of schooling, - Lack of cultural activities and social services, - Lack of access to socio-cultural and sport facilities, - Lack of health and social security, - Lack of social insurance as a consequence of the marginal sector or unemployment, - Lack of employment opportunities especially for females, - Irregular income distribution, - Non-qualified labour force, - Risk of cultural and ecological memory loss with migration.
ECONOMIC	- Lack of economic activities, - Increasing marginal sector , - Low income rates of illegal housing residents, - The relative low value of illegal buildings.
ADMINISTRATIVE	- Uncertain ownerships, - Unfair distribution of socio-cultural services, - Administrative failures, - Disregard to legal frameworks, - Uncontrolled urban growth, - Uncontrolled urban population increase, - Political pressures on urban planning practices.

Tab. 2 Characteristics of the Vulnerabilities in Sultanbeyli.

Although this table may not include the complete list of the vulnerabilities of Sultanbeyli, however some of the vulnerabilities were shown under the context of this study. The further step may be the definition of "key vulnerabilities" and the determination of policies to address these vulnerabilities.

4 HOW ES AND UR CAN BE INTEGRATED IN THE SULTANBEYLI DISTRICT

A research on ecosystem services will make a contribution to understand capabilities of social and ecological systems in the district as well. An important issue for this perspective is the definition of social and ecological vulnerabilities to maintain resilience in the area. Resilience is clearly related to the capacity of response to components of vulnerability, but resilience seems also to be a subset of capacity of response for social systems (Gallopin, 2007). Managing resilience is thus not only a matter of sustaining capacity and opportunities for development for now and in the future, but also a matter of environmental, social and economic security (Folke et al. 2002).

As it was emphasized, the resilience approach assumes nature and society being an integrated system. Moreover, based on the fact that the community development depends on the generation of ecosystem goods such as food, timber, genetic resources, and medicines, and services such as water purification, flood control, carbon sequestration, pollination, seed dispersal, soil formation, disease regulation, nutrient assimilation and the provision of aesthetic and cultural benefits on which humans are depended (Sessa, 2009; Folke et al. 2002; Tezer et al. 2011 (b)).

Ecosystem services provide outputs or outcomes that directly and indirectly affect human well-being and these services should be linked to the socio-economic dynamics as well as to the ecological processes (MEA, 2005). At this point, *resilience* concept, which aims to define dynamics, interactions and interdependencies between human and ecological systems, can be a relevant tool for poverty reduction and maintenance of ES which will support all aspects of human life (Adger, 2000; Carpenter and Folke, 2006).

Social resilience is related to adaptive governance, income stability, social diversity – stability (Adger, 2000), and these indicators can be examined by reference to economic, demographic and institutional variables in Sultanbeyli. On the other hand, ecological resilience is related to ecosystem stability and diversity of ecosystem functions. Therefore, the determination of ecological units, ecosystem services and ecosystem quality are necessary to display stability and functional diversity of ecosystems in Sultanbeyli. Since Sultanbeyli is located on the long-range protection zone of the Omerli Watershed, the resilience of Sultanbeyli depends on the resilience of the Omerli Watershed for ecological reasons. In fact, Sultanbeyli is an area developed as an illegal settlement near the watershed; it is not possible to generate a resilience theory without the reduction of the negative impacts of the irregular settlements in the watershed area and the vulnerabilities arising as a result of the socio-economic and ecological changes.

Therefore, the integration of ES and UR in Sultanbeyli together with the reduction of negative effects of irregular settlements based on these targets are listed below:

-Controlling and holding up urban sprawl is determined by laws
-Enhancing awareness for the importance of surrounding ecosystems among local people and stakeholders
-Improving construction and living environment qualities
-Enhancing buffer zones between settled area and ecologic units with ecological harmony.

The targets for strengthening the key vulnerabilities of social structure are;
-Extending education
-Enhancing different employment opportunities in harmony with qualified living environment and surrounding ecosystems
-Enhancing social networks for improving learning and adaptation capacity

Better integration of social-ecological systems
-Defining the relation types between local people and surrounding ecosystems apart from irregular constructing. How they benefit from ecosystems and what actions of them effect the surrounding ecosystems
-Identifying the inventory of surrounding ecosystems that local people have communication. Also enhancing these knowledge between other local people, authorities and associations
-Preventing adverse effects by law and social-networks

Achieving these targets will be directly related with the benefits of integration ES and UR for sustainable urban development (Figure 6).

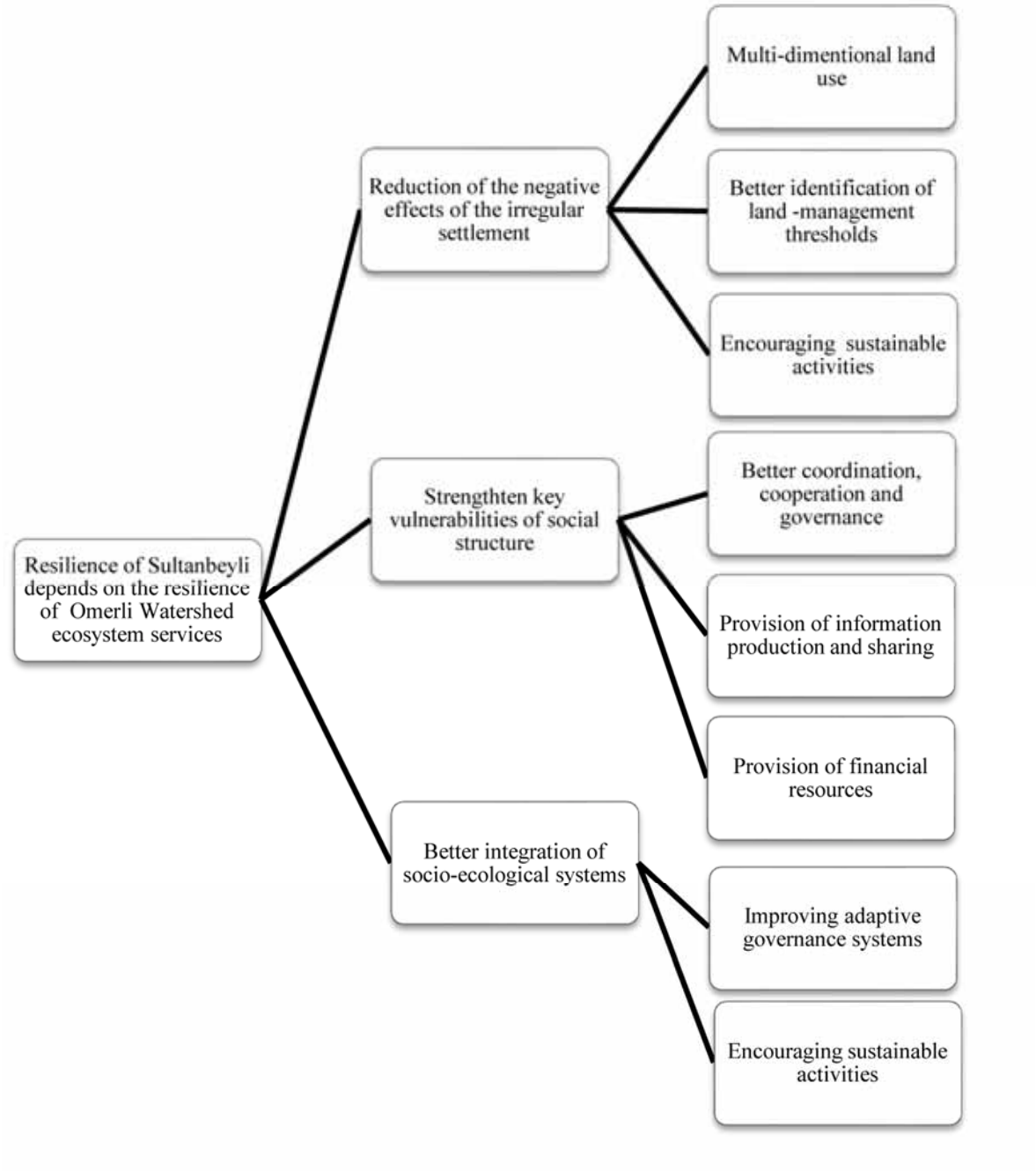

Fig. 6 The figure of integration of ES and UR in Sultanbeyli.

5 CONCLUSION AND RECOMMENDATIONS

A resilient city is a sustainable network of constructed physical systems, social structure and natural environmental components of settlements, like roads, buildings, infrastructures, communications, and energy facilities, as well as waterways, soils, topography, geology, further natural systems, and human communities who can regard to social, economic, cultural and political aspects of that settlement (Godschalk, 2003; Morrow, 2008). An urban system can be regarded as an ecological system with natural environment (ecological) and economic (social) subsystems, or coupled ecological-economic systems (Tezer

et al. 2011 (b); Isik and Pinarcioglu, 2001) where humans and ecological processes united as a mutually collaborating networks (Hurfikir, 1994). The principle of resilience indicates that cities are not passive victims, but they have to show flexibility by adjusting their sustainability policies to challenges and opportunities by more pro-active development policies. Since cities experience a world-wide rapid change process, the question is how to guarantee continuity in change; simply, how to use the precious elements from the past such as culture, science, and entrepreneurial spirit as the basis for a promising future. This resilience behaviour does not happen automatically, but definitely, it requires a successful sustainable urban development policy (Nijkamp et al. 1999). The following policies explain how the possible sustainable urban development policies in Sultanbeyli should integrate ES into resilience indicators:

- Social & Economic

Provisionary: The percentage of the society to benefit from the ES should be improved.
Regulatory: It is crucial to use recyclable, healthy, durable building materials also compatible with natural environment and to improve basic infrastructure systems. Appropriate building densities should be provided according to the position of ecologically sensitive units. Besides, it is essential to improve employment, education, access to socio-cultural activity opportunities especially for unemployed female population.
Supporting: Improving recreational facilities and infrastructure for the quality of life of intensive population as well as for the well-being of ecosystems is necessary to achieve resilient community.
Cultural: Sharing, generosity, reciprocity, redistribution, respect, patience, humility, equity are fundamental for a developed social network. Moreover, generation, accumulation and transmission of ecological knowledge and the construction of ecological data-base are important for the strengthening of social-ecological networks.

- Ecological

Provisionary: Agricultural land (crop fields, livestock production), water bodies (Surface water resources, Ground water storage, Fishing areas), forests, bush-lands and heath-lands (endemic species) should be protected.
Regulatory: Pollination, water regulation, erosion regulation, natural hazard regulation, air quality regulation, climate regulation, water purification and waste treatment, disease regulation and pest regulation should be provided.
Supporting: Nutrient cycling and water cycling primary production should be considered.
Cultural: Recreation and ecotourism can be considered as sustainable cultural policies, including the aesthetic values. Furthermore, generation, accumulation and transmission of ecological knowledge and the construction of ecological data base are essential for the educational policies and programs.

- Administrative & Urban Planning

Provisionary: It is necessary to strengthen participatory processes for spatial management of ES' provisionary services.
Regulatory: Improving and supporting individual-institutional (private-governmental) communications; land acquisition/regulation of critical ecosystems for critical services; extending mixed-uses on the benefit of ES services; disseminating/ advertising ecologically sensitive technologies; and ES services based watershed management tools and regulations.
Supporting: The change in ecosystems and in resource abundance should be monitored. Total protection of certain species, specific habitats and the protection of vulnerable stages in the life-cycle of species should be managed. Landscape patchiness management and integrated management for multiple species should be provided. Temporal restrictions of harvest should be programmed.
Cultural: Generation, accumulation and transmission of ecological knowledge and the construction of ecological data base should be directed by regulatory and implementation tools for management and urban planning purposes.

Although in the literature, there are studies such as explaining not only the ecological characteristics but also the social and administrative characteristics of resilience theory (Berkes et al. 1998; Lebel et al. 2006), this paper aims to present an integrative aspect of the socio-economic, ecological, administrative and urban planning indicators of resilience with the four basic ecosystem services (provisionary, regulatory, supporting and cultural services). Although it may not be the complete list of the aspects on ecosystem services and resilience interaction, however, it may open up a discussion for the further researches. Some of the indicators may be relevant for other crosschecks too. The aim was to represent the possible indicators of the integration of ecosystem services and resilience concepts at the urban planning scale for policy development and spatial organization.

ACKNOWLEDGEMENT

This paper is produced under the TUBITAK Project No.108K615 "Integrating Ecosystem Services into Spatial Planning". The authors would like to express their gratitude to the project research-group members, Prof. Necla Ulugtekin, Assist. Prof. Ozhan Ertekin and Assist. Prof. Cigdem Goksel for their valuable contribution in the project.

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TeMA Journal of Land Use, Mobility and Environment

TeMA 2 (2012) 177-183
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: 10.6092/1970-9870/946

La Resilienza: futuro della Protezione Civile

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Il termine Resilienza è stato adottato in protezione civile nel 2009, ad opera dell' United Nations International Strategy for Disaster Reduction: "In this field, Resilience has been defined as "the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions." (ISDR, 2009)." La resilienza è un antico termine, primordiale come i concetti di pericolo-rischio-difesa, ma oggi "coniato" nel mondo della Protezione Civile con una specifica declinazione del suo significato. Nel percorso evolutivo dei sistemi di Protezione Civile, la moderna Resilience riesce ad unire due visioni ed approcci differenti. Ovvero unisce gli elementi tipici del Proteggere afferenti alla Protezione Civile di stampo latino, con quelli del Difendere propri della Difesa Civile di matrice anglosassone. Questa fusione porta ad una nuova e più completa concezione di Disaster Risk Reduction (DRR) ed Emergency Management in grado di prendere il meglio di entrambi i sistemi. Questa evoluzione concettuale darà nuova spinta e rinnovamento al Sistema italiano di Protezione Civile, individuando risvolti tecnici ed operativi che implicheranno una revisione delle formule di Rischio ed Emergenza, giungendo ad una formula innovativa e chiara di Resilienza. Conseguenza di questo processo: la possibilità di modificare radicalmente le nostre chiavi di pianificazione territoriale e gestione degli eventi in un ottica…resiliente!

KEYWORDS:
UN-ISDR, DDR, Resilienza, Protezione Civile, Formule di Rischio ed Emergenza

1 LA RESILIENZA: FUTURO DELLA PROTEZIONE CIVILE

L'uomo ha sempre avvertito un profondo bisogno di sicurezza, definibile come uno degli impulsi fondamentali per la propria vita individuale e sociale. In via generale possiamo affermare che laddove un gruppo di individui di fronte alla percezione di un pericolo, valutato in termini di rischio, abbia approntato una qualsivoglia organizzazione di soccorso (non necessariamente tecnologica), di fatto abbia costituito una struttura di Protezione Civile. Per quanto si faccia riferimento a concetti definibili insiti nel nostro "DNA Umano", non essendo necessarie articolate definizioni per comprendere elementi come pericolo o rischio, la strada per la loro accettazione nel mondo tecnico della protezione civile è stato tutt'altro che lineare e rapido ed oggi ci troviamo di fronte alla necessità di affrontare la naturale evoluzione di un cammino spinti dai cambiamenti sociali, tecnici e scientifici avvenuti negli ultimi anni. Volendo ripercorrere rapidamente l'evoluzione italiana in questo campo possiamo individuare alcuni snodi fondamentali, non a caso collegati ad eventi importanti del nostro passato. Se nel 1908 con Messina lo Stato interpretava le azioni di Protezione Civile[1] come mere azioni di soccorso post-evento, si dovrà aspettare quasi 80 anni per iniziare a parlare di previsione e prevenzione (post terremoto irpino) e serviranno altri 15 anni (post Sarno) per introdurre in pianta stabile il mondo scientifico all'interno del Sistema di Protezione Civile Nazionale. Oggi ci troviamo di fronte ad un nuovo cambiamento, forse epocale, sicuramente sostanziale, che vede l'Italia recepire dal contesto internazionale termini, concetti ed approcci nuovi con cui affrontare le attività di Protezione Civile. Il periodo storico che stiamo vivendo, con la sua elevata incidenza sia delle attività umane sull'Ambiente, sia di capacità di risposta agli eventi avversi, pone in maniera sempre più diffusa il problema Sicurezza.

1.2 LA VISIONE INTERNAZIONALE

Nel 2005 l'ONU[2], delineò con chiarezza il concetto Sicurezza e l'insieme delle attività volte a ridurre il livello di Rischio:

- assicurarsi che la riduzione del rischio sia una priorità nazionale e locale con una forte base istituzionale per la sua implementazione;
- identificare, valutare e monitorare i rischi e predisporre sistemi di sorveglianza e preannuncio (early warning);
- usare la conoscenza, l'innovazione e l'educazione per costruire una cultura della sicurezza e della resilienza a tutti i livelli;
- ridurre i fattori di rischio nascosti;
- rinforzare la preparazione all'emergenza per una risposta efficace a tutti i livelli.

Di fatto le Nazioni Unite stavano già parlando di quell'insieme di azioni che più tardi, nel 2009, verranno racchiuse nel concetto di Resilienza. Per poterci addentrare in questo nuova tematica è necessario partire proprio dalla definizione di Sicurezza. Tra le molte definizioni esistenti, tutte strettamente legate al contesto (sociale, storico, ambientale, lavorativo) in cui si opera, un enunciato estremamente generale potrebbe essere quello che vede la Sicurezza come: la condizione di assenza di rischio, o meglio ancora, come la condizione (o percezione) di assenza di possibili eventi negativi. Il concetto Sicurezza deve quindi essere concepito in termini relativi: possiamo ritenere qualcosa sicuro, non in senso assoluto, ma quando lo si possa ritenere "adeguatamente" sicuro, ovvero quando si abbia la percezione di un grado di sicurezza ritenuto sufficiente rispetto all'attività o alla situazione che si sta vivendo. Dal concetto di sicurezza come "assenza di rischio" deriva necessariamente che il rischio possa essere visto come il complementare della sicurezza.

[1] Da notare che il termine Protezione Civile comparirà in via ufficiale in una norma di legge solo nel 1956 e verrà definito come concetto a partire dal 1970.

[2] Dalla risoluzione finale della Conferenza mondiale sulla riduzione dei disastri. Kobe, Giappone, Gennaio 2005.

Quando ci troviamo in una situazione di sicurezza elevata vorrà dire che il livello di rischio sarà basso, o quanto meno percepito come tale. Il Disaster Risk Reduction, filosofia a marchio ONU per affrontare le tematiche di protezione civile, abbraccia tale approccio concettuale: se la sicurezza è termine opposto e complementare del rischio, ovvero se l'assenza di Sicurezza comporta necessariamente un elevato valore di Rischio, è altrettanto vero che il nuovo concetto di Resilienza[3] può essere vista come l'insieme d'azioni volte ad aumentare il livello di Sicurezza e ridurre drasticamente quello di Rischio. Sicurezza e Resilienza divengono in tal modo due concetti strettamente legati.

