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From the «Resilient City» to Urban Resilience. A review essay on understanding and integrating the resilience perspective for urban systems

Lorenzo Chelleri
Universitat Autònoma de Barcelona. Departament de Geografia
lorenzo.chelleri@uab.cat

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Abstract

Resilience appears to have become a buzz word since the ecological, psychological, social and economic sciences began to use it to refer, respectively, to the capacity of ecosystems, people, societies, the economy, and more recently even urban systems to cope with disturbance. In fact, it is unclear exactly what the catchword «resilient city» means. Based on these assumptions, this article reviews resilience perspectives and their possible application to urban systems. In the first part of the paper, the concept of resilience, its evolution and perspectives (from engineering to social ecology) are analyzed with reference to ecosystems, societies and complex systems. In the second part we try to shed light on this panacea of concepts applied to cities. Important insights of this review are that certain resilience engineering perspectives (such as recovery and persistence views) can lead to unsustainable patterns of development in cities, while from complex systems resilience perspectives the principles of sustainability and transformability emerge as the consequent and necessary trajectory. While the term «resilient cities» often refers only to the capacity to maintain functions and structures, we argue that urban resilience should be framed within the resilience (system persistence), transition (system incremental change) and transformation (system reconfiguration) views.

Keywords: Resilient cities; urban resilience; adaptation to climate change; transition towns; sustainability.

Resum. *De la «ciutat resilient» a la resiliència urbana. Un estat de la qüestió sobre la comprensió i la integració de la perspectiva de la resiliència en sistemes urbans*

El concepte de resiliència sembla que actualment ha perdut significat. La banalització del concepte es deu, potser, a la proliferació del seu denominador comú o «capacitat de fer front a les pertorbacions» en moltes disciplines diferents. Un problema que se'n deriva és la manca de comprensió d'un nou concepte relacionat amb l'adaptació al canvi climàtic: «Resilient City». En aquest article, es pretén revisar l'evolució i les perspectives diferents del concepte de resiliència i analitzar la possible relació i aplicació d'aquestes perspectives a l'àmbit urbà. Un resultat de la revisió són les possibles malinterpretacions de la resiliència aplicada a l'ambient urbà quan ens referim a la principal propietat de conservació (resiliència entesa com a recuperació i tornada a l'estat previ després d'una pertorbació), que pot promoure un model urbà insostenible. Hi ha unes altres perspectives (la resiliència dels sistemes complexos) que ens transmeten missatges més sostenibles per a l'aplicació urbana d'aquest concepte, ja que s'interessen per les propietats de transformació i transició sostenible d'un sistema. D'aquesta manera, el concepte de resiliència aplicat a les ciutats ha de tenir en compte les propietats de conservació (capacitat de sobreviure al canvi), transició (mudar i adaptar-se al canvi) i transformació (reconfiguració del sistema) al mateix temps i desenvolupar-se d'acord amb unes dimensions socioeconòmiques i polítiques específiques.

Paraules clau: ciutats resilients; resiliència urbana; adaptació al canvi climàtic; transicions urbanes; sostenibilitat.

Resumen. *De la «ciudad resiliente» a la resiliencia urbana. Un estado de la cuestión sobre la comprensión e integración de la perspectiva de la resiliencia en sistemas urbanos*

El concepto de resiliencia parece haber perdido significado en la actualidad. La banalización del concepto se debe quizás a su proliferación de su denominador común o «la capacidad de hacer frente a las perturbaciones» en muchas disciplinas diferentes. Un problema derivado es la falta de comprensión de un nuevo concepto relacionado con la adaptación al cambio climático: «Resilient City». En ese artículo, se pretende revisar la evolución y distintas perspectivas del concepto de resiliencia y analizar la posible relación y aplicación de estas perspectivas al ámbito urbano. Un resultado de la revisión son las posibles malinterpretaciones de la resiliencia aplicada al ambiente urbano cuando nos referimos a la principal propiedad de conservación (resiliencia entendida como recuperación y vuelta al estado previo después de una perturbación), que puede promover la resistencia de un modelo urbano insostenible. Otras perspectivas (la resiliencia de los sistemas complejos) nos transmiten mensajes más sostenibles para la aplicación urbana de este concepto, más interesados en las propiedades de transformación y transición sostenible de un sistema. De este modo, el concepto de resiliencia aplicado a las ciudades debe de tener en cuenta las propiedades de conservación (capacidad de sobrevivir al cambio), transición (mudar y adaptarse al cambio) y transformación (reconfiguración del sistema) a la vez y desarrollarse según dimensiones socioeconómicas y políticas específicas.