1.3 DALLLE PAROLE CHIAVE ALLE FORMULE BASE DELLA RESILIENZA

A questo punto, al fine di comprendere i confini entro cui si muove il Disaster Risk Reduction è necessario aver chiari elementi quali Crisi ed Emergenza, fattori chiave della Resilienza che, seppur diffusi in ogni cultura, hanno definizioni quanto mai disomogenee. Infatti l'universalità dei due elementi fa si che vengano utilizzati nei campi più disparati, spesso con sfumature tutt'altro che sottili. Senza dubbio, non è difficile comprendere una situazione di crisi o un contesto emergenziale, quanto individuarne i confini precisi. In altre parole non è affatto semplice focalizzare, nello spazio e nel tempo, quando in un determinato contesto si verifichi uno stato di crisi, o anche quando da una condizione di crisi vi sia un passaggio ad uno stato d'emergenza. Una cosa è certa: in entrambe le situazioni agenti esterni concorrono a determinare i due contesti ed il fattore tempo gioca un ruolo centrale. In generale si può affermare che, nel caso in cui un dato evento, di matrice antropica o naturale, si manifesti in un dato territorio, avremo una condizione di crisi**,** con la possibilità che questi possa degenerare in una situazione di emergenza. Parleremo di crisi quando: "un sistema in equilibrio (statico o dinamico, naturale od antropico) viene sconvolto da uno o più fattori interni od esterni al sistema stesso"[4]. Se il sistema, a seguito di tale situazione di disequilibrio, non riesce con le proprie forze, a ritornare alla situazione originaria, o a raggiungere una nuova condizione di equilibrio, si verificheranno i presupposti per una condizione d'emergenza. Il significato di emergenza è tanto semplice da comprendere quanto complesso da spiegare. Allacciandosi, infatti, al concetto di pericolo cui, in un certo qual modo, è legato e rimanda, richiama immediatamente alla mente una situazione reale anche se non necessariamente presente, che fa comprendere come i due termini (pericolo ed emergenza) possano essere fortemente correlati ed entrambi definibili anch'essi primordiali. Per comprendere il significato di emergenza, dobbiamo quindi ricorrere essenzialmente a descrivere una situazione, ovvero: "A seguito di un determinato evento (naturale o antropico, prevedibile o imprevedibile) il suo superamento, volto ad affrontare e risolvere le problematiche verificatesi, o a evitare ulteriori situazioni di pericolo, crisi o disagio, è fortemente legato ai fattori di tempo e risorse disponibili."[5] Per quanto un determinato contesto possa essere evidente nella sua criticità, al punto di definirlo Emergenza, è difficile stabilire in modo netto quando, una situazione, passi da uno stato di crisi ad una emergenziale. Senza fissare qui confini troppo marcati, possiamo descrivere lo stato d'Emergenza:

$$E = R / (T \bullet Ri) \qquad \text{formula 4.1}$$

3 Da notare che si parla di concetto nuovo in quanto utilizzato per la prima volta in protezione civile, ma è bene ricordare che il termine resilienza viene già ampiamente utilizzato in numerose discipline tecniche ed umanistiche.
4 Fulvio Toseroni, Protezione e Difesa Civile, EPC Libri, Roma, 2009, p. 310.
5 Ibidem.

Un'emergenza dipenderà dal valore di Rischio[6] (R= P*V*E), ovviamente non più considerato in termini probabilistici, dal momento che l'evento è avvenuto, e dai fattori Tempo e Risorse. Questi due fattori sono tipici e caratteristici di uno stato emergenziale. Non vi sarebbe infatti una situazione d'emergenza, se non vi fosse un contesto in cui "c'è bisogno di fare qualcosa e di farlo in breve tempo". Ecco quindi che il fattore Tempo riveste una posizione cruciale. Se si avesse un tempo notevole per affrontare una situazione, non ci troveremmo di fronte ad una situazione d'emergenza. Collegare il concetto di Tempo all'azione del "compiere qualcosa", ovvero del raggiungere uno scopo tramite una sequenza di passaggi, significa introdurre il concetto di Tempistica[7]. L'altro fattore sono le Risorse, ovvero "quel qualcosa di cui abbiamo bisogno per compiere delle azioni", ovviamente in poco tempo, per raggiungere il nostro scopo o evitare una determinata situazione. Il possedere enormi risorse fa si che un contesto non sia subito e necessariamente emergenziale, viceversa l'esiguità di risorse o la povertà prestazionale di queste, può portare nel giro di poco tempo un evento, diversamente semplice, ad essere estremamente complesso nella sua risoluzione. Da queste riflessioni né consegue che Tempistica e Risorse siano i punti di riferimento di un'Emergenza. Questi elementi, possono essere rappresentati all'unisono dal concetto di Organizzazione:

$$\textit{Organizzazione}\ (O) = \textit{Tempistica}\ (T) \bullet \textit{Risorse}\ (Ri) \qquad \textit{formula 4.2}$$

Il fattore Tempistica può, a sua volta, essere scomposto in due elementi caratteristici:

$$\textit{Tempistica}\ (T) = \textit{Coordinamento}\ (C) \bullet \textit{Comunicazione}\ (Com)$$

formula 4.3

Ciò significa che la buona riuscita di una determinata azione è fortemente legata alla nostra capacità di coordinare le risorse (uomini, mezzi materiali..). Ciò è possibile solo se abbiamo un efficace sistema di Comunicazione. A questo punto il nostro concetto di Organizzazione può essere descritto tramite la seguente formula:

$$\textit{Organizzazione}\ (O) = \textit{Coordinamento}\ (C) \bullet \textit{Comunicazione}\ (Com) \bullet \textit{Risorse}\ (Ri)$$

formula 4.4

Una buona Organizzazione si basa, senza dubbio, sulle Risorse che si possiedono, ma queste se non opportunamente utilizzate, tramite un efficace azione di Coordinamento, saranno sicuramente mal impiegate rispetto alle loro potenzialità. Quanto maggiori saranno le Risorse tanto più complessa sarà la funzione di Coordinamento, la quale non potrà non prescindere, per il suo corretto funzionamento, da un efficace sistema di Comunicazione (interna ed esterna). Saper gestire le risorse disponibili (uomini, mezzi,materiali...) e ottimizzare i tempi, sia di reperimento delle stesse come anche il loro impiego armonico, significa avere un buon livello organizzativo, che non potrà, in nessun modo, non essere considerato che un elemento caratterizzante la pianificazione d'emergenza.

6 La formula di Rischio più conosciuta e diffusa vede questo valore essere il prodotto dei tre elementi: Pericolosità (P), Vulnerabilità (V) ed Esposizione (E).

7 Tempistica: dalla definizione dell'Accademia della Crusca: "tempo necessario per compiere un dato lavoro; serie di scadenze in cui si suddivide un lavoro".

$$E\ (\textit{emergenza}) = O\ (\textit{organizzazione}) \ /\ R\ (\textit{rischio})$$ *formula 4.5*

O in forma estesa:

$$E = C \bullet Com \bullet Ri \ /\ P \bullet V \bullet E$$ *formula 4.6*

Si può, nell'ottica di ridurre il Rischio come anche il grado di Emergenza, intervenire praticamente su tutti i fattori descritti in questa relazione. Le azioni condotte andando ad operare in modo particolare sul fattore Organizzazione, prendono il nome di Resilienza.

1.4 PRINCIPI DI RESILIENZA

A questo punto è doveroso sottolineare come è al verificarsi di una calamità o un disastro, sono sempre esistite due grandi scuole di pensiero, una di stampo latino l'altra anglosassone. In entrambe elemento centrale è sempre il cittadino (dal latino cives), scopo ultimo: proteggerlo, salvaguardarlo o assisterlo rispetto ad una serie variabile di eventi possibili. Fin dagli albori della sua storia, l'uomo ha sempre cercato la vita comunitaria, scoprendo ad esempio che "l'unione fa la forza", o che insieme ci si difende (o protegge) meglio dai pericoli8, infatti "la nascita della società può essere fatta coincidere con la nascita dei primi villaggi preistorici dove famiglie, vincolate da legami di sangue, di casta, o di ordine strategico, si raggruppavano intorno ai primi nuclei abitativi definibili villaggi. Tale scelta risultò tanto naturale quanto vitale per potersi meglio difendere da quei fattori esterni, come gli animali o gli abitanti di villaggi vicini, che in qualche misura potevano essere fonte di pericolo per la sopravvivenza della comunità a cui si apparteneva.9" Nel mondo latino moderno questo insieme di azioni operate intorno al soggetto Cittadino, ha preso il nome di Protezione Civile. Il termine Protezione (dal latino: pro-tegere = coprire) sta ad indicare quell'insieme di attività che hanno come oggetto finale il cittadino, da qui l'utilizzo del termine "civile", con il quale si indica sia l'oggetto dell'azione, i cittadini, sia il carattere non militare del settore. L'utilizzo della dizione Protezione, rimanda ad un concetto di tipo passivo, che potremmo definire a carattere preventivo. Nel mondo anglosassone la stessa tipologia d'azioni ha preso in prestito il termine Difesa (Civil Defence). Anche in questo caso si tratta di sostantivi di origine latina (de-fendere = Spingere, allontanare, pressare...). La differenza tra Protezione e Difesa, pur di fronte ad un comune obiettivo, è nel modo di leggere il contesto ed attuare l'azione necessaria. Nel campo della Difesa l'azione è marcatamente attiva, a tratti aggressiva, decisamente volta a ridurre qualcosa percepito come avverso, pericoloso, aggressivo, nemico. Come accennato precedentemente a partire dal 2009 l'UN-ISDR introdusse il nuovo concetto di Resilienza, in grado di fondere insieme elementi propri della Protezione Civile e della Difesa Civile, raccogliendo e valorizzando sia le caratteristiche più passive (preventive) della Protezione, sia quelle più attive della Difesa. Anche in questo caso, seppur il termine Resilence oggi provenga dalla lingua anglosassone, la sua origine è squisitamente latina[10]:

Resilienza (*resiliens*) =
Proteggere (*pro-tegere = coprire*) + Difendere (*de-fendere = spingere, allontanare, pressare*)

8 Il socio-biologo Trivers parla di "forme di altruismo reciproco". Queste sono riconducibili ad una serie limitata di condizioni di cui due principali: a) la possibilità di ottenere benefici in un momento successivo da parte del beneficiario della nostra azione; b) quando si ha un rapporto costi/benefici a noi favorevole.

9 *Ivi,* p. 25.

10 *resiliens*, genit. *resilientis*, part. pres. di *resilire* = saltare indietro, rimbalzare.

La resilienza è quindi un antico termine che viene oggi "coniato" con un significato ed in un settore nuovo. Dove riesce ad unire entrambi gli elementi-azioni, portando ad una nuova più completa concezione di soccorso. Nel mondo anglosassone il termine Resilience è definito come "the positive ability of a system or company to adapt itself to the consequences of a catastrophic failure caused by power outage, a fire, a bomb or similar event", in tempi più recenti ha incluso anche la seguente definizione-campo d'azione: "a burgeoning movement among entities such as businesses, communities and governments to improve their ability to respond to and quickly recover from catastrophic events such as natural disasters and terrorist attacks". Mentre in campo ONU: Disaster Risk Reduction con il termine Resilienza, si indica: "the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions."[11] Utilizzando termini e concetti italiani la Resilienza, riferiti all'ambito della Sicurezza e Protezione Civile potremmo definire il concetto di Resilienza nel modo seguente: "capacità di un Sistema di assorbire, al fine impedire o ritardare, il passaggio da uno stato di Crisi ad uno Emergenziale, un fattore perturbante ed invasivo, esterno o interno, previsto o imprevisto, reagendo e modellando la risposta della propria struttura allo scopo di superare l'evento avverso, ristabilendo un nuovo equilibrio nel Sistema." (Toseroni, 2010) Con tale definizione il concetto di Resilienza abbraccia numerosi aspetti del nostro vivere e del nostro operare nel campo della Protezione Civile. Il concetto di Resilienza viene ad indicare quindi un insieme di azioni possibili in grado d'interessare uno qualsiasi, o tutti gli elementi caratterizzanti un'emergenza descritti nella formula 4.6 . Se è vero che un Emergenza è: direttamente proporzionale all'evento accaduto (P), al livello di distruzione provocata (V) e al valore dell'oggetto distrutto (E), ed inversamente proporzionale alla capacità di coordinamento delle forze in campo (C), al livello di comunicazioni tra le forze (Com) e alla quantità e qualità di risorse disponibili (Ri); possiamo anche affermare che, allo stesso tempo, un'attività di Resilienza nell'ottica di abbassare il livello di un'Emergenza, sarà tanto più efficace quanto più bassi saranno i fattori riconducibili con azioni strategiche o programmatiche, alle attività per la riduzione della Pericolosità (P), Vulnerabilità (V) ed Esposizione (E), e tanto più elevati i fattori riconducibili, con azioni progettuali-formative-addestrative agli ambiti del Coordinamento (C), delle Comunicazioni (Com) e delle Risorse (Ri). Rileggendo questi fattori in chiave Emergenza o in chiave Resilienza appare subito evidente che in fondo, di fronte ad un Evento, Emergenza e Resilienza non sono altro che le due facce di una stessa medaglia.

$$E\ (\text{Emergenza}) = P \cdot V \cdot E\ /\ C \cdot Com \cdot Ri = Res\ (\text{Resilienza})\ (\text{Toseroni, 2010})$$

Al fine di ridurre i danni di un Evento è compito di, Istituzioni e Tecnici, far si che vi sia la miglior compensazione possibile tra numeratore e denominatore. L'unico modo per ridurre la magnitudo di un'Emergenza consiste nell'operare in un'ottica di Resilienza, quest'ultima potrà essere una prevalente azione preventiva (previsione) operando sui fattori P e V ed E, oppure una prevalente azione difensiva (soccorso) operando sui fattori C, Com e Ri o, infine, entrambe le cose. E' importante ricordare che non ci si trova comunque di fronte ad una formula lineare tra i vari fattori elencati, molti di essi infatti, rimandano a relazioni molto complesse. Un insieme bilanciato di tali azioni è in grado di rendere una Comunità "resistente all'urto di un evento". In altre parole una comunità, un Ente di Protezione Civile o una Nazione, è tanto più

[11] L'abilità di un sistema, comunità o della società esposta ai rischi di resistere, assorbire, adattarsi e recuperare di fronte agli effetti di un pericolo in modo tempestivo ed efficiente, anche attraverso la salvaguardia delle funzioni e strutture di base essenziali

"protetta" nei confronti di un emergenza, quanto più elevato è il suo grado di resilienza. Ciò significa che la capacità di assorbimento e risposta, rispetto ad un evento avverso, è fortemente legato alla gestione del territorio, al grado di vulnerabilità di ciò che vi ci risiede, all'atteggiamento e alla preparazione della popolazione e dei suoi amministratori, nonché al grado di professionalità, risorse, capacità di comunicazione e competenze delle strutture (pubbliche, private, professionali o volontaristiche) adibite al soccorso.

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L'immagine in apertura costituisce il logo del Cnetro Studi cui l'Autore afferisce.

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Fulvio Toseroni

Ha frequentato l'Università degli Studi di Perugia acquisendo nel 2005 la laurea in Coordinamento delle Attività di Protezione Civile, seguita da un Master di I° livello in Gestione delle Emergenze ed infine nel 2008 il titolo magistrale di dottore in Protezione e Difesa Civile. Nel 2010 ha frequentato presso l'Università di Roma "La Sapienza" il Master di II° livello in Ingegneria dell'Emergenza, presentando una tesi dal titolo: "Dal concetto di Rischio alla Resilienza: Praesidium, la pianificazione d'emergenza nelle aree montane. Il metodo Augustus applicato alle realtà montane." Ha collaborato con le principali Istituzioni ed Enti operanti nel settore Protezione Civile, seguendo tra l'altro, la pianificazione di difesa civile presso la Prefettura di Perugia, la pianificazione locale della Provincia di Perugia tramite l'utilizzo di sistemi GIS. Nel 2006-2007 ha lavorato al Dipartimento della Protezione Civile, svolgendo numerose attività presso l'Ufficio Emergenze e nell'Unità di Crisi. Nel periodo 2008-2011 ha ricoperto l'incarico di vice direttore tecnico del servizio di protezione civile presso la Comunità Montana Valnerina (Pg), con il mandato di strutturare il servizio intercomunale di protezione civile per i piccoli Comuni montani. Nello stesso periodo è stato membro del Comitato Tecnico Nazionale paritetico DPC-UNCEM fino al suo discioglimento. Nell'ottobre 2008 ha fondato la rivista tecnica Sistema Protezione Civile di cui è direttore e nel gennaio 2011 l'Istituto Italiano di Resilienza di cui è presidente. E' membro dell'Institute of Civil Protection and Emergency Management ed Emergency Manager Italiano Certificato dall'Associazione Italiana Disaster Manager. Nel 2009 ha pubblicato il testo: "Protezione e Difesa Civile –Storia, organizzazione, pianificazione ed analisi delle minacce future". Nel 2012 il testo: "Scautismo e Protezione Civile: storia, metodo, esperienze".

TeMA
Journal of
Land Use, Mobility and Environment

TeMA 2 (2012) 185-193
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: 10.6092/1970-9870/860

review paper. received 11 May 2012, accepted 15 July 2012

www.tema.unina.it

THE EFFECT OF CENTRAL METRO STATIONS ON REAL ESTATE VALUES.

A CASE STUDY OF THESSALONIKI, GREECE

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ABSTRACT

Almost all of the most populated cities in the world have invested heavily on high capacity urban public transit systems.
Apart from the direct economic benefits –travel time reduction, environmental benefits, some indirect benefits are the increase in real estate values (residential and commercial), improved accessibility and possible land use changes towards the development of an area. This study investigates the impact of the future central metro stations of Thessaloniki on real estate values. Real estate values can increase up to 11,3% at a distance shorter than 50 m and gradually decrease up to -14% for a distance greater than 500 m. A hedonic analysis is presented so as to determine the influence of metro stations to 52 commercial properties.
The results of the investigation indicate that the changes in market are not necessarily connected or totally attributed to the construction of the metro stations. Instead interesting results show that in some cases common belief about the impact of urban public transit systems can be slightly different.

KEYWORDS:
Metro stations, real estate values, Thessaloniki

1 INTRODUCTION

Public transport systems have always been a vivid economic sector for investment. Public transport is a shared passenger transportation service which is available for use by the general public so as to facilitate the transportation of huge masses between two destinations (Debrezion G., Pels E. and Rietveld P. 2007).

Apart from this primal goal, public transit systems provide benefits such as environmental protection, vehicle cost savings and economic development of commercial and residential areas (Swamy 2010). More specifically, after the construction of the first metro subway line in London in 1890, almost all large cities have constructed such metro lines.

Thessaloniki is the second largest city in Greece with an average population of 1300000 residents. The bus company operating in the city is O.A.S.TH. and is the only public means of transportation in the city. Therefore, after numerous studies and debates, in 2006 the construction of the Metropolitan Railway began with a time schedule of completion in 2015.

The main line will cover 9,6 km with 13 platform station which will cover the central part of the city. Moreover, at the first phase of the construction an extension to the east (Kalamaria) and another one to the west (Stauroupoli) of 5 km and 5 stations each will complete the first phase of the most important transportation system in Thessaloniki.

Lastly, the completion of the Metropolitan Railway will finish with the construction of the connective line to the Thessaloniki Airport Macedonia and the hospital “Papagerorgiou”.

A good transit system provides a high level and quality of access to work and other activities for households and for customers and employees for businesses. One way to acknowledge the value of this access is to examine the value of a home or a business, in addition to the value of other features such as the specific physical attributes of the building, the neighborhood characteristics and the surrounding environmental conditions (i.e. air pollution, cleanliness etc.) (Smith and Gihring 2011).

The impact of rail transit on property values has been studied from many perspectives, including analyses of different types of systems (e.g., rapid, commuter, light rail), of residential and commercial impacts and studies that have attempted to isolate both positive and negative effects.

As a result, many contradictory results have appeared mostly due to the different methods of analysis.

Yet, almost all studies show that transit systems are valued by property owners and, more specifically, they are positively valued increasing the property values in turn (Parsons Brinkerhoff 2001).

2 METHODOLOGY

Two central platform stations were chosen for the examination of their impact on commercial values (Venizelou and Agia Sofia) and a more eastern station of the main line (Flemigk) was chosen for the examination of its impact to residential values.

The property transactions, both for commercial and residential, are based on sales from 2000 to 2010 in a short distance from the studied stations.

The first two stations are believed to be ideal for such research because of the large number of commercial and office uses in their area. The main roads from which data was collected are Egnatia Street, Venizelou, Valaoritou, Ionos Dragoumi and Karolou Ntil. RICS states that the impact area of a metro station could extent up to 1000 m (RICS, 2004). Nevertheless, this statement is based on studies in much more populated cities around the world, so the findings should be adapted to Thessaloniki. Due to the fact that these stations are close to each other, a buffer of influence of 250 m is more than enough so as to avoid overlapping between the stations.

Fig. 1 Metro stations of Venizelou (left) and Agia Sofia (right)

The data were collected via questionnaires and interviews.

Firstly, a number of real estate agencies, offices, consumers and shop owners were interviewed in order to acquire a general idea of the economic situation, the market power, their knowledge of the characteristics of a transit system and their opinion about Thessaloniki's future subway line.

Secondly, specific questions were made especially to shop owners (private and on rent), which referred to the general economic state and specifically the market activity.

The questions that were asked are:

- What is the exact rent per square meter (rent rates)?
- If they believe that there will be positive, negative or neutral influences on their stores when the metro is going to be operational.
- If there was a decline in their incomes after 2008 and if yes with what percentage.
- If they tried to reduce the rental rate they pay because of the current difficult economic conditions and if so with w hat percentage.

A number of 52 shops were questioned about their opinion for the construction of the station, the reasons for any change in the market and the possible reduction of the rent.

At the same time they had the opportunity to express their opinion about the construction of the metro network, the problems that they faced the last five years and their ambitions in the near future.

The year 2008 is the crucial year for the Agia Sophia district because even though the whole project started in June 2006, the constructive operations in this specific area started in 2008.

So, comparisons are made over the period before and after 2008 and property values refer to before or after 2008 transactions.

During the research, a question emerged about which streets are more important for the current study.

For instance, according to a number of shops questioned at Ermou street, it was obvious that the construction of the metro in Egnatia street did not influence them (negatively) this specific period of time, so it was not necessary to expand the research in that street.

At this point, the used software is the IBM SPSS Statistics 19. A hedonic model is organized so as to present the influence that the changes in market due to economic crisis, construction of the subway or both, the positive/negative future effects of the subway to the market, the rent and the percentage of decrease of the rent have on the income of the shop owners.

The eastern station, Flemink, is located in an area where the most common use is the residential.

The studied streets are Delfon, Makedonias, Flemigk, 28th Septembriou and some other small roads.
The influence buffer is measured up to 300 m in this case because the two closest metro stations are far from Flemigk and there is no overlapping in this case.
The residential values ara based on data of transactions from 2000 to 2010 which were collected by specially designed questionaires. The survey included a large number of inquiries, including questions on the floor, the area, the antiquity and of course the value of the property.
The interviews were conducted face to face and the interviewed people were composed by assessing offices, homebuilders, commercial developers, leasing agents, appraisers, real estate brokers, development offices, land economists and land use planners.
The sample comsists of 100 values from which a small number was removed as unsuitable and inaccurate.
The methodology of the study follows a simple pattern. Answers of the questionnaires are organized and inserted in Microsoft Excel. The most important year for the Flemigk station of 2009 as it was the year that the construction started in the area.

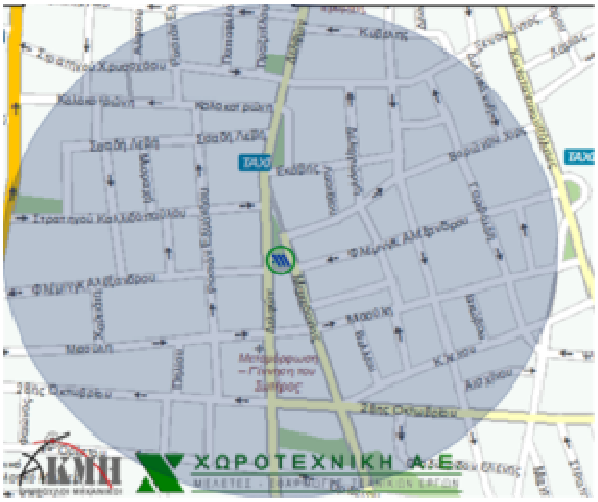


Fig.2 Buffer area of the metro station of Flemigk

The goal of this study is to identify if the general belief that transportation infractures influence and sometimes form a city's economic status.
Many studies have shown that investment in transportation provides a development boost in major cities (City UEZ 2011; Cavill et al., 2008; California Infracture Coalition 2006).
So the question is if and in what extent the construction of the subway line in Thessaloniki, a city of much smaller population and in a country of great economic instability, has an economic impact in real estate values and if this impact is attributed only to the subway line or if the general economic crisis plays its role as well.

3 RESULTS AND DISCUSSION

The hedonic model is based only on data for commercial uses.
The number of the entered data is 40.
The reason for which all 52 data were not entered is that 12 shop owners were private owners of the shop and, therefore, they did not pay any rent and no data were available for the variable "SqrootRsqm".

	DESCRIPTION	MEAN	STD. DEVIATION	N
SqrootRsqm	Rent/ sqm*	3,8971	3,54972	40
Road	Road on which the shop is located	1,6154	0,78188	40
Expect	Positive, negative, neutral influence of the metro when operational	1,6410	0,77755	40
Chmark	Changes in market (%)	47,5000	22,63846	40
Csfall	Causes of market fall	2,6154	0,71139	40
Nerent	Negotiation of rent	1,3333	0,47757	40
Prent	Percentage of rent change (%) after negotiation	-5,2949	10,87472	40

*After many transformations, the Square rout of the variable (√R/sqm) proved to be most suitable for the prediction equation of the model.

Table 1 Descriptive statistics

The variables primarily entered in the model are shown in Table 1 but according to the model only the "Nerent" remained in the equation, as its significance was lower than 10%. Special reference must be made to the variable "Chmark" which almost entered the model, as its significance was 10,5%. However, for reasons of suitability and propriety of the model, the variable was not entered.

This indicates that at least in Thessaloniki the rent that the shop owners pay and the change in their income is not attributed to the construction of the metro, a belief that is proved by the fact that in smaller roads where the construction does not take place the decrease in rent and income is present too. Moreover, the changes in market activity are attributed to other factors as well, such as high prices, unwillingness of consumers to make transactions etc.

The R coefficient (78,6%) indicates the correlation between observed and predicted values of the dependent variable. The next indicator is the R square (61,9%), which shows the percentage of dispersion that can be interpreted by the dependent variable. Both indicators are considered satisfactory. The next indicator is the adjusted R square (60,8%). The higher the value of the indicator, the better the regression model is, due to the fact that the indicator shows the predictive power of the regression model (Wooldridge 2003).

In this case, the indicator is satisfactory too.

R	R SQUARE	ADJUSTED R SQUARE	STD. ERROR OF THE ESTIMATE	DURBIN-WATSON
0,786	0,619	0,608	2,22187	1,513

Table 2 Model Summary

Table 3 indicates the amount of influence each variable has on the value. More specifically, the only entered value in the equation has a B coefficient equal to -5,846 which shows that the rent decreases by this amount each time that the answer to the question of whether there has been a negotiation of the rent or not changes.

MODEL	UNSTANDARDIZED COEFFICIENTS		T	95,0% CONFIDENCE INTERVAL FOR B		COLLINEARITY STATISTICS	
	B	STD. ERROR		LOWER BOUND	UPPER BOUND	TOLERANCE	VIF
(Constant)	11,691	1,067	10,954	9,529	13,854		
Negotiation of rent	-5,846	0,755	-7,745	-7,375	-4,316	1,000	1,000

Table 3 Coefficients table

The function of the hedonic model is:

SqrootRsqm= 11,691 – 5,846 Nerent

At this point, it is crucial to verify the appropriateness of certain hypothesis on which the method of least square is based on.

Independence test

Durbin-Watson indicator identifies if the variables are positively, negatively or not at all correlated, as wanted. The values of this indicator vary between 0 and 4. When the values vary between 1,5 and 2,5, the variables are independent and, therefore, no related problem exists in the model (Harrel 2002). In this case, the value is 1,513 (Table 2).

Residuals' normality test

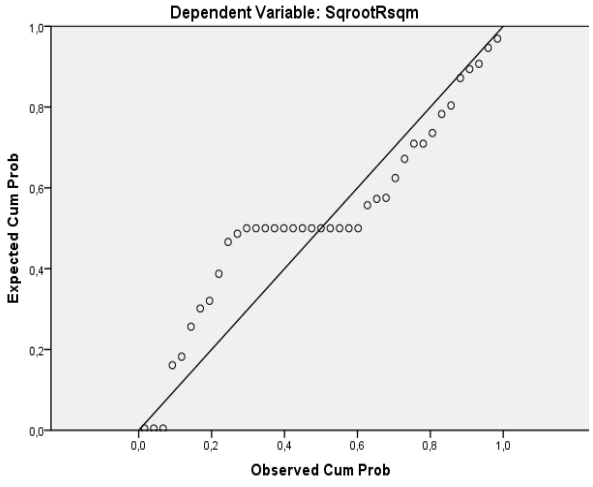
In every linear regression analysis, the existence of outliers is very dangerous for the stability and the accuracy of the model. Chart 3 and 4, which include the std. residuals, are very satisfactory ways of proving the normality of the model. Through these charts, it is clear that approximately normality is satisfied. The histogram shows a tendency to the right but, according to the figures, this tendency does not play a significant role to the results or incapacitate the model.

Linearity test

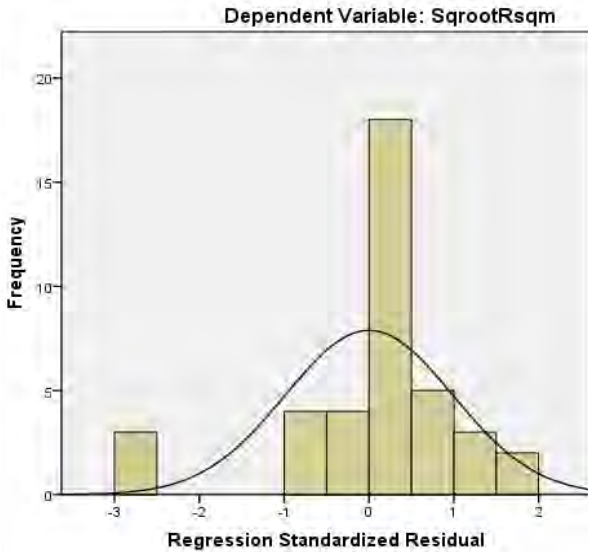
Both charts are sufficient for the linearity test.

Collinearity test

The indicators used for the collinearity diagnostics are the Tolerance factor and VIF. If the tolerance factor is near 1, then no problem of collinearity is observed. On the hand, if VIF exceeds 10, then there is a problem of collinearity (Luchters and Chakrabarty 2006). In this case of study, both indicators prove the absence of collineraity or multicollinearity.



Normal P-P Plot of regression standardized residual



Histogram for the normality of the residuals

It is clear that after taking into consideration the characteristics of the shop (size, floor, layout etc.) the value of commercial properties is not always directly connected to the most common reasons, such as road where the shop is located. As far as residential properties are concerned, the most influential factor is the

distance to a metro station which is measured- in most cases- by the walking distance that the residents are willing to walk. Many studies have shown that this distance is approximately between 150-500 m (Dittmar and Ohland 2004). Some of the findings in several studies are shown below (Planning Commission TOD Committee 2011):

JURISDICTION	WALKING DISTANCE
Mass Transit Administration (Maryland)	500 m
Mid-America Regional Council (Kansas City, Missouri)	500 m
NJTransit (New Jersey)	400- 800 m
Ontario Ministry of Transportation	400 m
Regional Plan Association (NY, CT, NJ Tri-metro area)	400 m
Snohomish County Trans. Authority (Snohomish City, Washington)	300 m

Table 4, TOD Manuals from other Jurisdictions/Transit Agencies

In Thessaloniki, the results differ as far as the walking distance is concerned due to its much smaller population. Therefore, values differ within a very small walking distance from the Flemink station. More specifically, the crucial distance at this phase of construction -as it is expected to maximize after the beginning of the operation of the transit system- is approximately 60 m. This result is attributed to the dissatisfaction of the residents during the construction (noise, air pollution etc.) and the perspective that after such nuisance during the construction each resident wants the metro station to be as close to him as possible.

Therefore, if the distance is less than 50 m, residential values increase up to 4% and in some cases extremely more. If the distance is between 50-100 m, the values can decrease up to -11% and, finally, if the distance reaches 300 m and more, values can drop up to 22,5%. At this point, it must be pointed out that these percentages refer only to the walking distance to the metro station if taken for granted that the properties have the same or almost the same characteristics.

4. CONCLUSION

High level transit systems are a need to all major cities especially after the expansion of the urban sprawl in America at the beginning of the 19th century (Arbury 2005) and in Europe from the second half of this decade (EEA 2006).

Their effects can expand in various sectors, such as mobility benefits, efficiency benefits, travel time impacts, land use impacts, economic development impacts, environmental benefits etc (Litman, 2012). Therefore, it was unlikely that transit systems did not affect property values, commercial or residential.

Proximity to transit systems' platforms can affect property values. Any property close to a metro station is probably overestimated. Depending on how close the property lies to the station, whether the station is constructed or under construction, the value of a common property can be affected in many different ways (Ghebreegziabiher et al. 2006).

Devalued or not affected properties can gain some of their value after some time from the beginning of the operation of the transit system as its advantages are more perceptible and observable after its practical operation.

Thessaloniki is a city of many difficulties, one of the most important of which is the traffic problem.

Almost 1300000 residents move every day with their vehicles causing huge traffic conjunctions as the only transportation system in the city is the bus service.

After the construction of Athens metro line, it has become clear that many positive (i.e. decrease in private vehicle use, improved air quality etc.) effects alter the quality of the residents' lives.

Although negative effects are evident too (i.e. unsuccessful utilization of the park and ride system) (Spillar 1997), they are not connected with the failure or the unsuitability of the transport (OMEGA 2010).

In this study, Thessaloniki's transit system construction had some effect on property values.

It is fact that the economic crisis in Greece influences the markets of Thessaloniki simultaneously with the construction of subway line.

Therefore, it is difficult to state and present the real effects of the transit system on commercial and residential values. Furthermore, the negative aspect that must be taken into account is the delay of the constructions.

People are very disappointed and they do not have clear and certain future ambitions because there is no standard organized time schedule by the construction company or the government.

Residential values drop up to an average of 15% and commercial (as far as their transactions are concerned) drop up to an average of 19%.

Apart from the figures, an important factor of influence is the psychological. When residents and users view a worksite as the façade of their property, they tend to exaggerate for its impact (visual impact, noise nuisance etc). Moreover, the fact that the transit system was scheduled to finish earlier but, on the contrary, it will last 2 more years, influence the public opinion as well.

These are the main results and reasons for which the construction of the subway has to deal with most negative opinions. It is obvious that there will be influences in the area but the fact that current information was collected and people who were asked are not that objective proves that the survey is circled around the current problems in the area.

Therefore, these impacts associated with Thessaloniki's Metro development should be studied again after the completion of the whole project and after a period of time of its operation in order to permit the complete adjustment of the real estate market. However, the majority of the citizens –if not all– in every part of Thessaloniki believe that the subway will have a very positive effect to the city and to one of its most important problems, the traffic conjunction.

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TeMA
Journal of
Land Use, Mobility and Environment

TeMA 2 (2012) 195-212
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: 10.6092/1970-9870/905

I FINANZIAMENTI EUROPEI PER L'AMBIENTE E LA MOBILITÀ

European funds for environment and sustainable mobility

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ABSTRACT

The "Guide on the European Programmes Funding for Energy, the Environment and Sustainable Mobility" is an overview of the most significant European funding programs (in the period 2007-2013) to promote the territory and mobility. The programs are aimed at financial measures and measures of environmental policy and governance, information and communication, product development, technical and research activities aimed at reducing CO2 emissions, reducing road congestion and pollution, for example by promoting media greener transport for the traffic of European goods.

The total resources made available by the programs is around 14 billion of euros, with financing arrangements and beneficiaries belonging to different geographical areas, including Italy and the Mediterranean. A peculiarity of these programs is to provide for notices (these calls) usually published on an annual/six monthly, which allow recipients to plan participation in the call later. These programs represent an opportunity for developing regions, such as the Southern Regions "Mezzogiorno", who need more support to align with the average levels of growth in Europe.

The complete guide, was presented by ANCE (National Association of Builders) and RENAEL (National Network of Local Energy Agencies), March 22, 2012, during EnergyMed (Exhibition and Conference on Renewable Sources and Energy Efficiency that held annually in Naples).

KEYWORDS:
Ambiente, Mobilità sostenibile, Finanziamenti europei, Ance, Renael

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I FINANZIAMENTI EUROPEI

La "guida sui Programmi Europei di Finanziamento per l'Energia, l'Ambiente e la Mobilità Sostenibile", costituisce una rassegna dei più rilevanti programmi di finanziamento europei (periodo 2007-2013) per favorire il territorio e la mobilità. I programmi mirano a finanziare interventi e misure di politica e governance ambientale, informazione e comunicazione, sviluppo di prodotti, tecniche, e attività di ricerca finalizzate a ridurre le emissioni di co2, la diminuzione della congestione stradale e dell'inquinamento, promuovendo ad esempio mezzi di trasporto più ecologici per il traffico di passeggeri e merci europee.

Il totale delle risorse messe a disposizione dai programmi si aggira sui 14 miliardi di euro, con modalità di finanziamento diverse e beneficiari appartenenti ad aree geografiche che includono l'italia e il mediterraneo. una peculiarità di tali programmi consiste nel prevedere bandi (detti call) generalmente pubblicati su base annuale/semestrale, che permettono ai beneficiari di pianificare la partecipazione alla call successiva. Tali programmi rappresentano un'occasione di sviluppo per regioni, come il mezzogiorno, che necessitano di un maggiore sostegno per allinearsi ai livelli medi di crescita europea.
La guida completa, è stata presentata dall'Ance (Associazione Nazionale Costruttori Edili) e da Renael (rete nazionale delle agenzie energetiche locali), il 22 marzo 2012, in occasione di Energymed (Mostra Convegno sulle Fonti Rinnovabili e l'Efficienza energetica che si tiene annualmente a Napoli), e si articola in due sezioni principali:
La I sessione riguarda i programmi di finanziamento comunitari, che forniscono sovvenzioni nei settori dell'ambiente e dell'energia per il settore delle costruzioni, destinati agli stati membri dell'Unione europea, tra cui l'Italia ("Programmi di finanziamento interni").
La II sessione riguarda i principali programmi e strumenti destinati all'assistenza ai paesi terzi da parte dell'Unione europea ed è denominata "Programmi di Finanziamento esterni".
Le singole schede di ogni programma riprendono gli obiettivi, la descrizione delle azioni finanziate, l'importo disponibile, la percentuale di cofinanziamento e i criteri di ammissibilità per partecipare agli inviti a presentare proposte: nella maggioranza dei casi sono state inserite le principali informazioni sull'ultimo bando per il programma analizzato, in modo da fornire un'idea più chiara dei criteri necessari ad ottenere i finanziamenti. alla fine di ogni scheda sono poi fornite una serie di informazioni utili per approfondire la conoscenza del programma.
In particolare, per quanto concerne i primi, la presente guida analizza:

1. Life plus, il programma per la tutela dell'ambiente;
2. Eco-innovation, il programma a sostegno delle tecnologie innovative;
3. Energia Intelligente per l'Europa, il Programma a sostegno dell'efficienza energetica;
4. Marco Polo, programma che offre un finanziamento a fondo perduto per progetti di riduzione del traffico o che forniscono servizi di supporto che permettono di trasferire il passaggio delle merci dalla strada verso altri modi di trasporto più efficienti e redditizi;
5. 7° programma quadro per la ricerca e lo sviluppo;
6. Programma Operativo Interregionale - Energie rinnovabili e risparmio energetico.

In ambito di "Programmi di finanziamento esterni", vengono analizzati i seguenti strumenti:

1. Enpi, il programma che finanzia gli interventi nei paesi confinanti ad est e a sud con l'unione europea, con focus particolare sul programma che coinvolge l'italia e la tunisia;

2. Ipa Adriatico, il programma a sostegno dello sviluppo dell'area adriatica;
3. Med - Programma Operativo Transnazionale Mediterraneo .

Fig.1 - Presentazione della guida dei finanziamenti europei ad EnergyMed 2012

SESSIONE 1

1.1 LIFE PLUS, LO STRUMENTO COMUNITARIO PER FINANZIARE PROGETTI AMBIENTALI

Life plus è lo strumento comunitario utilizzato dall'Unione Europea per finanziare progetti ambientali. Life plus è nato per contribuire all'attuazione, all'aggiornamento e allo sviluppo della politica e della normativa comunitarie in materia di ambiente, compresa l'integrazione dell'ambiente in altre politiche, contribuendo in tal modo allo sviluppo sostenibile.

Il programma life è iniziato nel 1992 e da allora si sono succedute tre fasi di programmazione complete (Life I:1992-1995, life II:1996-1999, life III:2006-2007). durante questo periodo life ha cofinanziato 3104 progetti in tutta l'Ue contribuendo approssimativamente con 2,2 miliardi di euro alla protezione dell'ambiente.