Palabras clave: ciudad resiliente; resiliencia urbana; adaptación al cambio climatico; ciudades en transición; sostenibilidad.

Resumé. *De la «ville résiliente» à la résilience urbaine. Un essai critique sur la compréhension et l'intégration de la perspective de résilience des systèmes urbains*

La large utilisation du terme résilience semble avoir mené à une perte de sens. Ce mot est en-effet utilisé indifféremment pour qualifier une propriété des écosystèmes, ou des sociétés et de leurs économies à faire face et se rétablir suite à des perturbations. Ainsi le sens de l'expression «Ville Résiliente» laisse la voie à de nombreuses interprétations.

Partant de ces constatations, cet article a pour but de clarifier les différentes visions de la résilience et leur application possible aux systèmes urbains. Dans une première partie seront analysés le concept de résilience et ses évolutions depuis différents points de vue (depuis l'ingénierie jusqu'à la socio écologie). Dans une deuxième partie, il sera tenté de clarifier le large panel de concepts faisant référence aux villes.

Ce travail laisse entrevoir que de mauvaises interprétations du terme résilience peuvent surgir lorsque qu'il se réfère à l'ingénierie (entendu comme la capacité de récupération et la persistance dans le temps) et donc entraîner des modes de développement non durable.

D'autres perspectives (celles de la résilience de systèmes complexes) apportent une vision plus durable en faisant émerger la transformabilité comme trajectoire nécessaire.

Ainsi, alors que le concept de «Ville Résiliente» se réfère parfois uniquement à la capacité de maintenir les fonctions et structures, il apparaît qu'il devrait prendre en compte également les propriétés de conservation (capacité de survivre au changement), de transition (adaptation graduelle au changement), de transformation (reconfiguration du système) en même temps que se développer suivant des dimensions socioéconomiques et politiques (plus que technique).

Mots clé: villes résiliente; résilience urbaine; adaptation au changement climatique; villes en transition; dévelopment durable.

Summary

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Why speak about resilience and cities

The joint evolution of societies and cities has been studied at length (Geddes, 1915; Diamond 2005) and many unsustainable trajectories have been recorded (Club de Roma, 1972). Resilience is about adapting and reducing vulnerability. It is the capacity of any system to deal with external changes whilst maintaining its structure, functions and identity (Holling, 1973). Even if it seems quite easy to link resilience and adaptation to evolution and sustainability, the long-term history of human-environment interactions, contained in the archaeological records, reveal that many human responses and adaptive strategies that apparently helped to increase resilience in the short term, or even over a few generations, nonetheless led to a serious erosion of resilience in the long term, resulting in the collapse of both environmental and social systems (Van Andel et al., 1990; Redman, 1999). This is a key point when discussing what resilience could represent in short, medium and long term perspectives. From this argument we conclude that resilience is much more than «becoming adaptable», and that, if translated into the urban framework, it increases complexity and, therefore, may be subject to possible misinterpretations (Redman and Kizing, 2003). Nevertheless in recent times the term «Resilient Cities» has become a buzz word, mainly related to urban adaptation to Climate Change (CC). Thus conferences, workshops, programs and worldwide networks have risen from risk management, ecological, sustainability or political sciences under this new umbrella concept of «resilient cities». Such a flood of contributions adds more and more meanings to resilience, making the concept fuzzier for some authors (e.g. Markusen, 1999). However, fuzziness and policy detachment (advanced by some of the critics to resilience theory) may just be symptoms of the immaturity of a concept (Lagendijk, 2003). Resilience shares part of its framework with vulnerability and sustainability studies, (Miller, 2010; Turner, 2010). The systemic vision (dealing with complex systems theories) grants resilience the relevance for a debate on the city and illuminates many shortcomings of urban planning. The most promising and challenging advance of the resilience approach applied to cities is precisely the notion that not everything can be planned (Churchill, 2003) because of the dynamic and highly complex nature of urban areas (Aberti, 2008). Furthermore resilience perspectives emphasize the integration of ecosystem functions within the social dynamics (Andersson, 2006), which is an essential issue for governing and managing the transition of cities toward more sustainable development paths (Lambin, 2005).