La fase attuale del programma è denominata life + e, per il periodo 2007-2013, sono stati stanziati un totale di circa 2,1 miliardi di euro per progetti ripartiti secondo tre componenti:

- Natura e biodiversità
- Politica e governance ambientale
- Informazione e comunicazione

Potenziali beneficiari

Le proposte possono essere presentate da enti pubblici e/o privati, soggetti ed istituzioni registrati negli stati membri dell'unione europea. le proposte possono anche essere presentate da un singolo beneficiario o da una partnership che include un beneficiario ordinante e uno o più beneficiari associati. Essi possono essere nazionali o transnazionali ma le azioni possono svolgersi solo nel territorio dei 27 stati membri dell'Ue.

Percentuale di cofinanziamento

La percentuale massima del sostegno finanziario dell'unione è pari al 50 % delle spese ammissibili per i progetti life plus presentati nell'ambito delle tre componenti (natura e biodiversità, politica e governance ambientale e informazione e comunicazione).

Eccezionalmente può essere applicata la percentuale massima di cofinanziamento fino a 75 % delle spese ammissibili ai progetti riguardanti habitat o specie, prioritari delle direttive "uccelli selvatici" e "habitat", relativi all'area tematica natura e biodiversità.

Modalità di partecipazione

Coloro che partecipano al programma devono presentare le proposte all'autorità nazionale competente, utilizzando appositi moduli di domanda disponibili sul sito web del programma life plus e trasmesse su cd-rom o su dvd alle autorità nazionali competenti. Si noti che il regolamento life permette agli stati membri di specificare delle priorità nazionali in merito all'invito a presentare proposte Life plus.

Per il bando del 2011, 6 stati membri hanno esercitato questo diritto, tra cui l'Italia. i progetti di questi stati membri hanno maggiori possibilità di essere selezionati per ricevere il finanziamento se corrispondono alle priorità indicate, oltre a dover soddisfare i criteri di Life plus.

Selezione del progetto

L'autorità nazionale riceve le proposte e le trasmette alla commissione europea che a sua volta invia un avviso di ricevuta al beneficiario coordinatore. L'unità Life della direzione generale ambiente della commissione è responsabile della valutazione dei progetti. essa verifica l'ammissibilità, esclusione ed eleggibilità, i criteri di selezione e propone al comitato Life+ una lista di progetti per il cofinanziamento, in accordo con i criteri sottolineati nella guida per la valutazione delle proposte Life+ che viene pubblicata ogni anno insieme all'invito a presentare proposte.

Referenti nazionali	Giuliana Gasparrini Ministero dell'Ambiente e della Tutela del Territorio e del Mare, tel: +39 06 57228252 lifeplus@minambiente.it
Programma life Commissione europea dg ambiente (dg env)	http://ec.europa.eu/environment/life/funding/lifeplus.htm
Invito a presentare proposte life plus 2012	http://eur-lex.europa.eu/lexuriserv/lexuriserv.do?uri=oj:c:2012:074:0011:0013:it:pdf
Priorità nazionali annuali per l'italia (2012)	http://ec.europa.eu/environment/life/funding/lifeplus2012/call/documents/nap_italy2012.pdf

1.2. ECO-INNOVATION, IL PROGRAMMA CHE SOSTIENE PRODOTTI, SERVIZI E PROCESSI ECO-INNOVATIVI

Lanciata nel 2008 l'iniziativa cip Eco-innovation fa parte del programma per l'innovazione e l'imprenditorialità (eip) che supporta l'innovazione e la competitività delle Pmi. Eip, a sua volta, fa parte del più ampio programma quadro per la competitività e l'innovazione (cip).

Eco-innovation sostiene i progetti legati a prodotti eco-innovativi, tecniche, servizi o processi che puntano a prevenire o a ridurre l'impatto ambientale o che contribuiscono all'uso ottimale delle risorse. Inoltre esso intende sanare il gap esistente tra ricerca e mercato, favorire la formulazione di buone idee per la creazione

di prodotti innovativi, servizi e processi produttivi che rispettano l'ambiente. In questo modo, l'iniziativa aiuta non solo l'Ue a raggiungere i suoi obiettivi ambientali, ma anche a favorire la crescita economica.

Eco-innovazione significa ridurre il nostro impatto ambientale e utilizzare meglio le risorse a disposizione. ciò significa sviluppare prodotti, tecniche, servizi e processi che riducono le emissioni di co_2, che usano risorse in modo efficiente e che promuovono il riciclo. I progetti Eco-innovation non sono progetti di ricerca. Le idee devono essere già sviluppate e fattibili nel lungo periodo per accedere al finanziamento.

Vi sono tre principali aspetti considerati in questa iniziativa:

- Benefici ambientali
- Benefici economici
- Contributo dei progetti all'innovazione

L'iniziativa Eco-innovation è gestita dall'Agenzia Esecutiva per la Competitività e l'Innovazione (Eaci) in cooperazione con la direzione generale ambiente della Commissione Europea. per il periodo 2008-2013 sono stati stanziati 200 milioni di euro per il finanziamento di progetti nell'ambio di questa iniziativa.

REFERENTI NAZIONALI	Per questioni riguardanti il programma in generale: Giuliana Gasparrini Ministero dell'Ambiente e della Tutela del Territorio e del Mare, tel: +39 06 57228252 Per le questioni amministrative: Stefania Betti Ministero dell'Ambiente e della Tutela del Territorio e del Mare tel: +39 06 57228252
Programma eco-innovation Commissione europea Dg ambiente (dg env)	Http://ec.europa.eu/environment/eco-innovation/index_en.htm

1.3. ENERGIA INTELLIGENTE PER L'EUROPA, IL PROGRAMMA PER L'EFFICIENZA ENERGETICA E L'USO DI FONTI DI ENERGIA NUOVE E RINNOVABILI

Il Programma Energia Intelligente per l'Europa 2007-2013 (EIE II) rientra nel programma quadro per la competitività e l'innovazione (Cip) dell'unione europea. basato sull'esperienza acquisita nel quadro del programma "Energia Intelligente in Europa 2003-2006", EIE II contribuisce alla strategia europea per un'energia competitiva "energia 2020", proponendosi il raggiungimento degli obiettivi UE 2020 in materia di cambiamento climatico /energia:

- Riduzione delle emissioni di gas serra del 20% (o del 30% qualora le condizioni lo permettano) rispetto al 1990
- 20% del fabbisogno di energia proveniente da fonti rinnovabili
- Aumento del 20% dell'efficienza energetica

La maggior parte del programma EIE è gestita dall'agenzia esecutiva per la competitività e l'innovazione (EACI) per conto della commissione europea.

Obiettivi

L'obiettivo del Programma Energia Intelligente in Europa II (EIE II) è di sostenere azioni volte a:

- incoraggiare l'efficienza energetica e l'uso razionale delle risorse energetiche
- Promuovere le fonti d'energia nuove e rinnovabili e incoraggiare la diversificazione energetica

- Promuovere l'efficienza energetica e l'uso di fonti d'energia nuove e rinnovabili nei trasporti

Il Programma è aperto a tutti gli stati membri UE più la Norvegia, Islanda, Liechtenstein, Croazia e Repubblica di Macedonia.
Importo disponibile (2003-2013): 730 milioni di euro.
Importo disponibile (annuale): 67 milioni di euro.

Referente nazionale	Ing. Marcello Capra Ministero dello Sviluppo Economico tel.: +39 06 47053550, fax: +39 06 47053803
Programma Cip-Eie Commissione europea dg energia (dg ener)	http://ec.europa.eu/energy/intelligent/index_en.html

Fig.2: Foto di archivio Flickr

1.4 IL PROGRAMMA MARCO POLO

Il Programma Marco Polo è gestito dalla Commissione Europea - direzione generale della Mobilità e Trasporti e dall'Agenzia esecutiva dell'Ue per la Competitività e l'innovazione (EACI).
Marco Polo offre un finanziamento a fondo perduto per progetti di riduzione del traffico o che forniscono servizi di supporto che permettono di trasferire il passaggio delle merci dalla strada verso altri modi di trasporto più efficienti e redditizi.
L'attuale programma durerà fino al 2013 con una sovvenzione annua di circa € 60 milioni di euro.

Obiettivo generale
Il programma mira a ridurre la congestione stradale e l'inquinamento, promuovendo il passaggio a modi di trasporto più ecologici per il traffico merci europeo.
I progetti co-finanziati devono riguardare il traffico internazionale di merci (è escluso il trasporto passeggeri) e ricadere in una delle cinque "Funding areas":

- trasferimento modale dalla strada alle ferrovie o alle vie d'acqua.
- azioni catalizzatrici che promuovono il trasferimento modale
- autostrade del mare tra i porti più importanti
- riduzione del traffico e prevenzione

Importo disponibile (2007-2013) è pari a 450 milioni di euro.

Aree geografiche ammissibili
Sono ammessi i beneficiari che hanno sede negli stati membri dell'unione europea e nei vicini paesi terzi (che hanno "una frontiera comune con l'Unione europea o che si affacciano su un mare chiuso o semichiuso confinante con l'Unione Europea").

Referente	Marco Polo helpdesk e-mail: eaci-marco-polo-helpdesk@ec.europa.eu tel: +32 2 29 50924 fax: +32 2 29 79506
Programma marco polo	http://ec.europa.eu/transport/marcopolo/about/index_en.htm

1.5 SETTIMO PROGRAMMA QUADRO PER LA RICERCA E LO SVILUPPO

Il Settimo Programma Quadro per la ricerca e lo sviluppo tecnologico (7° PQ) riunisce tutte le iniziative dell'UE collegate alla ricerca che hanno un ruolo fondamentale per raggiungere gli obiettivi di crescita, competitività e occupazione, assieme al programma quadro per la competitività e l'innovazione (Cip), a programmi di istruzione e formazione, ai fondi strutturali e ai fondi di coesione per la convergenza regionale e la competitività. inoltre è un pilastro fondamentale per lo Spazio Europeo della Ricerca (SER).

Il programma usufruisce di uno stanziamento di bilancio che supera i 50 miliardi di euro e quindi beneficia di un notevole aumento rispetto al programma quadro precedente: il 6° PQ (aumento del 41% ai prezzi del 2004 e del 63 % ai prezzi correnti). Questo aumento dimostra l'importanza della ricerca in Europa. la maggior parte di questi fondi saranno erogati sotto forma di sovvenzioni a ricercatori in Europa e altrove e serviranno a co-finanziare la ricerca, lo sviluppo tecnologico e i progetti dimostrativi.

Obiettivo generale
Il programma è suddiviso in 5 programmi specifici: cooperazione, idee, persone, capacità e ricerca nucleare. in particolare il programma cooperazione (fondi per oltre 32 miliardi) incentiva la ricerca in una serie di aree tematiche: salute, prodotti alimentari, agricoltura pesca e biotecnologie, tecnologie dell'informazione e della comunicazione, nanoscienze, nanotecnologie, materiali e nuove tecnologie di produzione, energia, ambiente (compresi i cambiamenti climatici), trasporti, scienze socioeconomiche e discipline umanistiche, spazio e sicurezza.

Importo disponibile (2007-2013)
L'importo disponibile per il programma è pari a 53,2 miliardi di euro (di cui 2,35 miliardi di euro destinati all'energia e 4,1 miliardi di euro destinati ai trasporti, inclusa aeronautica).

Aree geografiche ammissibili
LA PARTECIPAZIONE AL SETTIMO PROGRAMMA QUADRO È APERTA A TUTTI I PAESI DEL MONDO, CON PROCEDURE DI PARTECIPAZIONE E POSSIBILITÀ DI FINANZIAMENTO CHE VARIANO IN FUNZIONE DEL PAESE.

Beneficiari

Università, centri di ricerca, multinazionali, PMI (Piccole e Medie Imprese), Enti Pubblici e singoli individui. sono applicate norme di partecipazione diverse a seconda del tipo di iniziativa di ricerca.

Coordinatore nazionale (energia)	APRE - Agenzia per la Promozione della Ricerca Europea via Cavour 71, v piano – 00184 - Roma referente: Chiara Pocaterra tel: 06-48939993
Settimo programma quadro	http://cordis.europa.eu/fp7/home_it.html

1.5.1 Smart Cities, l'iniziativa che sostiene l'efficienza energetica ed i sistemi di trasporto per la creazione di città intelligenti

La commissione europea ha lanciato nel 2011 l'iniziativa Smart Cities - città intelligenti - che sosterrà le città che intendono incrementare l'efficienza energetica dei propri edifici, delle reti energetiche e dei sistemi di trasporto. l'obiettivo è la riduzione, entro il 2020, del 40% delle emissioni di gas ad effetto serra attraverso l'uso e la produzione di energia sostenibile.

L'iniziativa Smart Cities si basa su programmi europei e politiche nazionali preesistenti come Civitas, Concerto e Energia Intelligente per l'Europa (EIE) e rientra fra le iniziative del piano europeo set, creato per stabilire una politica energetica europea che consenta di ridurre del 20% le emissioni di gas a effetto serra, di portare al 20% il risparmio energetico e di aumentare al 20% il consumo di fonti rinnovabili entro il 2020 (obiettivo 20-20-20). Inoltre, le autorità locali coinvolte nel patto dei sindaci dell'unione europea1 (più di 3000 città) verranno mobilitate a favore di questa iniziativa per amplificarne l'impatto.

Fig.3– Mobilità ciclistica a Utrecht

Obiettivi specifici

- Promuovere una domanda sufficiente di tecnologie ad alta efficienza energetica e a bassa emissione di Co_2 per svilupparne la diffusione;
- ridurre del 40% il livello - rispetto al 1990 - di emissioni di gas ad effetto serra entro il 2020, apportando vantaggi socio-economici in termini di qualità della vita, affari e

possibilità di impiego, responsabilizzazione dei cittadini, oltre ad una maggiore sicurezza ambientale ed energetica;

- diffondere in Europa, a livello locale, le migliori pratiche relative all'energia sostenibile, ad esempio attraverso il patto dei sindaci dell'UE.

I tre ambiti d'azione individuati per raggiungere questi obiettivi sono:

- gli edifici:
  - creazione di nuovi edifici a zero emissioni di anidride carbonica e fabbisogno energetico;
  - rinnovamento di edifici già esistenti per portarli ai più bassi livelli di consumo energetico mantenendone o aumentandone il rendimento ed il confort.
- le reti energetiche:
  - Riscaldamento e climatizzazione: utilizzo di applicazioni innovative e di sistemi di riscaldamento e climatizzazione di tipo termosolare, geotermico o che utilizzano biomasse;
  - Energia: creazione e utilizzo di reti, contatori ed elettrodomestici intelligenti, che consentano una gestione più efficace dell'energia;
  - Produzione di energia locale che privilegi le fonti rinnovabili.
- I trasporti:
  - Sistema di trasporto pubblico e privato basato su basse emissioni di Co2, incluse applicazioni intelligenti per la gestione dei titoli di viaggio e delle informazioni ai viaggiatori;
  - Mobilità sostenibile: trasporti pubblici intelligenti, gestione del traffico intelligente e prevenzione di ingorghi stradali, gestione della domanda, distribuzione delle merci, traffico pedonale e ciclistico.

Azioni

A partire dagli obiettivi identificati, Smart Cities intraprenderà una serie di azioni in tutta Europa: la connessione fra queste azioni sarà garantita dall'adesione delle città al patto dei sindaci dell'UE.

l'iniziativa Smart Cities sarà modulata in base alle ambizioni delle città partecipanti e ai rischi corsi. le "città ambiziose" potranno ricevere fondi di assistenza tecnica per agevolare l'accesso al credito e al credito di condivisione del rischio. le "città pioniere", che correranno i rischi maggiori attuando trasformazioni tecnologiche e organizzative radicali, potranno inoltre beneficiare di sovvenzioni.

Lo schema qui di seguito illustra il modo in cui si intende procedere per sfruttare al meglio le potenzialità del programma, che prevederà delle soluzioni comuni, singoli progetti per ogni città, ma anche una collaborazione e un'intersezione tra i vari progetti.

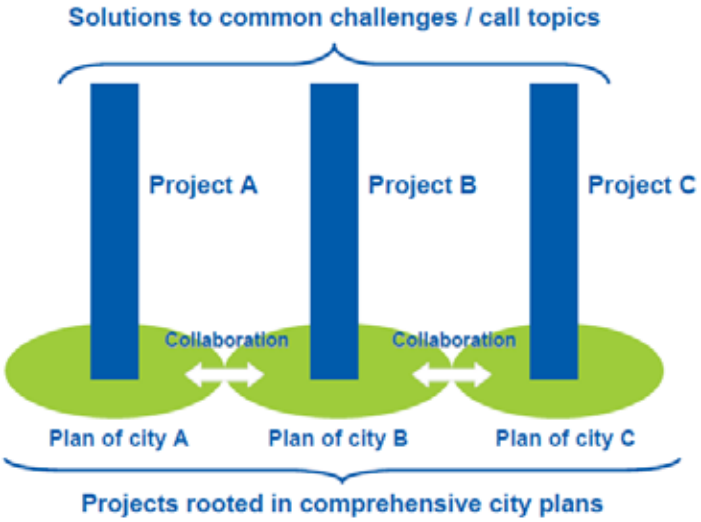

Fig 4: schema di funzionamento dell'iniziativa smart cities - 7° pq

Costi indicativi (2010-2020)

La previsione di investimenti pubblici e privati a sostegno dell'iniziativa Smart Cities è di 10-12 miliardi di euro.

Iniziativa europea Smart Cities Commissione Europea, setis	http://setis.ec.europa.eu/about-setis/technology-roadmap/european-initiative-on-smart-cities
Invito a presentare proposte 2011 Smart cities	http://ec.europa.eu/research/participants/portal/page/cooperation?callidentifier=fp7-energy-smartcities-2012

1.6 PROGRAMMA OPERATIVO INTERREGIONALE - ENERGIE RINNOVABILI E RISPARMIO ENERGETICO

Il programma Poi - energia 2007-2013 è il risultato di un intenso lavoro di concertazione tra il 7ministero dello Sviluppo economico (Mise), il Ministero dell'Ambiente (Mattm), le Regioni italiane obiettivo "convergenza" ed un nutrito partenariato economico e sociale. e' finanziato da fondi comunitari e nazionali.

Obiettivo generale

Aumentare la quota di energia consumata proveniente da fonti rinnovabili e migliorare l'efficienza energetica, promuovendo le opportunità di sviluppo locale, integrando il sistema di incentivi a disposizione, valorizzando i collegamenti tra produzione di energie rinnovabili, efficientamento e tessuto sociale ed economico dei territori in cui esse si realizzano. il programma prevede i seguenti assi di intervento:

- Asse I: produzione di energia da fonti rinnovabili:
  - attivazione di filiere produttive;
  - sostegno dello sviluppo dell'imprenditoria innovativa;
  - sostegno della produzione di energia rinnovabile per edifici e utenze energetiche pubbliche;
  - interventi innovativi di utilizzo della fonte geotermica;

- promozione e diffusione di piccoli impianti nelle aree naturali protette e nelle isole minori.

- Asse II: efficienza energetica ed ottimizzazione del sistema energetico:
  - sostegno dell'imprenditorialità collegata al risparmio energetico;
  - efficientamento energetico degli edifici e utenze energetiche pubbliche;
  - promozione e diffusione dell'efficienza energetica nelle aree naturali protette e nelle isole minori;
  - potenziamento e adeguamento delle reti di trasporto;
  - interventi sulle reti di distribuzione del calore;
  - animazione territoriale, sensibilizzazione e formazione;
- Asse III : assistenza tecnica e azioni di accompagnamento:
  - rafforzamento della capacità di indirizzo e di gestione del programma e della capacità strategica e di comunicazione dello stesso.

Importo disponibile (2007-2013): 1,6 miliardi di euro (di cui il 50% cofinanziato dall'Unione europea - fesr).
Aree geografiche ammissibili
Il programma interviene sulle regioni italiane dell'obiettivo "convergenza" (Calabria, Campania, Puglia e Sicilia).
Autorità di gestione: Struttura di missione P.O.R.E. - Presidenza del Consiglio dei Ministri

SESSIONE 2

2.1 IPA ADRIATICO

Il programma Ipa-Adriatico è un Programma di cooperazione transfrontaliera co-finanziato dalla Commissione Europea attraverso lo strumento di assistenza per la preadesione (Ipa). L'Ipa è uno strumento finanziario istituito dall'Unione Europea per aiutare i paesi candidati (Albania, Bosnia-Erzegovina e Serbia) a promuovere un grado di allineamento con l' "acquis communautaire" e il ravvicinamento con i criteri di adesione.

Obiettivo generale
L'Ipa transfrontaliero adriatico attraverso una strategia concordata di azioni tra i partner dei territori eleggibili mira a:

- rafforzare la ricerca e l'innovazione per facilitare lo sviluppo dell'area adriatica attraverso la cooperazione economica, sociale e istituzionale;
- promuovere, valorizzare e proteggere le risorse naturali e culturali attraverso la gestione congiunta dei rischi naturali e tecnologici;
- rafforzare ed integrare la rete delle infrastrutture esistenti, promuovendo e sviluppando i servizi di trasporto, di informazione e comunicazione.

L'obiettivo globale è ottenuto attraverso obiettivi specifici che mirano a produrre risultati favorevoli in termini di crescita della competitività e attrattività territoriale. i quattro obiettivi specifici corrispondono a quattro priorità del programma:

Priorità 1. cooperazione economica, sociale e istituzionale.
Rafforzare ricerca e innovazione per migliorare la competitività e promuovere lo sviluppo nell'area adriatica attraverso la cooperazione economica, sociale ed istituzionale

Priorità 2. tutela delle risorse naturali e culturali e prevenzione dei rischi.
promuovere, migliorare, e proteggere le risorse naturali e culturali anche attraverso la gestione congiunta dei rischi naturali e tecnologici.

Priorità 3. accessibilità.
Rafforzare e integrare le reti infrastrutturali esistenti, promuovere e sviluppare i servizi di trasporto, di informazione e di comunicazione.

Priorità 4. assistenza tecnica.
garantire la gestione, l'attuazione, il monitoraggio e la valutazione del programma.

Importo disponibile (2007-2013) è pari a 90,44 milioni di euro.

Aree geografiche ammissibili
Il programma distingue tra beneficiari (alcune regioni della Grecia, dell'Italia e della Slovenia) e potenziali beneficiari (alcuni territori di Albania, Croazia, Bosnia Erzegovina, Montenegro, Serbia). in particolare per l'Italia sono beneficiari i territori adriatici: province di Pescara, Teramo, Chieti, Ferrara, Forlì-Cesena, Rimini, Ravenna, Trieste, Gorizia, Udine, Pesaro-Urbino, Ancona, Macerata, Ascoli Piceno, Campobasso, Foggia, Bari, Brindisi, Lecce, Venezia, Rovigo, Padova.

Autorità di Gestione: Regione Abruzzo - Direzione Affari della Presidenza, politiche legislative e comunitarie - servizio attività internazionali

Referente nazionale	Regione Abruzzo - Giovanna Andreola. tel: 0862364285 email: managing.authority@adriaticipac.org
Programma Ipa-adriatico	http://www.adriaticipacbc.org

2.2 IL PROGRAMMA ENPI: LO STRUMENTO PER LA POLITICA EUROPEA DI VICINATO

L'Enpi è lo strumento europeo di vicinato e partenariato volto a fornire un'assistenza comunitaria finalizzata alla creazione di una zona di prosperità tra l'unione europea ed i paesi partner con i quali l'Ue ha avviato una politica di vicinato.
Dal 1° gennaio 2007 tale strumento di vicinato e partenariato ha sostituito il programma Med ed il programma tacis.

Obiettivi
Lo strumento europeo di vicinato e partenariato (Enpi) si propone di incentivare il consolidamento della cooperazione e la progressiva integrazione economica tra l'unione europea ed i paesi partner, l'attuazione di accordi di partenariato e cooperazione e di accordi di associazione.

Priorità
Le priorità dello strumento di vicinato e partenariato sono la promozione del buon governo e di un equo sviluppo sociale e economico presso i paesi partner.

A tal fine i paesi partner e l'unione europea concordano un programma di riforme economiche e politiche volto all'adozione di priorità a breve o medio termine.
Le priorità possono riguardare:

- la riforma politica;
- la cooperazione e lo sviluppo economico e sociale;
- le questioni commerciali e la riforma della regolamentazione del mercato;
- la cooperazione in materia di giustizia e di affari interni;
- settori quali: trasporti, energia, nuove tecnologie informatiche, ambiente, ricerca sviluppo.

Paesi partner
Enpi sud: Algeria, Egitto, Israele, Giordania, Libano, Libia, Marocco, Palestina, Siria E Tunisia.
Enpi Est: Armenia, Azerbaigian, Bielorussia, Georgia, Moldavia E Ucraina.
La Russia è finanziata da Enpi anche se le relazioni con i Paesi vicini non sono sviluppate nell'ambito dello strumento europeo di partenariato, ma attraverso partnership strategiche.

Importo disponibile
Il programma Enpi 2007-2013 è dotato di un ammontare di risorse finanziarie di circa 11,2 miliardi di euro dei quali:

- almeno il 95% destinato ai programmi nazionali e multinazionali;
- un massimo del 5% destinato ai programmi di cooperazione transfrontaliera.
- circa il 90% dei fondi enpi saranno destinati alle azioni bilaterali, mentre il rimanente 10% sarà destinato alla cooperazione transfrontaliera ed a specifiche iniziative come la neighbourhood investment facility (nif).

Enpi- strumento europeo di vicinato e partenariato Commissione Europea europeaid	http://ec.europa.eu/europeaid/where/neighbourhood/overview/index_en.htm
Enpi info centre	http://www.enpi-info.eu/main.php?id=402&id_type=2

2.2.1 ENPI CBC - Cooperazione transfrontaliera: lo strumento che finanzia programmi congiunti tra gli Stati membri e i Paesi che condividono una frontiera terrestre o marittima

Tra le varie misure di implementazione di Enpi si analizza il programma Enpi Cbc di Cooperazione Transfrontaliera. Enpi Cbc finanzia programmi congiunti tra i territori degli stati membri e dei paesi vicini che condividono una frontiera terrestre o marittima. La peculiarità di questo programma di cooperazione transfrontaliera è la sua specifica capacità di operare a beneficio di entrambi i lati dei confini esterni dell'unione europea, a differenza degli altri programmi di cooperazione. inoltre il programma si avvale di un bilancio unico, di strutture di gestione comuni e di un quadro giuridico e modalità di attuazione comuni che garantiscono al programma un partenariato realmente bilanciato tra i paesi partecipanti.
Obiettivi
Gli obiettivi principali del programma enpi cbc sono essenzialmente quattro:

- promuovere lo sviluppo sostenibile nelle regioni di entrambi i lati dei confini esterni dell'unione;
- indicare e gestire sfide comuni in ambito di: ambiente, sanità pubblica, prevenzione e lotta al crimine organizzato;
- assicurare un controllo efficiente delle frontiere;

- incentivare azioni transfrontaliere che incrementino le relazioni tra gli attori della società civile.

Programmi

Esistono due categorie di programmi stabilite dall'Enpi Cbc: i programmi che coprono Paesi con confini terrestri e marittimi e programmi destinati ai bacini marittimi.

Nel quadro dell'Enpi Cbc sono finanziati 15 programmi:

- 9 programmi riguardanti i confini terrestri;
- 3 programmi riguardanti le frontiere marittime;
- 3 programmi rivolti ai bacini marittimi.

Finanziamenti

2007-2010: 583,283 milioni di euro, di cui 274,923 milioni di euro provenienti dalle risorse Enpi e 308,360 milioni di euro provenienti dal programma Fesr;

2011-2013: ulteriore finanziamento di 535,152 milioni di euro

Programma di Cooperazione Transfrontaliera enpi cbc, Commissione Europea	http://ec.europa.eu/europeaid/where/neighbourhood/regional-cooperation/enpi-cross-border/index_en.htm
Enpi info centre	http://www.enpi-info.eu/mainmed.php?id=176&id_type=10&lang_id=469

2.2.2 ENPI CBC MED, lo strumento per la politica di vicinato con i Paesi del bacino del Mediterraneo

Il Programma per il Bacino del Mediterraneo (Enpi Cbc Med) è uno dei 15 programmi finanziati nel quadro della Cooperazione transfrontaliera della politica di vicinato dell'Unione Europea. il Programma Enpi Cbc Med mira alla promozione di un processo armonioso e sostenibile di cooperazione tra i paesi dell'unione europea ed i paesi del bacino del mediterraneo.

Obiettivi

Gli obiettivi principali del Programma Enpi Cbc Med sono:

- promozione dello sviluppo socio-economico ed il rafforzamento dei territori;
- promozione della sostenibilità ambientale del bacino mediterraneo;
- promozione di migliori condizioni per garantire la mobilità di persone, merci e capitali;
- promozione del dialogo interculturale e della governance locale.

Progetti

I tipi di progetti che possono essere presentati sono sostanzialmente due: progetti strategici e progetti ordinari. i temi dei progetti strategici sono selezionati dal comitato di sorveglianza congiunto, secondo le principali priorità dell'area di cooperazione. essi devono rispondere alle esigenze dei territori eleggibili.

I progetti strategici possono essere:

- orizzontali: privilegiano un approccio tematico specifico considerato strategico per l'area di cooperazione e coinvolgono diversi territori e partner delle due sponde del bacino;
- geograficamente concentrati: focalizzati sull'individuazione di soluzioni condivise a problemi comuni e sulle sfide relative ad un numero limitato di territori delle due sponde del bacino.

Le proposte relative ai progetti strategici devono prevedere un budget minimo è di 2 milioni di euro ed un massimo di 5 milioni di euro. Il numero minimo di partecipanti alla partnership è di 4 di cui almeno uno stato membro dell'Unione Europea che si affaccia sul mediterraneo ed un Paese partner del Mediterraneo.
I progetti ordinari sono proposti dagli attori locali organizzati in partenariati transfrontalieri, a seguito di inviti a presentare proposte lanciati dal programma.
Le proposte relative ai progetti ordinari devono prevedere un budget minimo è di 500 mila euro ed un massimo di 2 milioni di euro. il numero minimo di partecipanti alla partnership è di 3 di cui almeno uno stato membro dell'Unione Europea che si affaccia sul Mediterraneo ed un Paese partner del Mediterraneo.
Territori ammissibili
I territori ammissibili al programma sono:

- Paesi che si affacciano sul mediterraneo facenti parte dell'Ue: Cipro, Francia, Grecia, Italia, Malta, Portogallo, Spagna.
- Paesi partner che si affacciano sul Mediterraneo: Egitto, Israele, Giordania, Libano, Autorità Palestinese, Siria, Tunisia.

Si noti che il Marocco ha aderito al programma ma non ha firmato l'accordo finanziario con la Commissione Europea. l'Algeria, la Libia e il Regno Unito (territorio di Gibilterra) sono Paesi eleggibili secondo il documento strategico Enpi Cbc, ma non partecipano al programma.

Infine, la Turchia ha richiesto di non essere più inclusa nella lista dei territori eleggibili, trattandosi di un paese in fase di pre-adesione all'Unione Europea.
Autorità di gestione del programma Enpi Cbc Med
Regione Sardegna.
Importo disponibile: 56,5 milioni di euro.

Importo disponibile (2007-2013)
Il contributo comunitario ammonta a 173,6 milioni di euro, di cui:

- 156,2 milioni di euro destinati al finanziamento di progetti transfrontalieri;
- 17,4 milioni di euro destinati all'assistenza tecnica.

Percentuale di cofinanziamento
Il contributo concesso dall'Unione Europea può coprire un massimo del 90% del costo totale del progetto. il rimanente 10% deve essere stanziato dai beneficiari/partner come cofinanziamento del progetto.

Programma di cooperazione transfrontaliera Enpi- Cbc Med, bacino del Mediterraneo, Commissione europea Europeaid, Cooperazione e Sviluppo	http://www.enpicbcmed.eu/

2.2.3 ENPI CBC, Italia - Tunisia: il programma che promuove l'integrazione economica, sociale, istituzionale e culturale tra i territori siciliani e tunisini

Lo scopo del programma Enpi Cbc Italia-Tunisia è di promuovere l'integrazione economica, istituzionale, e culturale tra la Tunisia e La Sicilia attraverso un processo di sviluppo sostenibile nell'ambito della cooperazione transfrontaliera.
Priorità

- Priorità 1: Sviluppo e Integrazione Regionale

  - Misura 1.1 sviluppo e integrazione delle filiere economiche;
  - Filiera agro-alimentare;
  - Pesca;
  - Turismo.
  - Misura 1.2 promozione dei flussi di merce, valorizzazione dei flussi migratori e economici;
  - Misura 1.3 promozione della ricerca e l'innovazione;
  - Sviluppo dei poli tecnologici;
  - Innovazione nei processi di produzione;
  - Nuove tecnologie dell'informazione e della comunicazione.
  - Misure 1.4 cooperazione istituzionale per promuovere lo sviluppo regionale.
- Priorità 2: promozione di uno sviluppo duraturo
  - Misura 2.1 gestione efficace delle risorse naturali;
  - agricoltura;
  - pesca;
  - misura 2.2 valorizzazione del patrimonio naturale e culturale;
  - misura 2.3 sviluppo delle energie rinnovabili.
- Priorità 3 : cooperazione culturale e scientifica e sostegno al tessuto associativo
  - Misura 3.1 sostegno alla cooperazione a livello associativo;
  - Misura 3.2 cooperazione culturale e scientifica;
  - Misura 3.3 formazione e scambio di giovani e di studenti.

Importo disponibile (2007-2013) è pari a 22,7 milioni di euro.

Aree eleggibili
Italia: province Di Agrigento, Caltanissetta, Ragusa, Siracusa E Trapani.
Tunisia: Regioni di Ariana, Béja, Ben Arous, Bizerte, Nabeul, Jendouba, Manouba e Tunisi.

Autorità di gestione del Programma: Regione Sicilia.

2.3 PROGRAMMA OPERATIVO TRANSNAZIONALE MEDITERRANEO - MED

Il Programma Operativo Transnazionale Mediterraneo (Med) fa parte dell'obiettivo "Cooperazione territoriale" della programmazione dei fondi strutturali 2007 -2013 dell'unione europea. esso si colloca in stretta continuità con i programmi per la collaborazione territoriale, cofinanziati dall'Unione Europea, come Medocc e Archimed. infatti, le aree interessate sono le stesse dei precedenti programmi, incluse tutte le regioni di tutti gli stati membri dell'unione europea che si affacciano sul Mediterraneo.

Obiettivo generale
Stimolare la cooperazione tra i territori per trasformare il bacino mediterraneo in una regione competitiva a livello internazionale, assicurando crescita e occupazione per le generazioni future, oltre a promuovere la coesione territoriale e la tutela ambientale in una logica di sviluppo sostenibile.
Questo obiettivo generale è sviluppato nel programma Med attraverso quattro assi prioritari di intervento:

- asse 1. rafforzamento delle capacità d'innovazione: diffusione di tecnologie innovative e di know-how, rafforzamento della cooperazione strategica tra attori dello sviluppo economico ed autorità pubbliche;
- asse 2. protezione dell'ambiente e promozione dello sviluppo sostenibile: protezione e valorizzazione delle risorse naturali, promozione delle energie rinnovabili e miglioramento dell'efficienza energetica;
- asse 3. miglioramento della mobilità e dell'accessibilità territoriale: miglioramento dell'accessibilità marittima e delle capacità di transito attraverso la multi modalità e sostegno all'uso delle ict;
- asse 4. promozione di uno sviluppo integrato dello spazio mediterraneo: coordinamento delle politiche di sviluppo e miglioramento della governance locale, valorizzazione delle risorse culturali per una migliore integrazione dello spazio mediterraneo.

Importo disponibile (2007-2013)
l'ammontare complessivo per i sette anni di programmazione è di 257 milioni di euro.

Aree geografiche ammissibili
Sono ammessi i beneficiari che hanno sede nei seguenti stati: Cipro, Grecia, Malta, Slovenia (tutto il territorio nazionale), Spagna (6 regioni e 2 città autonome), Francia (4 regioni), Italia (18 regioni), Portogallo (2 regioni) e Regno Unito (1 regione).

National Contact Point	Regione Toscana - settore attività internazionali - piazza dell'Unità, 1 - 50100 Firenze Maria Dina Tozzi Mara Sori - tel 055 438 2904 Lucia Polverini - tel 055 438 4582, fax 055 438 4110 e-mail med.ncp@regine.toscana.it
Programma Med	http://www.programmemed.eu
Bando	http://www.programmemed.eu/index.php?id=15477&l=1

REFERENCES

Bulletin Européen du Moniteur, http://www.pressviewpro.com/index.php?option=com_content&task=view&id=22&publication=123;

Cordis, il portale europeo per le attività di ricerca e sviluppo, http://cordis.europa.eu/home_it.html;

Entreprise Europe Network, http://www.enterprise-europe-network.ec.europa.eu/index_en.htm;

Eur-Lex, portale on-line della legislazione UE, http://eur-lex.europa.eu/it/index.htm;

Europa Press room, l'Ufficio stampa della Commissione Europea, http://europa.eu/press_room/index_en.htm;

Europe Innova, la piattaforma per l'innovazione, http://www.europe-innova.eu;

Portale europeo per le piccole e medie imprese, http://ec.europa.eu/small-business/index_it.htm;

Sistema informativo per gli appalti pubblici europei, http://simap.europa.eu/index_it.htm;

TED, Tenders Electronic Daily, http://ted.europa.eu/TED/main/HomePage.do;

Ufficio statistico europeo, http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/;

Ufficio delle Pubblicazioni dell'UE, http://publications.europa.eu/index_it.htm

IMAGES SOURCES

Fig. 1: Presentazione della guida dei finanziamenti europei ad EnergyMed 2012 (archivio ANEA); Fig 2: Foto di archivio Flickr ; Fig.3: Mobilità ciclistica a Utrecht (archivio ANEA); Fig.4: Schema di funzionamento dell'iniziativa smart cities - 7° pq (fonte: rielaborazione ance su dati commissione europea, dg energia).

AUTHORS' PROFILE

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TeMA
Journal of
Land Use, Mobility and Environment

TeMA 2 (2012) 213-238
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: 10.6092/1970-9870/910

www.tema.unina.it

REVIEWS PAGES

RESILIENT 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 offer the readers interesting web pages which are directly connected with the issue theme.

author: DANIELA CERRONE
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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

RESILIENT CITIES

REVIEW PAGES: WEB RESOURCES

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In questo numero
RESILIENZA URBANA

La resilienza, intesa come capacità di resistere in modo elastico ad una improvvisa sollecitazione, assorbendo una determinata energia e modificando la propria condizione senza compromettere irrimediabilmente la propria struttura è un concetto che, se pur mutuato dall'ingegneria dei materiali, ben interpreta la necessaria complessità cui devono tendere i sistemi urbani e territoriali che sottoposti a determinati fenomeni, anche traumatici, devono poter modificare il loro stato senza perdere la loro funzionalità.
Una delle prime definizioni del concetto di resilienza applicato all'ambiente va ricondotta a Crawford Holling che, già negli anni Settanta, definì tale la capacità dei sistemi naturali e umani di assorbire fenomeni di disturbo, organizzando le proprie componenti in accordo con i fenomeni di sollecitazione e modificando senza compromettere la propria struttura e funzionalità. Più recentemente, Rob Hopkins ha definito la resilienza come la capacità di un sistema di assorbire i disturbi generati da fenomeni anche esterni e di riorganizzarsi modificando il suo stato senza perdere la propria funzione, struttura e identità e sulla necessità di aspirare a tale comportamento ha dato vita al movimento *Transition Towns*.
Il panorama web sul concetto di resilienza urbana è molto vario, così come molteplici sono gli approcci, le strategie e le motivazioni che spingono organizzazioni, istituzioni ed associazioni a promuovere atteggiamenti, iniziative, interventi, sistemi di azioni tesi a fornire alle città, ai territori alle comunità la necessaria capacità di affrontare il cambiamento senza perdere la propria identità, individuando *Best Practices* relative, in primo luogo, ai modelli organizzativi e gestionali dei sistemi urbani e promuovendo il concetto di resilienza come componente necessaria per lo sviluppo sostenibile.
I siti selezionati per questo argomento forniscono occasione di approfondimento del concetto e luogo di confronto e di promozione di buone pratiche finalizzate alla definizione di modelli urbani ad elevata resilienza, vale a dire sistemi capaci di modificarsi costruendo risposte sociali, economiche e ambientali tese ad assorbire e non subire le sollecitazioni potenzialmente rischiose.