In the next sections we will analyze the different dimensions of resilience theories and the different interpretations regarding the application of those dimensions to cities. In the first part of the article we will analyze engineering resilience, or the capacity to bounce back to equilibrium, and complex system's resilience dealing with multi equilibrium paths. In the second part the article introduces the urban dimensions, firstly from an engineering perspective (or the capacity of the cities to be resistant to disturbance maintaining their living functions) and afterwards from the more complex social ecological view.

Resilience perspectives: from engineering to social-ecological resilience

The existing literature on resilience spans several disciplines and remains fragmented due to different starting points and subsequent evolutions of the same concept. From an engineering perspective, resilience is defined as the property of a specific material to absorb energy when it is deformed elastically and the recovery of this energy when returning to its original state (Avallone, 2007). This definition fits well with the stability properties of systems recovering after a disturbance. This same principle is used in psychology and psychiatry when referring to individual resilience which is defined in this case as the capacity to deal with changes and events during life course transitions (Rutter, 1987; Kaplan, 1999). Therefore withstanding shocks or difficulties is a key factor in children, adolescent or adult's life. From these stability and recovery principles, on materials and individuals, we can move towards upper conceptual scales (from material to infrastructures and from people to societies). One of the first examples in this shift emerges from Neil Adger's definition of social resilience, as the «ability of groups or communities to cope with external stresses and disturbances as a result of social, political and environmental changes» (Adger, 2000: 347). At the same time, from the literature on engineering resilience (focusing on the vulnerability of people and places), social resilience depends on hazardous environments, the forecasting of catastrophic events, and systemic breakdowns and their social and economic implications (Vale and Campanella, 2005). This represents a way of thinking about safety in which resilience attempts to express or ensure that any organization maintains (or recovers to) a safe stable state, helping people to cope with complexity under pressure and therefore achieve success. The concepts of «maintaining», «recovering» and «looking for equilibrium» are key points of those different meanings and frameworks of resilience. However, far from such views, resilience thinking has already explored new dimensions of what resilience could mean, referring also to complex systems (Levin, 1998) with multi equilibrium states (Holling, 1986).

Ecosystem resilience (Holling, 1973 and 1986) moved afterwards to include social-ecological systems (SESs) (Folke et al, 1998; Berkes et al, 2003) emphasizing the management dimension of this coupled system dynamics (Folke et al, 2005). The key step in this evolution is the shift from the recovery to the transformation principle in adapting to disturbance. In fact, Holling defined resilience in ecosystems as the system's capacity of reorganizing and managing changes in order to maintain the same identity, structure and functions (Holling, 1973). Focusing on the identity and structure of systems (within the «one-equilibrium» view), criticisms of this view began underlining that ecological resilience related better to the functioning of the system, rather than to the stability of its components (populations), or even to the ability to maintain (recover) a steady ecological state (Pimm, 1984). Many examples of ecosystem functioning (Schindler 1990) began to demonstrate a predictable, however surprising, variability in ecological systems (Holling, 1986), while, at the same time, the science of complexity was carving its way into system theory (Costanza et al, 1993; Kauffman, 1993). From those new approaches nonlinearity, but also uncertainty or self-organization (Levin 1999), were the main attributes influencing resilience theory. The importance of such advances brought a new (and common) framework, based on the multi equilibrium and nonlinearity properties, between complex ecological systems thinking, and a reframing of the theory on the stability of ecological systems (Holling, 1986). At the same time, resilience in terms of ecological recovery (functions, structure and identity) was shifting into a more complex paradigm when evidence from case studies began to demonstrate that the interactions with human systems were the primary reasons for expected changes and shifts into ecosystem's regimes (Wilson, 2000; Scheffer et al, 2001). This evidence supported the novel conceptual framework that natural and social systems maintain a synergistic and co-evolutionary relationship (Norgaard, 1994, Berkes and Folke, 1998) and that the resilience of ecological systems strictly depends on the dynamics of social systems. Although many disciplines (Human Geography, Human Ecology, Ecological Economics, political ecology) address the SESs dimension (Zimmerer, 1994; Gunderson et al., 1997; Levin et al., 1998; Adger, 2000; Folke, 2006), at the very core of resilience thinking there are two main ways of understanding this dimension (Salt and Walker, 2006): the first concerns system's thresholds (Scheffer, 2001; Walker and Meyers, 2004) and regime domains, while the second is represented by the heuristic model of adaptive cycles (Gunderson and Holling, 2002).