CITTÀ RESILIENTE

http://www.resilientcity.org

ResilientCity.org è il sito che promuove le attività dell'omonima organizzazione non-profit cui aderiscono urbanisti, architetti, designer, ingegneri e architetti del paesaggio la cui missione è quella di sviluppare una progettazione creativa, pratica e attuabile finalizzata a definire strategie di intervento che contribuiscano ad aumentare la capacità di resilienza delle comunità e delle città agli shock e allo stress associati ai cambiamenti climatici, al degrado ambientale, alla carenza di risorse. Il sito si pone l'obiettivo di diventare un portale finalizzato a facilitare il dialogo tra quanti, scienziati, ambientalisti, urbanisti e architetti ritengono possibile definire strategie tese ad aumentare la capacità di resilienza delle nostre città. Obiettivi principali del portale sono:

- sensibilizzare l'opinione pubblica ai temi del cambiamento climatico, delle energie rinnovabili, della scarsità delle risorse, del continuo degrado ambientale, dei trend di crescita della popolazione mondiale affrontabili anche attraverso una attenta pianificazione urbana ed architettonica;
- fornire un luogo di discussione che, attraverso forum pubblici, concorsi di idee ed utilizzando anche i canali di comunicazione più moderni quali *blog*, *twitter*, possa contribuire a sviluppare ed accelerare idee per aumentare la capacità di resilienza delle città agli impatti economici, sociali, culturali ed ambientali;
- organizzare un "contenitore" in cui raccogliere esempi di progettazione, *best practices*, notizie, ricerche, approfondimenti tecnici per analizzare i temi inerenti la resilienza dei sistemi urbani e territoriali.

Nella sezione ***Challenges*** sono definite le principali sfide che le comunità, i sistemi urbani e territoriali sono chiamanti ad affrontare per evitare pesanti conseguenze in termini economici e sociali. Specifici approfondimenti sono dedicati alle problematiche dei cambiamenti climatici e alla necessità di ridurre le emissioni di CO_2, alla scarsità di risorse energetiche ancora troppo dipendenti dal petrolio e alla crescita della popolazione, stimata in 9 miliardi nel 2040 e in 11 nel 2050. Nella sezione ***Resilience*** sono invece riportate e approfondite alcune delle molteplici interpretazioni del concetto di resilienza, sono riproposte le principali sfide che i sistemi urbani e territoriali sono chiamati ad affrontare e sono presentate le strategie perseguibili per incrementare la resilienza dei sistemi territoriali ai cambiamenti. Da questo spazio è possibile accedere alle aree dedicate ai principi di resilienza riconducibili ai concetti di diversità, ridondanza, modularità e indipendenza delle componenti del sistema e alla capacità di risposta, di adattamento, di reattività ai cambiamenti. Si enunciano i principi di una corretta pianificazione e progettazione urbana (*Urban Design Principles*) che fanno leva sui concetti di densità, mix funzionale, pongono forte attenzione alla varietà tipologica del costruito e degli spazi pubblici, promuovono la mobilità sostenibile, auspicano la realizzazione di luoghi e spazi simbolo fortemente identitari. Tali principi trovano ulteriore specificazione nei principi di progettazione alla scala edilizia (*Building Design Principles*) a partire dalla previsione di materiali ecocompatibili, a basso impatto ambientale, duraturi, facilmente manutenibili e di provenienza locale.

MAKING CITIES RESILIENT

http://www.unisdr.org

Creato nel dicembre 1999, l'UNISDR (The United Nations Office for Disaster Risk Reduction) opera per il perseguimento della strategia internazionale per la riduzione dei disastri.

Nel 2010 lancia la campagna *The Making Cities Resilient: My City is getting ready!* con l'obiettivo di affrontare le questioni relative alla mitigazione dei rischi urbani attraverso forme di buona *governance* locale.

Il successo dell'operazione, confermata dall'adesione di molteplici città alla prima fase (2010-2011), ha reso possibile il prolungamento dell'esperienza fino al 2015, con attività che coinvolgono un numero sempre maggiore di realtà territoriali.

Tra gli obiettivi della seconda campagna si evidenziano:

l'attivazione di forme di sostegno da parte dei governi nazionali alle città resilienti;

l'implementazione di forme di apprendimento reciproco tra città attraverso la predisposizione di manuali, linee guida comuni e promozione di *best practices* di *governance*.

Sindaci e amministrazioni locali sono contestualmente obiettivi chiave e driver per la campagna di sensibilizzazione.

Il sito si articola, tradizionalmente ma efficacemente, in sezioni facilmente individuabili nel menu a tendina.

Nella ***Home*** page è dato risalto ai contenuti maggiormente interessanti e agli aggiornamenti.

La sezione ***About*** è dedicata ai risultati della prima campagna e agli obiettivi della seconda.

La sezione ***Sign Up*** evidenzia le procedure finalizzate a prendere parte alla campagna, promuovere best practices da condividere, divenire sponsor o attivista dell'iniziativa.

Cities è l'area dedicata alle città partecipanti all'iniziativa. Ad ogni città è dedicata una pagina contenente delle informazioni generali quali l'indirizzo web istituzionale, la localizzazione, l'estensione territoriale, la popolazione e il sindaco in carica. Una parte specifica è dedicata ai profili di rischio e di vulnerabilità che caratterizzano il sistema urbano e alle attività messe in campo per la riduzione dei danni.

L'area ***Toolkit*** promuove una serie di strumenti che possono facilitare le attività di mitigazione dei rischi. Si pone l'obiettivo di offrire a sindaci, governatori e dirigenti afferenti ai livelli di governo locale alcuni strumenti utili per la comprensione delle molteplici fonti di rischio, una serie di principi finalizzati alla riduzione del rischio di catastrofi e alla promozione di buone pratiche e strumenti che vengono già utilizzati a tale scopo. Infine offre una guida pratica per capire e agire sulle "*Ten Essentials for Making Cities Resilient*".

Completano il sito un'area, ***Champions***, dedicata a uomini e donne in posizioni di governo che si sono attivati in modo esemplare per ridurre in modo efficace il rischio di disastri per le comunità che governano; l'area ***Partners***, dedicata ai sostenitori dell'iniziativa, e l'area ***News & Events***, costantemente aggiornata.

CITTÀ SOSTENIBILE

http://www.cittasostenibile.it

Il sito Città sostenibile è uno dei canali attraverso i quali l'Ufficio Ricerche e Documentazione sulla Storia Urbana dell'Assessorato alla Cultura del Comune di Modena, in collaborazione con l'Assessorato alle Politiche Ambientali e l'Assessorato all'Urbanistica, promuove la conoscenza sui temi della storia delle trasformazioni urbane, dell'urbanistica, dell'architettura e della pianificazione territoriale. Il progetto nasce nel 2003, come prodotto del Gruppo di Lavoro dell'Associazione Nazionale Coordinamento Agende 21 Locali Italiane e si pone come obiettivi principali, da un lato, l'approfondimento delle relazioni fra la storia della città, del suo territorio e le risorse naturali, dall'altro la promozione di percorsi partecipati di riqualificazione ambientale, tutela e progettazione urbanistica, finalizzati alla sostenibilità. Tra i molti, collaborano al Progetto l'Istituto Nazionale di Urbanistica, l'ISPRA, l'IUAV, l'Associazione Coordinamento Nazionale Agende 21 Italia, l'AISU.

Dalla sezione ***Progetti*** è possibile accedere alle aree dedicate ai lavori ideati e condotti dal Gruppo di ricerca ed in particolare a quelli relativi alla Pianificazione ambientale, alla Pianificazione d'area vasta, alla Pianificazione e partecipazione nelle trasformazioni urbanistiche per le città sostenibili e alla linea di lavoro sulle città resilienti avviata a seguito della Conferenza Nazionale sul Clima del 2007, anno in cui si è sviluppata una intensa elaborazione e organizzazione di attività sul tema "*Clima delle città*" i cui prodotti sono disponibili nel sito web dedicato (www.comune.modena.it/ilclimadellecitta).

Il sito raccoglie informazioni, materiali, documenti, molti dei quali scaricabili. Si segnalano tra le altre, le sezioni *Eventi*, *Documenti* e *Per approfondire*, molto ricche di materiali. In particolare, la sezione ***Eventi*** contiene informazioni relative a convegni, workshop, lezioni sui temi di interesse. Nella maggior parte dei casi è possibile scaricare i programmi delle giornate e i contributi dei differenti relatori che hanno preso parte alle occasioni di studio ed approfondimento sui temi inerenti i cambiamenti climatici e il loro impatto sui sistemi urbani e territoriali. Tra i tanti, si segnalano i materiali relativi al workshop nazionale *"Le città resilienti. Cambiamento climatico: rischi ed opportunità per le città e i territori"* tenutosi a Modena il 15 dicembre 2011. Dal sito sono inoltre scaricabili i contributi presentati e la bozza, aggiornata a febbraio 2012, del documento *"Città resilienti. L'adattamento dei sistemi urbani al cambiamento climatico. Linee di indirizzo per i Piani d'Azione locale per l'energia sostenibile e il clima"*. La sezione ***Documenti*** contiene invece i materiali prodotti dal Gruppo di Lavoro A21 "Città sostenibili" e presenta documenti redatti dal Coordinamento Agende 21 Italiane e da altri Gruppi di Lavoro che svolgono attività di ricerca ed approfondimento inerenti le tematiche d'interesse. Tra i materiali presenti si segnalano *"Gli impegni delle Città e dei Territori d'Italia per il Clima"* e il *"Contributo all'allegato della Carta delle Città e dei Territori d'Italia per il Clima"*.

Interessante anche la sezione ***Per approfondire***. Da questa è possibile scaricare dati, casi studio, *best practices* e contributi tecnici. Infine dalla sezione ***Link utili*** è possibile accedere ai web dedicati ai principali progetti nazionali ed internazionali connessi al tema dei cambiamenti climatici.

02

RESILIENT CITIES

REVIEW PAGES: BOOKS

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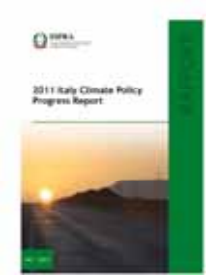
In questo numero

LA SFIDA DEI CAMBIAMENTI CLIMATICI NELLE CITTA' RESILIENTI

L'immissione di grandi quantità di gas serra nell'atmosfera, i conseguenti cambiamenti climatici, l'aumento dei consumi energetici e le numerose catastrofi provocate da eventi naturali che si susseguono con una frequenza temporale ravvicinata, costituiscono delle sfide ambientali sempre più impegnative per i sistemi urbani. Si tratta di questioni sia di carattere globale, per componenti ed impatti, che locale, considerato che le città svolgono un ruolo cruciale nella riduzione delle emissioni inquinanti e della vulnerabilità ai cambiamenti climatici. Al verificarsi di un evento, la vulnerabilità definisce la propensione al danno di persone o di beni; essa costituisce, quindi, una misura della fragilità, dell'incapacità dei singoli individui, della collettività, dei singoli manufatti edilizi, delle singole infrastrutture o del territorio nel suo complesso ad assorbire l'impatto di un evento (Galderisi 2003). Per evitare, allora, le ormai ben note e gravi conseguenze del climate change bisognerebbe adottare idonee misure tese al contenimento delle emissioni di gas climalteranti e favorire l'adattamento alle dinamiche in atto. Aumentare o agevolare l'adattamento di un sistema significa minimizzare gli effetti negativi causati dalle sollecitazioni esterne e sfruttare al contempo le opportunità di trasformazione (sociale, economica, spaziale, organizzativa) relative a tali fattori di cambiamento. Le capacità di adattamento, in pratica, sono tanto maggiori quanto minore è la vulnerabilità, cioè, quanto è maggiore la resilienza del sistema stesso. La resilienza (dal latino resilire che significa fare un salto all'indietro, rimbalzare) indica, quindi, la capacità di un sistema di assorbire le perturbazioni esterne; in particolare, i sistemi complessi sono in grado di raggiungere un nuovo stato di equilibrio, grazie alle proprie capacità di auto-organizzazione, di apprendimento e di adattamento (Holling 1973). Resilienza e vulnerabilità possono, da questo punto di vista, essere interpretate come le due facce di una stessa medaglia.
In questo numero si presentano due contributi che analizzano, rispettivamente, lo stato di fatto delle politiche e delle principali misure mirate alla riduzione dei gas serra nel nostro Paese e come i cambiamenti climatici impattino sul legame tra vulnerabilità e resilienza urbana.



Titolo: 2011 Italy climate policy report progress
Autore/curatore:AA VV
Editore: ISPRA
Download:www.isprambiente.it
Data pubblicazione: 2011
Codice ISBN: 978-88-448-0503-6

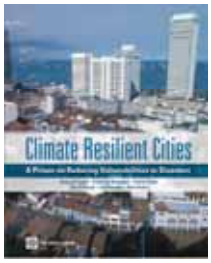
Nel maggio 2011 il Ministero dell'Ambiente ha presentato alla Comunità Europea un rapporto sulle politiche e sulle misure nazionali per la riduzione delle emissioni dei gas serra prese fino al 2010. Secondo quanto stabilito dalla Decisione della Comunità Europea 284/2004, che «istituisce un meccanismo per monitorare tutte le emissioni di origine antropica, valutare i progressi compiuti nell'adempimento degli impegni assunti a riguardo ed attuare il protocollo di Kyoto», gli Stati Membri devono, ogni due anni, riferire alla Commissione Europea sullo stato di fatto delle scelte effettuate per combattere i cambiamenti climatici, sulle stime quantitative riguardanti l'effetto di tali decisioni, nonché sulle previsioni nazionali rispetto alle emissioni climalteranti. In accordo con tali elementi, e su incarico del Ministero dell'Ambiente, il report elaborato dall'ISPRA contiene:

- la descrizione delle politiche e delle misure attuate ed adottate (capitolo 2);
- le proiezioni sulle emissioni dei gas serra in funzione dei due scenari considerati: WEM, relativo alle misure esistenti, e WAM, relativo alle misure previste (capitolo 3);
- l'attuazione della legislazione comunitaria e degli Accordi istituzionali e finanziari (capitolo 4).

L' obiettivo di riduzione delle emissioni dell'Italia è, per il 2012, pari al 6,5% rispetto ai valori del 1990 e del 13% per i settori che non rientrano nell'*Emission Trading System*. Il riequilibrio dell'approvvigionamento energetico costituisce, poi, un'altra priorità della nostra politica energetica, visto che esso risulta essere ancora troppo dipendente dai combustibili fossili (PAN 2010). Nella panoramica delle principali misure a sostegno del raggiungimento di tali obiettivi nazionali si analizzano, in particolare, i Titoli di Efficienza Energetica (TEE), che certificano i risparmi energetici conseguiti, e il Conto Energia per l'incentivazione di produzione di energia elettrica da fonte solare. Grazie a queste azioni la produzione di energia elettrica totale attraverso fonti rinnovabili dovrà raggiungere il 14% al 2020 (scenario WEM), percentuale che salirà al 17% (scenario WAM) con l'attuazione di ulteriori misure previste nel PAN.

Tra i settori compresi nell'*Effort Sharing Decision* (quote di emissione da ridurre nei settori non compresi nell'ETS) vi è quello dei trasporti per il quale è stimato un aumento delle emissioni di CO_2 del 3,1% nel periodo 2010-2020, comunque più moderato rispetto all'enorme incremento verificatosi tra il 1990 ed il 2000; tale riduzione è resa possibile dall'attuazione di politiche relative ai livelli di prestazione delle emissioni dei veicoli leggeri ed alla diffusione dei biocarburanti e del gas naturale.

Attraverso le politiche e le misure già adottate e messe in atto nell'ambito dell'ESD la riduzione totale di emissioni da raggiungere al 2020 è di 284,9 $MtCO_2$ eq ed il relativo gap da colmare è pari a 33,8 $MtCO_2$ eq. Sulla base del modello di stima utilizzato (Markal model), inoltre, nel rapporto si ritiene possibile che l'attuazione di tutte le misure considerate, sia quelle operative che quelle previste, possa consentire un ulteriore calo delle emissioni totali, stimate compreso tra la metà ed i due terzi di tali valori.



Titolo: Climate resilient city-a primer on reducing vulnerabilities to disaster
Autore/curatore: AAVV
Editore: The World Bank
Download: www.worldbank.org/eap/climatecities
Data pubblicazione: 2009
Codice ISBN: 978-0-8213-7766-6

World Bank, con la collaborazione dell'UNISDR e di altre istituzioni internazionali, ha guidato il progetto Green Cities i cui risultati sono stati raccolti in questo manuale che vuole costituire uno strumento di supporto alla costruzione di città resilienti. Il manuale si rivolge, nello specifico, alle istituzioni locali dell'area del Sud-Est asiatico, area caratterizzata da un intenso e quasi inarrestabile processo di urbanizzazione che sembra non avere paragoni con gli altri continenti e che interessa territori soggetti annualmente ad eventi catastrofici.

Le sei sezioni che compongono questo compendio sono strutturate per rispondere a tre interrogativi: quali sono le conseguenze del cambiamento climatico per la popolazione e le attività economiche? Come esso contribuisce ad incrementare la vulnerabilità urbana? Cosa è stato fatto nei vari Paesi per la costruzione di città resilienti? Si tratta di un "percorso guidato di apprendimento" che partendo dalla descrizione del rapporto tra la gestione dei rischi, dagli impatti dell'effetto serra e dalle politiche territoriali aiuta i governi locali a delineare le proprie strategie per lo sviluppo di comunità resilienti in grado di affrontare le attuali questioni energetico-ambientali.

Nell'Asia orientale sono presenti oltre 30 grandi aree metropolitane localizzate in zone ad alto rischio sismico e ad alta vulnerabilità ad eventi catastrofici come tifoni o tzunami e dove risiedono milioni di abitanti. Se poi si considera che questi paesi stanno diventando rapidamente tra i maggiori produttori di gas serra (entro il 2025 si prevede che la Cina incrementi le proprie emissioni del 118%) e che i conseguenti mutamenti climatici peseranno fortemente sull'intensità e sulla frequenza dei disastri naturali, già destinati ad aumentare, si capisce perché la guida ribadisca di continuo la necessità di «adottare una visione olistica che definisca efficaci misure di mitigazione di adattamento e di gestione del rischio».

L'approccio, suggerito dal manuale per la costruzione di una comunità resiliente si basa su due strategie:

- ridurre le emissioni climalteranti promuovendo l'efficienza energetica, il controllo della dispersione urbana, servizi di trasporto a basse emissioni, il riciclo dei rifiuti urbani, etc.;
- affrontare gli effetti del cambiamento climatico attraverso precise misure adottate per tempo e che siano integrate e coerenti tra i vari settori e livelli di governo del territorio.

Prima di mettere a punto le azioni da implementare bisogna, però, effettuare una valutazione per verificare se il sistema urbano è un "hot spot", cioè, una città con un elevato grado di vulnerabilità e di rischio ad eventi naturali disastrosi. A tal fine la guida propone la compilazione di una matrice relativa alle caratteristiche geomorfologiche del territorio, alla struttura urbana (stato di conservazione degli edifici, sistema pianificatorio, risorse finanziarie, etc.), alla frequenza degli eventi calamitosi verificatisi negli ultimi 50 anni; maggiore è il numero degli elementi avversi risultanti, tanto più incisive dovranno essere le misure di mitigazione e gestione del rischio, la cui priorità di intervento sarà definita in funzione del livello di vicinanza della città alla condizione di "hot spot".

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03

LANDSCAPES OF URBAN SPRAWL

REVIEW PAGES: LAWS

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In questo numero

NORME IN MATERIA DI CAMBIAMENTI CLIMATICI E RISCHIO SISMICO PER INCREMENTARE LA RESILIENZA DEI SISTEMI URBANI

Il concetto di resilienza assume molteplici accezioni nei diversi campi disciplinari in cui viene utilizzato e può essere specificato in relazione ai diversi fattori di rischio in grado di influenzare le caratteristiche degli elementi esposti. Tale concetto è stato approfondito in ambito urbano sia per comprendere le dinamiche volte ad accrescere la capacità dei sistemi territoriali nel fronteggiare e nel riprendersi da un evento perturbativo imprevedibile ed improvviso (quale un sisma, un terremoto, una frana, un'alluvione, ecc.), sia per definire e sviluppare strategie di adattamento ai cambiamenti climatici.

In questo numero si intende analizzare alcuni interventi normativi orientati ad accrescere la resilienza dei sistemi urbani in riferimento a due tematiche di grande attualità: la lotta ai cambiamenti climatici e la mitigazione del rischio sismico.

Ciò che emerge dalla letteratura sul tema è che la resilienza dei sistemi urbani dipende fondamentalmente da due ordini di fattori: le caratteristiche ambientali e territoriali – definite da variabili ecologiche, morfologiche, geologiche e organizzative – e la possibilità del sistema socio-economico locale di intervenire attivamente e autonomamente per mitigare il danno. Risulta evidente che la prevenzione e la mitigazione dei rischi sia di natura sismica che legati ai cambiamenti climatici, richiedono approcci e soluzioni non settoriali che chiamano in campo competenze e ambiti disciplinari eterogenei e che siano in grado di incidere simultaneamente sulle relazioni esistenti tra rischi naturali, assetto fisico-morfologico degli insediamenti e organizzazione delle attività sul territorio (Galderisi 2004). Tale approccio, come vedremo, non trova ancora un effettivo riscontro nella normativa sul tema.

LA POLITICA ENERGETICA DELL'UNIONE EUROPEA E SUO RECEPIMENTO NELLA NORMATIVA ITALIANA

Dando seguito a quanto annunciato nel Piano d'Azione per una Politica Energetica Europea (approvato dal Consiglio europeo del marzo 2007) la Commissione europea ha presentato nel gennaio 2008 la comunicazione "Due volte 20 per il 2020. L'opportunità del cambiamento climatico per l'Europa" (COM(2008)30) con cui ha illustrato un pacchetto di interventi nel settore dell'energia e della lotta ai cambiamenti climatici.

Il cosiddetto pacchetto clima-energia rappresenta un contributo al nuovo approccio strategico integrato europeo che propone di combinare la politica energetica con gli obiettivi ambiziosi in materia di lotta al mutamento climatico prefiggendosi in particolare di limitare il riscaldamento globale della temperatura terrestre a 2 gradi Celsius entro il 2020. Gli obiettivi strategici che l'UE si è fissata per il 2020 sono:

- la riduzione delle emissioni di gas serra derivanti dal consumo di energia di almeno il 20% rispetto ai livelli del 1990;
- il miglioramento del 20% dell'efficienza energetica;
- l'aumento del 20% della percentuale di energia prodotta da fonti rinnovabili.

Il raggiungimento dell'accordo sul pacchetto clima ed energia nel dicembre 2008 e la sua successiva entrata in vigore nel giugno 2009, hanno consentito l'adozione di un pacchetto di atti normativi (tre direttive e una decisione) riguardanti tre principali linee d'azione.

1. La promozione dell'energia da fonti rinnovabili (Direttiva 2009/28/CE del Parlamento europeo e del Consiglio, del 23 aprile 2009), che stabilisce che «ogni Stato membro assicura che la propria quota di energia da fonti rinnovabili sul consumo finale lordo di energia nel 2020, calcolata conformemente ai criteri dettati dalla direttiva stessa (artt. da 5 a 11), sia almeno pari al proprio obiettivo nazionale generale per la quota di energia da fonti rinnovabili per quell'anno» che per l'Italia è pari al 17% (art. 3).

Inoltre, ogni Stato membro deve assicurare che la propria quota di energia da fonti rinnovabili in tutte le forme di trasporto nel 2020 sia almeno pari al 10% del consumo finale di energia nel settore dei trasporti. Questi obiettivi nazionali devono, poi, essere previsti all'interno di un piano di azione nazionale per le energie rinnovabili, che ciascuno Stato membro è tenuto ad adottare. Il Piano di Azione Nazionale (PAN) dell'Italia, è stato trasmesso alla Commissione Europea il 28 luglio 2010. Il PAN, in particolare, prevede di coprire grazie alle energie rinnovabili la quota del 6,38% del consumo energetico del settore trasporti, del 28,97% per l'elettricità è del 15,83% per il riscaldamento e il raffreddamento.

Il 28 marzo 2011, inoltre, è stato pubblicato sulla Gazzetta Ufficiale il decreto legislativo n. 28 del 03/03/2011 "Attuazione della direttiva 2009/28/CE sulla promozione dell'uso dell'energia da fonti rinnovabili" che illustra la strategia nazionale nello sviluppo delle fonti energetiche rinnovabili disegnando le principali linee d'azione. Le innovazioni introdotte da tale decreto riguardano fondamentalmente:

- l'obbligo di integrazione delle fonti rinnovabili negli edifici di nuova costruzione e negli edifici esistenti sottoposti a ristrutturazioni rilevanti (art. 11);
- l'introduzione di un bonus volumetrico del 5% per i progetti di edifici di nuova costruzione e di ristrutturazioni rilevanti su edifici esistenti, che assicurino una copertura dei consumi per la produzione di calore, di elettricità e per il raffrescamento in misura superiore di almeno il 30% rispetto ai valori minimi obbligatori (art. 12);
- l'obbligo di certificazione energetica degli edifici nei contratti di compravendita o di locazione di edifici o di singole unità immobiliari (art. 13).

2. La definizione dell'ambito di applicazione del sistema comunitario per lo scambio di quote di emissione (Emission Trading System ETS-UE) (Direttiva 2009/29/CE del Parlamento europeo e del Consiglio, del 23 aprile 2009) al fine di perfezionare ed estendere il sistema comunitario per lo scambio di quote di emissione di gas a effetto serra.

Le entrate derivanti dal sistema andranno agli Stati membri e dovranno essere utilizzate per aiutare l'UE ad orientarsi verso un'economia più attenta all'ambiente, promuovendo l'innovazione in settori quali le energie rinnovabili, la ricerca e lo sviluppo. Parte delle entrate, inoltre, dovrà essere destinata ad aiutare i paesi in via di sviluppo ad adattarsi ai cambiamenti climatici.

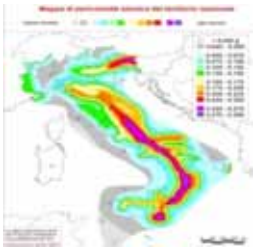
3. Lo stoccaggio geologico di biossido di carbonio (Direttiva 2009/31/CE del Parlamento europeo e del Consiglio, del 23 aprile 2009) che definisce le misure volte a garantire lo stoccaggio permanente di CO_2 in formazioni geologiche profonde in modo da eliminare il più possibile effetti negativi e rischi per l'ambiente e la salute umana. Tale Direttiva è stata attuata in Italia attraverso il Decreto legislativo n. 162 del 14 settembre 2011 che prevede:

- la creazione di un registro per il confinamento e lo stoccaggio di CO_2;
- l'individuazione delle aree dove lo stoccaggio è consentito;
- la definizione delle norme per il rilascio della licenza di esplorazione e per il rilascio dell'autorizzazione di stoccaggio;
- la definizione criteri per l'iniezione della CO_2;
- la prescrizione degli obblighi a seguito della chiusura del sito.

La ripartizione degli sforzi cui ciascuno degli Stati membri deve far fronte affinché l'UE rispetti gli obiettivi di riduzione delle emissioni per il 2020, (Decisione n. 406/2009/CE del Parlamento europeo e del Consiglio, del 23 aprile 2009), il cui obiettivo è quello di stabilire il contributo minimo degli Stati membri all'adempimento dell'impegno assunto dalla Comunità di ridurre, per il periodo dal 2013 al 2020, le emissioni di gas a effetto serra e le norme per la realizzazione di tali contributi e per la valutazione del rispetto di questo impegno.

In particolare l'Italia al 2020 è prevista una riduzione del 13% delle emissioni di gas a effetto serra rispetto ai livelli del 2005.

A tali atti normativi vanno poi aggiunti il regolamento europeo n. 443/2009 che fissa a 130 g/km a vettura i livelli di emissione di CO_2 delle autovetture nuove entro il 2015, e la direttiva 2009/30/CE sugli standard dei combustibili che fissa limiti al tenore di zolfo per il diesel e consente un maggior utilizzo di biocarburanti nella benzina (Camera dei Deputati 2009) che non hanno trovato ancora attuazione nel nostro Paese.



RESILIENZA E RISCHIO SISMICO NELLE "NUOVE NORME TECNICHE PER LE COSTRUZIONI"

Il DM 14 gennaio 2008 "Norme tecniche per le costruzioni" (NTC 08) ha aggiornato il quadro normativo nazionale in materia di costruzioni in zona sismica, introducendo nuovi criteri per la classificazione sismica del territorio nazionale definita mediante un approccio "sito dipendente" e non più tramite un criterio "zona dipendente", innovando l'apparato di norme per la realizzazione di manufatti antisismici e per l'adeguamento del patrimonio edilizio e infrastrutturale esistente. Con riferimento alla "Progettazione per le azioni sismiche", al Capitolo 7 viene disciplinata la progettazione e la costruzione di nuove opere soggette all'azione sismica in cui viene dedicato ampio spazio a predisposizioni volte al miglioramento delle prestazioni in termini di resistenza e duttilità dei singoli edifici sia nel loro complesso che a livello dei singoli elementi strutturali di cui si compongono. Solo un breve accenno viene fatto al punto 7.2.2. "Caratteristiche generali delle costruzioni" a parametri che possono influenzare le relazioni tra i manufatti che costituiscono un dato sistema urbano e le caratteristiche del sistema urbano stesso, prevedendo disposizioni relative a:

- distanza tra costruzioni contigue che non può essere inferiore «ad 1/100 della quota di due punti che si fronteggiano misurata dal piano di fondazione, moltiplicata per $a_g \cdot S /0,5g \leq 1$»;
- altezza massima dei nuovi edifici, che «deve essere opportunamente limitata, in funzione delle loro capacità de formative e dissipative e della classificazione sismica del territorio»; disposizioni alquanto generiche a meno che per gli edifici in legno e in muratura non armata ricadenti in zona 1 per i quali si prescrive un'altezza massima pari a due piani;
- limitazione dell'altezza in funzione della larghezza stradale per la quale è previsto che «i regolamenti e le norme di attuazione degli strumenti urbanistici possono introdurre limitazioni all'altezza degli edifici in funzione della larghezza stradale. Per ciascun fronte dell'edificio verso strada, i regolamenti e le norme definiranno la distanza minima tra la proiezione in pianta del fronte stesso ed il ciglio opposto della strada».

I recenti aggiornamenti del quadro normativo nazionale sembrano, quindi, ancora sottovalutare il possibile contributo urbanistico alla prevenzione e mitigazione del rischio sismico.

La normativa vigente incide principalmente sulle caratteristiche fisiche e tecnologiche che rendono i singoli edifici più o meno capaci di resistere alla sollecitazione prodotta dal sisma (vulnerabilità fisica o diretta) (Galderisi, Ceudech 2003).

In riferimento al tema della mitigazione del rischio sismico in ambito urbano bisognerebbe invece puntare, secondo un approccio di tipo olistico ai fenomeni urbani, a preservare e accrescere la resilienza del sistema territorio, agendo sui livelli di organizzazione del sistema stesso in modo tale da legare la capacità di risposta all'evento sismico non soltanto ai singoli edifici che la compongono, ma anche «alle caratteristiche spaziali e funzionali della città che incidono sulla vulnerabilità dell'evento sismico nonché alle dotazioni urbane, atte a consentire alla città di far fronte e riprendersi da un evento sismico» (Papa 2004).

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RIFERIMENTI IMMAGINI

L'immagine di pag. 223 è stata tratta dal sito web www.politichecomunitarie.it; l'immagine di pag. 225 è stata tratta dal sito dell'Istituto di Geofisica e Vulcanologia www.ingv.it/.

04

RESILIENT CITIES

REVIEW PAGES: URBAN PRACTICES

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In questo numero

STRATEGIE E MISURE PER INCREMENTARE LA RESILIENZA URBANA: ESEMPI DI PIANI CLIMA

Appare ormai chiaro quanto siano rilevanti gli impatti del cambiamento climatico sulle città. Dai primi anni del Duemila, grazie anche all'attenzione posta al problema in ambito scientifico (dal protocollo di Rio del 1996, al Protocollo di Kyoto e al Bali Roadmap), comincia a diffondersi dal basso un nuovo strumento urbanistico per limitare l'impatto dei gas serra e accompagnare le città costruite sull'economia capitalista del petrolio verso il modello della post-carbon city. Si tratta della città pianificata attraverso l'urbanistica per il clima, un modello di città in grado di rispondere alle sfide imposte dai cambiamenti climatici in atto sul pianeta (Lerch 2008).

Nella riflessione dei pianificatori sulla sostenibilità ambientale della pianificazione s'inserisce quindi il tema del cambiamento climatico (Bompan 2011) e si inizia a parlate esplicitamente di "piano per il clima" come strumento urbanistico e della nascita di una nuova urbanistica «for the climate change» (Mukheibir e Ziervogel 2007).

In Inghilterra e negli USA, dopo il 2005, si assiste ad una veloce diffusione dei piani clima, mentre in Italia è a partire dagli ultimi anni, con la conferenza nazionale "Il Clima delle Città, il Patto dei Sindaci e i Piani d'Azione per il Clima", tenutosi a Modena nel 2010 ed organizzata da Agenda 21, che si assiste alla promozione di questo nuovo strumento.

Per capire nello specifico di cosa si tratta, in questo numero sono presentati due esempi di piani clima: il *Piano di Azione per l'Energia Sostenibile e il Clima* del Comune di Milano (2009) e il *Climate Action Plan* di San Francisco (2008), di cui sono descritti le finalità e gli obiettivi e, soprattutto, le misure adottate per la riduzione delle emissioni di gas serra nelle città. Come vedremo, tali misure sono rivolte soprattutto alla riorganizzazione della mobilità urbana, che in entrambi i casi viene fuori come la principale causa di emissioni dirette di gas serra in ambito urbano.

IL PIANO DI AZIONE PER L'ENERGIA SOSTENIBILE E IL CLIMA DEL COMUNE DI MILANO

Nation: Italy - Milano
Year: 2009

Il *Piano di Azione per l'Energia Sostenibile e il Clima del Comune di Milano* (Piano clima) è stato redatto nel 2009 dall'Amministrazione comunale con la collaborazione tecnica e scientifica di AMAT (Agenzia Mobilità Ambiente e Territorio) e dello IEFE dell'Università Bocconi. Esso intende fornire un quadro di riferimento per le politiche energetiche e ambientali del Comune e il suo obiettivo principale è la riduzione, sul territorio comunale, delle emissioni complessive di anidride carbonica (CO_2): l'obiettivo è meno 20% entro il 2020 rispetto al livello emissivo del 2005, considerato come anno di riferimento.

Il piano considera le sole emissioni di CO_2 in quanto, tra i gas serra regolati a livello internazionale, rappresentano circa il 92% delle emissioni sul territorio comunale. Di contro, le emissioni di CH_4 e N_2O forniscono contributi modesti al totale, e la loro riduzione è oggetto di politiche a scala regionale e nazionale.

Le emissioni complessive considerate dal piano sono di due tipi:

- le emissioni dirette, generate all'interno dei confini comunali dal consumo di combustibili e dalla produzione di energia;
- le emissioni indirette o emissioni "ombra", generate fuori dai confini comunali dalla produzione di energia elettrica importata.

Per la stima delle emissioni complessive di CO_2 sul territorio comunale nell'anno 2005 si è fatto riferimento alle elaborazioni dell'Inventario delle Emissioni Comunali da Agenzia Mobilità Ambiente e Territorio (AMAT), che quantifica le emissioni dirette. Tali emissioni sono state distinte in 4 macrosettori:

- settore civile (emissioni dirette dovute all'uso di combustibili per riscaldamento e usi domestici);
- settore energia (emissioni dirette dovute alla produzione interna di energia da impianti CHP e termovalorizzazione di rifiuti ed emissioni indirette da importazione di energia elettrica);
- settore trasporti (emissioni derivanti da trasporto pubblico, privato e merci);
- settore industriale terziario (emissioni da usi di processo nel settore industriale/terziario).

A partire da tali stime, per definire quantitativamente le riduzioni da raggiungere in ragione dell'obiettivo posto (-20% delle emissioni al 2020 rispetto al 2005), è stato ipotizzato uno scenario evolutivo delle emissioni al 2020 in assenza delle azioni di Piano, cioè di misure già previste o approvate dalla amministrazione comunale che possono contribuire ad abbattere le emissioni di CO_2, o ulteriori misure individuate dal piano clima stesso.

L'approccio di stima adottato ha previsto la costruzione di un modello previsionale per le singole componenti citate. Si è giunti in questo modo a stimare che l'obiettivo di riduzione si traduce, per le sole emissioni dirette, nel passaggio da 4.795 $ktCO_2$/anno del 2005 a 3.836 $ktCO_2$/anno nel 2020 (riduzione di 959 $ktCO_2$).

Definito l'obiettivo da raggiungere, per individuare le strategie di intervento il Piano ha fatto ricorso alla metodologia proposta da Pacala-Socolow. Tale studio è costruito sull'assunto che la singola azione messa in campo non sia in grado di colmare il "gap" tra livello tendenziale e obiettivo di riduzione, quindi di

permettere il raggiungimento dell'obiettivo. Risulta invece più efficace l'individuazione di un ventaglio di possibili azioni e di tecnologie a basso contenuto di carbonio, già sperimentate e diffuse a livello internazionale.

	Settore	Descrizione	Riduzione emissioni (kt CO_2/anno)	
			Misure domestiche	*Misure extra confini comunali*
T1+T2	Trasporti	Sviluppo Trasporto Pubblico (Metropolitana e di superficie)	111	
T3	Trasporti	Mobilità ciclistica	76	
T4	Trasporti	Car sharing	8	
T5	Trasporti	Car pooling	11	
T6	Trasporti	Sistemi a chiamata	In T2	
T7	Trasporti	Efficienza autovetture private	405	
T8	Trasporti	Altre riduzione degli spostamenti auto (es. ecopass, ecc)	44	
T9	Trasporti	Cambio da auto a moto	18	
T10	Trasporti	Percorrenze mezzi commerciali	72	
T11	Trasporti	Efficienza mezzi commerciali	99	
T12	Trasporti	Efficienza mezzi trasporto pubblico	18	
R1	Residenza	Aumento efficienza energetica abitazioni esistenti	156	
R2	Residenza	Nuove abitazioni con interventi di efficienza energetica	97	
R3	Residenza (e edifici non abitativi)	Cambio combustibili (da gasolio a metano)	54	
R4	Residenza	Risparmio e.e. - efficienza usi finali	113	
Z1	Terziario servizi vendibili	Aumento efficienza energetica immobili esistenti	23	
Z2	Terziario servizi vendibili	Nuovi immobili con interventi di efficienza energetica	24	
Z3	Terziario servizi vendibili	Risparmio e.e. - efficienza usi finali	65	
E1	Comune MI	Aumento efficienza energetica immobili esistenti	6	
E2	Comune MI	Risparmio e.e. - efficienza usi finali - edifici	6	
E3	Comune MI	Risparmio e.e. - efficienza usi finali - illuminazione pubblica	13	
P1	Produzione energia	Miglioramento efficienza produzione energia		454
P2	Produzione energia	Solare Fotovoltaico	26	
P3	Produzione energia	Teleriscaldamento	73	
W1	Rifiuti	Rifiuti smaltiti in termovalorizzatore	19	57
A1	Agricoltura	Superficie coltivata con tecniche conservative	5	
A2	Agricoltura	Piantumazione alberature	2	
Totale riduzione emissioni			**1.546**	**511**

Tab. 1 Elenco degli interventi e potenziale di riduzione delle emissioni ad essi associato. Fonte: Elaborazioni IEFE-Avanzi

In tal senso, il Piano ha valutato tutte le possibili azioni da mettere in campo (sia previste all'interno degli strumenti programmatori comunali, che nuove) e ha selezionato, nel dettaglio, gli interventi in grado di fornire contributi significativi alla riduzione delle emissioni. Nello specifico, sono stati individuati 28 interventi

suddivisi per macrosettori e, per ogni singolo intervento, è stato stimato il potenziale di riduzione di emissioni di CO_2 ad esso associato, indipendentemente dalla realizzazione delle altre. L'elenco è riportato in tabella 1.
Dall'analisi sinteticamente descritta emerge che, in ragione delle stime delle riduzioni di singoli interventi e dell'analisi di coerenza interna, gli obiettivi prefissati dal piano clima sono realizzabili a patto che tutti gli interventi siano pienamente attuati. Nello specifico, l'implementazione delle misure "domestiche" (con effetto entro i confini comunali) consentirebbe un abbattimento di emissioni di CO_2 di 1.388 $ktCO_2$, nel pieno rispetto dell'obiettivo di riduzione del 20% delle emissioni dirette.
Infine appare interessante osservare il contributo dei diversi macrosettori: nella riduzione di emissioni dirette, il settore trasporti risulta preponderante (57% delle riduzioni), seguito dal macrosettore residenziale con il 27% e dai macrosettori terziario (7%) e produzione d'energia (6%).