Thresholds and Adaptation: Two ways of understanding the resilience of (Complex) Systems

As highlighted earlier, SESs deals with the assumption that living systems are continuously evolving in different trajectories, within multi equilibrium states and integrating the social and ecological dynamics within coupled systems. Along these trajectories, resilience perspectives are then re-focused on different properties like renewal, transformation and re-organization, instead of recovering, maintaining and bouncing back (Folke, 2006). The exact differences between these two approaches need to be clarified to avoid the misinterpretations of what the adaptation concept means. In defining how resilience (or adaptations) of SESs could be expressed to include renewal and transformation capacities we need to introduce the concepts of thresholds and regimes. In itself, a threshold is defined as a crossing point, near and after which the feedback to the rest of the system begins to change (Walker and Salt, 2006). Knowing that any system, independently from how many variables describe it, naturally tends to a dynamic equilibrium state, the (threshold) complementary concept of «regime» expresses all the possible system's movements within a basin of attraction (Walker et al. 2004). Notwithstanding this dynamic equilibrium, inside a basin of attraction, a system can flip from one basin to another one, crossing a threshold (also referred to as a tipping point) and assuming different functions and structure within the new regime. Many examples of this can be found in the real world. Perhaps one of the first and most cited examples is the eutrophication of lakes (Scheffer et al, 2001; Carpenter 2003). While receiving plant nutrients (phosphorus for example) present in runoff from the surrounding agricultural lands (the social system) the lake can cope with the increasing level of algae growth because the capacity of sediments (mud) to absorb phosphorus (which decreases the source of nutrients for algae growth). However, in a second stage the phosphorus level may reach a tolerance threshold (lake sediment saturated with phosphorus) so that a tipping point is reached. Therefore, the feedback between the lake's muddy bottom and algae growth (diminished capacity of the sediments to absorb phosphorus) changes. A new system regime is installed and the lake structure and functions change from the previous equilibrium. In this new phase a murky water lake develops, which will not recover its previous condition (of functions and feedbacks) even if no more phosphorus is added. This exemplification of SES dynamics reveals from the one stand the nested relationship between the social (phosphorus inputs caused by agriculture) and the ecological (the lake and its ecological functions) systems, and from the other hand the importance of recognizing thresholds and drivers that drive systems to tipping points. Resilience here would be about retaining the equilibrium within a concrete regime (Folke et al., 2004; Scheffer, 2004) or moving the system thresholds in order to make the equilibrium last longer (Berkes et al, 2003, Walker and Salt, 2006). In performing that, adaptability and transformability are the two main properties of SESs facing changes (Folke et al., 2010) and reflect our second paradigm of the resilience of learning, renewal and re-organization. Such development and evolution of dynamic systems is symbolized by the concept of adaptive renewal cycle (see Figure 1) (Holling, 1986).

In this model the evolution of systems is expressed as a dynamic cycle of growth (exploitation phase), conservation (steady state phase), collapse (release phase) and finally the reorganization phase. Resilience potential differs and depends on these different phases. It is lower in the system conservation and collapse phases (because of the specialization and the system's loss of response diversity), and higher in the renewal and growth phases. This model emphasizes two essential messages from resilience theory: that disturbance is a necessary part of development and that renewal (learning and self-organization for change), much more than conservation or bouncing back, is a resilient strategy (Gunderson and Holling, 2002). Contrary to what engineering resilience views claim, in SESs, evolution and development justify adjustments, transformations, and even the collapse of subsystems, because

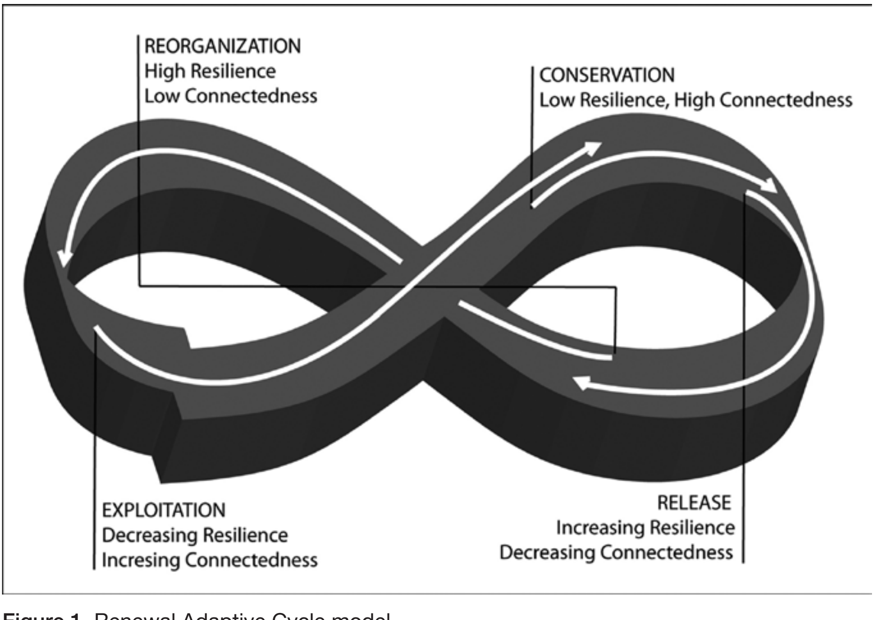

Figure 1. Renewal Adaptive Cycle model.

Source: Gunderson and Holling, 2002.

multi equilibrium, diversity and renewal are the key for new and sustainable systems trajectories (Berkes et al., 2003; Folke, 2010). In fact, in all systems (human, social, ecological) adaptations and transformations occur as multi-scalar (spatial and temporal) processes.

As Holling underlines in the introduction of the Panarchy book (see Figure 2): «there are several different ranges of scales each with different patchiness, attribute and textures»; referring to the systems and groups: «the one plays into the others dynamic interaction» as in «a nested adaptive cycle» scheme (Holling, 1992:15). Translating to cities, the concept of Panarchy