IL SFMTA CLIMATE ACTION PLAN DI SAN FRANCISCO

Nation: USA – San Francisco
Year: 2008

Il *Climate Action Plan*, piano per il clima di San Francisco, è stato redatto nel 2008 dal *San Francisco Municipal Transportation Agency* (SFMTA), l'agenzia di trasporto cittadina che comprende il *Municipal Railway* (Muni) e il *Department of Parking and Traffic* (DPT). Il SFMTA è responsabile della pianificazione, della progettazione e del funzionamento del trasporto pubblico e delle strutture di servizio ad esso connesse, dei servizi pedonali e ciclopedonali, del traffico e del parcheggio.
Gli esperti del settore hanno indicato che le emissioni mondiali di carbonio devono essere ridotte del 80% rispetto ai livelli del 1990 entro il 2050 al fine di evitare cambiamenti climatici catastrofici.
Nell'aprile 2008, il Sindaco ha firmato un'ordinanza che stabilisce i seguenti obiettivi in termini di emissioni di gas serra:

- la riduzione del 20% rispetto ai livelli del 1990 entro il 2012
- la riduzione del 25% rispetto ai livelli del 1990 entro il 2017;
- la riduzione del 40% rispetto ai livelli del 1990 entro il 2025;
- la riduzione del 80% rispetto ai livelli del 1990 entro il 2050.

Coerentemente con tale obiettivo globale, il piano si pone l'obiettivo di riduzione dei gas serra del 20% entro il 2012 rispetto ai livelli del 1990, come nel caso del Piano di Milano.
In altre parole, poiché nel 1990 le emissioni totali di gas serra erano di 9,1 milioni di tonnellate di CO_2 equivalente, l'obiettivo potrà essere raggiunto con una riduzione di 2,5 milioni di tonnellate di CO_2 equivalente. Ciò richiederà una diminuzione immediata del consumo di energia tradizionale, producendo al contempo l'energia necessaria attraverso fonti non inquinanti come il sole, il vento, l'acqua. Inoltre, dal

momento che circa la metà delle emissioni di anidride carbonica in città sono prodotte dal settore dei trasporti (l'energia elettrica in città è generata principalmente da fonti idroelettriche), sarà necessario individuare misure volte alla riduzione dell'uso degli autoveicoli e allo spostamento della modalità di trasporto verso veicoli a basse o zero emissioni.

	Emissions (million tons CO_2)				
Year	Road vehicles	Municipal fleet	SFMTA rail and buses	Other transit	Total
1990	4.27	0.08	0.09	0.16	4.60
2000	4.67	0.08	0.10	0.26	5.10
2012-Status quo	5.07	0.08	0.10	0.28	5,50
2012-20% reduction target	3.42	0.06	0.07	0.13	3.70
Required reduction by 2012	-1.65	-0.02	Note 1	Note 1	-1.80

Note 1: Transit service increases to accomodate new riders may cause transit emissions to increase, but would be offset by much larger decreases in road vehicles emissions.

Tabella 2 Dati relativi alle emissioni di gas serra dal 1990

Dall'analisi dei dati relativi alle emissioni di gas serra prodotte dal settore dei trasporti dal 1990 emerge che per conseguire l'obiettivo è necessaria una riduzione annuale di 1,8 milioni di tonnellate di CO_2. Dal momento che oltre il 90% delle emissioni connesse ai trasporti proviene dai veicoli stradali, per raggiungere questo obiettivo è necessaria una strategia combinata: riduzione in termini di miglia percorse (VMT - *Vehicle Mile Traveled)* e in spostamenti dalle automobili private, nonché una riduzione dei consumi di carburante con l'introduzione di nuove tecnologie automobilistiche.

Il piano inoltre passa in rassegna tutti gli interventi già previsti dall'Amministrazione cittadina, con cui condivide l'obiettivo comune di riduzione delle emissioni del 20% entro il 2012, e suggerisce le nuove necessarie misure da mettere in campo, riconducibili a tre grandi linee d'azione:

- la riduzione delle emissioni veicolari attraverso l'utilizzo di veicoli alimentati da fonti di energia pulita;
- la riduzione della domanda di spostamento con mezzi privati;
- il potenziamento del trasporto pubblico, della mobilità ciclistica e pedonale.

In particolare, per i veicoli del trasporto pubblico il piano ritiene necessario sostituire progressivamente la flotta municipale con veicoli elettrici o ad idrogeno. Per i veicoli del trasporto privato, la SFMTA sta studiando la fattibilità e i costi per incentivare l'installazione in diversi luoghi (strada, parcheggi, luoghi di lavoro) di punti di ricarica elettrica per i veicoli privati.

Per quanto riguarda invece la riduzione della domanda di spostamento con mezzi privati, il piano ritiene che il ricorso al *Transit-Oriented Development* (TOD), ossia orientare la pianificazione degli usi del suolo verso sistemi integrati con il trasporto pubblico e la pedonalità, sia uno dei modi più efficaci per gestire la domanda di trasporto e ridurre gli spostamenti con mezzi privati. Ciò significa insediamenti ad elevata densità, caratterizzati da mix di funzioni e serviti dalla rete del trasporto pubblico. Sebbene San Francisco sia una delle città a più elevata densità degli Stai Uniti, ci sono quartieri a più bassa densità dove il tasso di proprietà delle auto private è ancora molto alto. Tale misura è sostenuta anche dal Dipartimento di Pianificazione urbana che promuove iniziative politiche per sostenere e incoraggiare una maggiore densità e un uso misto degli insediamenti, prevalentemente residenziali, serviti dalla rete del trasporto pubblico.

Inoltre, il piano prevede una nuova gestione del sistema dei parcheggi attraverso l'iniziativa denominata *SF Park*, con l'obiettivo di ridurre la congestione riducendo i tempi di ricerca del parcheggio e il numero e la durata degli spostamenti in auto. Il piano punta anche su sistemi di *congestion pricing*, e sulla promozione del *car sharing*.
Infine, per il potenziamento del trasporto pubblico, della mobilità ciclistica e pedonale, il piano punta all'aumento dei percorsi ciclopedonali e delle piste ciclabili e al miglioramento della sicurezza delle strade e degli incroci. Per il potenziamento del trasporto pubblico, il piano ha individuato gli elementi della rete su ferro e su gomma che devono essere potenziati (soprattutto con l'estensione di alcune linee) e ha definito un programma per migliorare l'attuale livello di servizio, soprattutto in relazione ai tempi di percorrenza.

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RIFERIMENTI IMMAGINI

L'immagine di pag. 227 è tratta da http://www.ecologiae.com/inquinamento-a-pechino-tutta-colpa-delle-province/1794/.
L'immagine di pag. 228 è tratta da http://www.ecologiae.com/mobilita-sostenibile-milano-spazio-due-ruote/35792/.
L'immagine di pag. 230 è tratta da http://www.san-francisco.co.uk/Distinctly-San-Francisco.htm.

05

LANDSCAPES OF URBAN SPRAWL

REVIEW PAGES: NEWS AND EVENTS

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In questo numero

LE ORGANIZZAZIONI MONDIALI A SOSTEGNO DELLA RESILIENZA.

«L'erosione costiera, la decadenza delle infrastrutture urbane, le minacce geologiche, l'utilizzo eccessivo delle risorse naturali, nonché la crescente interdipendenza economica tra città e stati, stanno contribuendo ad aumentare le perdite umane ed economiche nelle città di tutto il mondo. Gli effetti del cambiamento climatico presentano nuove incertezze e i rischi minacciano di aggravare la vulnerabilità urbana» (ISDR, International Strategy for Disaster Riduction, Resilient Cities 2012, maggio 2012).

L'aumento della popolazione mondiale, l'urbanizzazione e la globalizzazione hanno notevolmente aggravato il potenziale rischio per tutte le comunità locali. Il rischio urbano è diventata una delle principali preoccupazioni planetaria e il cambiamento climatico è destinato a peggiorare la situazione.

Ancora una volta tematiche complesse legate all'ambiente, al territorio e ai fenomeni inarrestabili e incontrollabili sono al centro di discussioni internazionali scientifiche, tecniche e politiche al fine di definire e chiarire in maniera condivisa i principi che le regolano, gli elementi identificatori e le possibili risposte ai problemi alla base dello sviluppo e della crescita sostenibile delle città: l'adattamento del sistema urbano ai disastri ambientali dovuti principalmente alle pressioni delle attività umane sull'ambiente.

Ci si trova a fare di certi argomenti i principali temi di confronto e discussione multisciplinare e nascono così, attraverso campagne di sensibilizzazione prima e di sostegno finanziario e gestionale dopo, organizzazioni specifiche che affrontano l'argomento a 360 gradi con la prerogativa di diventare centri specifici di ricerca, centri di monitoraggio dei progressi nelle città, hub internazionali di discussione e confronto, incubatori di idee ed esperienze, promotori di scambi in rete, e supporti tecnici per i governatori locali e nazionali. La pianificazione, la cooperazione e lo sviluppo di comunità resilienti al rischio ambientale rimangono le condizioni essenziali per uno sviluppo sostenibile. Ancora pochi sono i casi al mondo in cui sono state applicate adeguate ed efficaci azioni al fine di rendere le città resilienti ai cambiamenti climatici e, soprattutto, molto poco si può ancora trarre dagli orientamenti politici o strategici applicati a scala locale o

nazionale, dato che i loro effetti diretti e indiretti sullo sviluppo urbano non sono immediatamente percepibili e, quindi, valutabili.
Le maggiori organizzazioni mondiali sul tema della resilienza convengono sul fatto che per ridurre il rischio ambientale è necessario partire dai livelli di governo locale e regionale.
The United Nations Office for Disaster Risk Reduction, ad esempio, creata nel 2000 come Segretariato delle Nazioni Unite con lo scopo di garantire l'attuazione della Strategia Internazionale per la Riduzione dei Disastri (ISDR), comprende numerose organizzazioni intergovernative e non governative, Stati, istituzioni finanziarie, organismi tecnici e organi della società civile. I diversi attori lavorano insieme per condividere le informazioni e ridurre il rischio di catastrofi. UNISDR funge da punto focale per l'attuazione del quadro d'azione di Hyogo (HFA), un piano di dieci anni di azione adottato nel 2005 da 168 governi per proteggere la vita e la sopravvivenza contro le calamità.

DISASTER RISK REDUCTION 2012 - 27TH DMISA CONFERENCE
Where: Limpopo - Sud Africa
When: 12-13 Settembre 2012

SOUTHERN AFRICA SOCIETY FOR DISASTER REDUCTION 1ST BIENNIAL CONFERENCE
Where: Potchefstroom - Sud Africa
When: 10-12 Ottobre 2012

3RD GLOBAL FORUM ON URBAN RESILIENCE AND ADAPTATION 2012
Where: Germania - Bonn
When: 12-15 Maggio 2012

6TH WORLD URBAN FORUM - WUF6- THE URBAN FUTURE
Where: Italia - Napoli
When: 1-7 Settembre 2012

IUCN WORLD CONSERVATION CONGRESS 2012
Where: Korea - Jeju
When: 6-15 Settembre 2012

4TH INTERNATIONAL DISASTER AND RISK CONFERENCE_IDRC DAVOS 2012
Where: Svizzera - Davos
When: 26-30 Agosto 2012

ICLEI, Local Government for Sustainability, è una associazione fondata nel 1990, con oltre 1.220 membri appartenenti a governi locali, regionali e nazionali, provenienti da 70 paesi del mondo. Essa è impegnata a

supportare gli amministratori per migliorare lo sviluppo sostenibile delle proprie città. La premessa fondamentale che orienta la sua missione è che le iniziative intese a livello locale sono in grado di fornire un modo efficace ed economicamente efficiente per raggiungere gli obiettivi di sostenibilità locale, nazionale e globale.
GRF DAVOS, Global Risk Forum è un centro di scambio di conoscenze per l'applicazione di strategie contemporanee, di strumenti e di soluzioni pratiche di gestione del rischio, con l'obiettivo di ridurre la vulnerabilità attraverso una politica della sostenibilità.

UNISDR'S MAKING CITIES RESILIENT CAMPAIGN 2012-2015

La campagna per la riduzione dei disastri mondiali, promossa nel 2012, dal titolo *Making Cities Resilient_ my city is getting ready*, e il confronto tra istituzioni nazionali, internazionali e locali, hanno condotto alla redazione di *How to Make Cities More Resilient: a Handbook for Local Government Leaders*, un documento composto da dieci linee guida a sostegno della politica pubblica e dei processi decisionali locali. Tale strumento è stato supportato e promosso dalla dichiarazione di Bonn, in cui i sindaci convenuti hanno definito le tre azioni principali per affrontare il rischio ambientale a partire dai metodi di gestione locale.
Gli amministratori locali sono sempre più consapevoli che si potrebbe affrontare in modo migliore il problema della resilienza se molteplici attori si aggregassero per rafforzare la partnership tra istituzioni, nazioni, governi, società di privati e la comunità civile. United Nations Office for Disaster Risk Reduction (UNISDR), ICLEI, Local Governments for Sustainability, World Bank Global Facility for Disaster Reduction and Recovery, United Cities for Local Governments (UCLG), Earthquakes and Megacities Initiative e UN-Habitat, insieme a sindaci e governatori locali, partecipando al Resilient Cities 2012 Congress, hanno definite una serie di obiettivi di sostegno locale, nazionale e internazionale:

- rafforzare la capacità delle amministrazioni locali e regionali di proteggere gli assetti sociali ed economici delle città attraverso programmi nazionali ed internazionali di riduzione dei rischi da disastri e attraverso strumenti normativi;
- autorizzare i governi locali e regionali ad accedere ai finanziamenti e ad attuare politiche, strategie ed azioni di resilienza locale e urbana;
- promuovere le dieci azioni essenziali per rendere le città più resilienti e adottare uno strumento di valutazione della resilienza al fine di sostenere l'importanza e il valore delle attività di riduzione del rischio ambientale;
- aumentare la resilienza urbana, la riduzione del rischio ambientale e l'adattamento ai cambiamenti climatici sulle agende politiche locali, nazionali e globali;
- incoraggiare la partecipazione attiva attraverso le città e gli amministratori locali e regionali.

Per raggiungere questi obiettivi, UNISDR invita i governi locali, le reti urbane e i governi nazionali ad aderire alle seguenti tre azioni:

- applicare gli strumenti e le risorse disponibili per migliorare la valutazione e la pianificazione del rischio di disastri ambientali, integrando la resilienza nei piani di sviluppo urbani e locali;
- lavorare in maniera partecipata e inclusiva per sviluppare programmi, costruire la resilienza, scambiare la propria esperienza con altre amministrazioni locali e sponsorizzare gli eventi basati sullo scambio di conoscenze;
- stabilire un budget per la riduzione del rischio di disastri e per la resilienza all'interno dei programmi di sviluppo urbano sostenibile e dei servizi municipali.

ICLEI, LOCAL GOVERNMENTS FOR SUSTAINABILITY_ RESILIENT CITIES 2012

Uno studio condotto dal Massachusetts Institute of Technology (MIT) e dall'ICLEI (Local Governments for Sustainability) sostiene che il 79% delle città sta avvertendo profondi cambiamenti dei rischi ambientali, delle temperature, delle precipitazioni e del livello dei mari; inoltre, il 68% delle città si sta impegnando nella progettazione di sistemi che si adattino ai cambiamenti, il 19% sta adottando una valutazione dei rischi e un altro 19% sta definendo sistemi di pianificazione che migliorino la resilienza.

Fig. 1 Gli elementi del progetto "Resilient Upgrade" (ICLEI 2011)

Le città hanno enormi sfide da affrontare ed esse possono essere risolte solo se si sviluppano soluzioni integrate urbane basate sulle valutazioni del rischio. L'implementazione di soluzioni dipende dall'accesso ai

fondi e dalla possibilità di attrarre gli investimenti privati a livello locale, nonché dalla possibilità di assicurare che le persone che appartengono alle comunità locali siano parte delle soluzioni.
Secondo Peter Gruetter dell'Internet Business Solutions, Cisco Systems, «Le città hanno bisogno di attingere dalla conoscenza locale e dalla capacità delle loro comunità per affrontare e mitigare i rischi che si trovano ad affrontare», mentre Konrad Otto-Zimmermann, Segretario Generale di ICLEI, sostiene che «le città hanno bisogno di costruire la resilienza, non solo agli impatti del clima, ma a tutti i tipi di urti potenziali e di crisi».
Queste sono le linee guida che sono state condivise al Resilient Cities 2012, il terzo Forum mondiale per l'apprendimento, la cooperazione e il networking su tutti gli aspetti legati alla resilienza urbana e all'adattamento ai cambiamenti climatici. Il forum è stato convocato dall'ICLEI, Local Governments for Sustainability, dalla città di Bonn, e dal World Mayors Council on Climate Change.
ICLEI è un'associazione mondiale di governi locali e organizzazioni comunali (più di 1200 i governi locali e associazioni, provenienti 70 paesi diversi) che si impegnano per promuovere ed educare allo sviluppo sostenibile.
Come movimento, ICLEI segue il programma climatico più grande del mondo. Esso lega l'azione locale al raggiungimento degli obiettivi nazionali e concordati a livello internazionale. ICLEI fornisce informazioni, fa formazione, organizza conferenze, facilita gli scambi in rete da città a città, svolge attività di ricerca e progetti pilota, offre, infine, servizi tecnici e di consulenza.

GRF DAVOS, GLOBAL RISK FORUM

GRF Davos riflette con le sue tre sezioni, *Risk Academy*, *International Disaster and Risk Conferences (IDRC)* e *Workshops and the Platform for Networks*, la necessità di creare interazione e coinvolgimento tra tutti gli attori principali nel settore della gestione dei rischi (autorità di gestione nazionali e locali delle catastrofi, dei rischi e della sicurezza, istituzioni accademiche, settore privato e media). I principali obiettivi sono:

- colmare il divario tra scienza e pratica;
- promuovere lo scambio di know-how ed esperienze a livello mondiale;
- individuare soluzioni e promuovere le buone pratiche in materia di gestione integrale dei rischi e di adattamento al cambiamento climatico per una migliore comprensione, valutazione e gestione dei disastri e dei rischi che incidono sulla sicurezza umana, sulla salute, sull'ambiente, sulle infrastrutture, sull'economia e sulla società in generale;
- costruire una rete tra i decision-makers, i professionisti, gli amministratori locali, le organizzazioni intergovernative, gli attori economici, quelli scientifici, le ONG, i media e le comunità.

Le società di oggi si trovano ad affrontare numerosi e complessi rischi. Rischi ambientali, tecnologici, sociali ed economici sono spesso strettamente collegati e possono causare differenti impatti. I rischi e i disastri indagati presso l'IDRC includono, tra gli altri, i rischi naturali, la criticità delle infrastrutture e dei servizi, gli

atti di terrorismo e le crisi finanziarie. Tutti possono gravemente incidere e influenzare gli esseri umani e le società collettive.
La natura complessa e multiforme dei rischi richiede un approccio innovativo, di tipo olistico, orientato a risolvere in primo luogo il problema della gestione del rischio. Il tema dell'*International Disaster and Risk Conferences (IDRC)* 2012 – Gestione integrata del rischio in un mondo che cambia – patrocinato dall'*United Nations Environments Programme*, dall'*UNESCO*, dall'UN-ISDR e dall'*International Labour Organisation*, è finalizzato a consolidare e migliorare l'approccio integrato alla gestione del rischio per aumentare globalmente la resilienza e ridurre la vulnerabilità. I contesti entro i quali si affronterà tale tema sono vari e complessi: la vulnerabilità e la resilienza; le grandi catastrofi; i rischi ambientali ed ecologici; il governo del territorio; i rischi urbani; le infrastrutture e i servizi; i rischi tecnologici; i rischi sulla salute e la risposta medica; l'educazione, la comunicazione e la formazione; gli strumenti finanziari per la gestione del rischio; il rischio della società, la gestione dei rischi e la cultura del rischio.

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