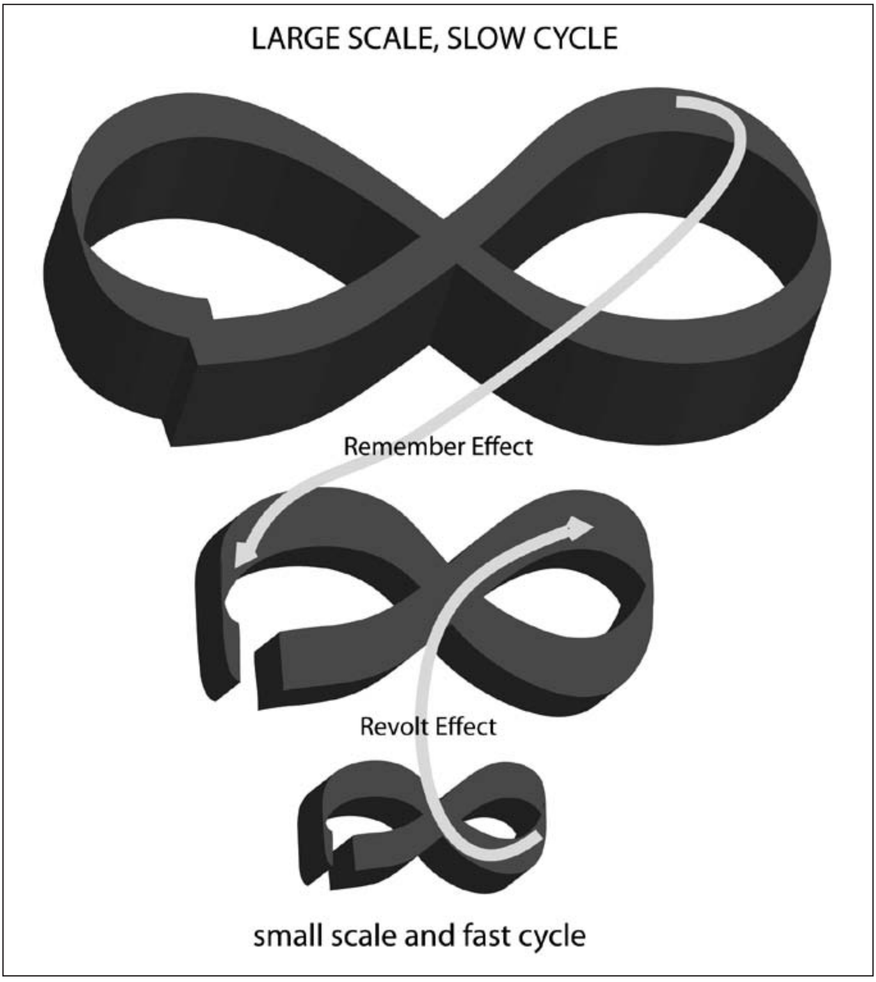

Figure 2. Panarchy cross scales interactions.

Source: Gunderson and Holling, 2002.

reflects the complex cross-scale effects between neighbourhoods, suburbs and the metropolitan regions (Porter, 2003), while regional resilience could be interpreted as the ability of a region to recover successfully from shocks of different types (Hill et al, 2008). In the economic literature this assumes also the potential for adaptation in terms of renewal capacities, in which partial collapses (of some local or sub-system elements) represent the needed (and the opportunity) for adjustments in order to cope with changes (Arthur et all, 1997). Those adjustments in systems are the results of autonomous, economical and ecological adaptations to external (supra-system) drivers. There is such little understanding of systemic thinking in the political and governance processes that what we know about resilience and urban systems is fragmented in topics (regional economy resilience, energy production and supply resilience, water management resilience, resilience against natural risks, etc) or in the analysis of the evolution of urban pasts (through the lens of historical experiences of adaptations or transformations in evolutionary patterns). In fact, in developed countries, societies, industries and urban settlements have been usually organized toward an economic efficiency paradigm, attempting to grow constantly thus overcoming periods of crisis. Because of such (short term) recovery perspective of resilience some important (long term) sustainability goals are missed or misunderstood. In fact simply trying to make systems more robust to changes may lead unsustainable systems to resist over time. As in the Schumpeter economic concept of creative destruction (Schumpeter, 1942) long term resilience requires constant transformations across different scales, components (groups), or subsystem collapses in order to make the entire system evolve.

Despite these useful and logical assertions, as Salt and Walker argue «when you hear managers and planners using the term resilience (for example «we're building a resilient industry» or «we are planning a resilient city») it is unclear which meaning these professionals have in mind. Often they may be thinking about engineering resilience in which the aim is to bounce back quickly to business as usual following a small disturbance. The distinction between «bouncing back» and «retain the ability to get back» is crucial.» (Salt and Walker, 2006: 73). This is what we will attempt to clarify in the next sections, addressing different perspectives on urban resilience.

Resilient or resistant cities? The persistence of urban systems

Recently, Lawrence Vale and Thomas Campanella argued that the city was «the humankind's most durable artifact». In fact, as they said, despite «the cities were sacked, burned, bombed, flooded, starved, irradiated – they have, in almost every case, risen again like the myth of the phoenix» (Vale and Campanella, 2005:3). Such an assumption is built on many historical evidences. As reported by Chandler and Fox, only forty two cities worldwide were permanently abandoned following destruction between the years 1100 and 1800 (Chandler and Fox, 1974). Narratives of destructions and reconstruction had in fact dominated the literature on cities following any natural or human induced disaster. Jerusalem, maybe the most destroyed and rebuilt city in history (Elon, 1989), «after suffering wars, earthquakes, religious transitions, destructions with no reconstructions and the maintenance of the ruins, still remains nowadays a place of special significance» (Beinart, 2005: 181). All this expresses a specific perspective of resilience over time. From Plato to Thomas Man the city has always been (and recognized) as a cultural and societal living artifact. As Lewis Mumford argued, before the metropolis «the city, the village, the cave and the cairn there was an essential disposition to social life. It (the city) begins as a meeting place» (Mumford, 1961: 5). Resilience as resistance emphasizes that although time has dissolved some built structures, the social structures remained durable (as in the examples of the «lost cities» like Pompeii, still a living site for remembrance). As far as we analyze or criticize concepts of cities, it is the human and social living properties that make cities express, through the tenacity of the urban life, their resilience over time. Almost any planner, architect, philosopher or economist will agree that the city in itself represents the maximum societal energy point in a territory, the place in which time and the human experience become visible throughout a process of power and cultural built symbols (Mumford, 1961). As in the adaptive cycle model of Holling, cities also evolve cyclically toward an ongoing process of destruction, redesign and reconfiguration (Vale and Campanella, 2005). Notwithstanding some experienced trauma in the short period (earthquakes, wars, etc) the narratives of disasters are permeated with a culture of optimism, in which resilience is a matter of political and social factors (Berke and Campanella, 2006) while urban rebuilding is a social-psychological need in order to make sense of the disaster (Kai, 1995). The conceptual step between the disaster-recovery process and the ongoing evolution of cities is illustrated by contrasting engineering resilience and the views of transformation and adaptation cycles. Between these models the difference is represented in practice by social learning elements and processes, that make people change their behaviors and adapt to stresses, and those elements that let the system evolve while recovering in the longer term. However from many case studies on urban disasters we can observe that social learning was evident from the first moment, in the reallocation of some destroyed cities (Tidball, 2010). In these cases social learning may explain why, notwithstanding the recovery of a city or region, these are seldom «transformed» by what happened (Mitchell, 1999; Pelling, 2003). This assumption links the perspectives on the evolution of cities (Geddes, 1915; Mumford, 1972) with the recovery and disaster narratives, both aiming at achieving a process of development and renewal after disturbances. In order to study such resilient evolutions many authors have begun to build models (for example cellular automata) attempting to explain fundamental principles of urban pattern dynamics and spatial self-organization (White and Engelen, 1993; Frankhauser, 1998; Portugali, 2000, Chen and Jiang, 2009). However, in this review we are not interested in arguing about the evolution of cities per se but in highlighting the links between the recovery and resilience capacities in becoming adaptable. In fact many disciplines have focused on (city) resilience enhancing urban robustness in terms of the economy, infrastructures and networks. For example Paul Baran introduced in 1964 the concept of network resilience (Baran, 1964) which was determined by the configuration of the systems structure: centralized networks (one source, more vulnerable), decentralized (networks of sources, less vulnerable) or distributed networks (the more resilient). Recent literature on terrorism, wars versus natural disasters (Körner, 2000; Gastil and Ryan, 2002) confirm the tendency to turn the attention specifically to consider spatial and territorial aspects of resilience in local and regional development and planning (Foster, 2007; Hill et al., 2008). Furthermore, since the events of September 11, 2001, safety began to be more and more synonymous of resilience (Chernick, 2005) because the more city functions are spatially sprawled the more the city vital elements (electricity, water, internet and more infrastructures) may be saved (resilient) from attacks. In this case, from the ecological resilience view, the concept of redundancy helps in bridging disciplines. In fact, in resilient ecosystems, redundancy is represented by the abundance of functional diversity (many groups performing the same functions and able to substitute one another in case of emergency or change). Likewise in cities the spatial decentralization of many essential functions can express resilience, because each element can substitute another in case of need so that the whole system survives. Furthermore, from this perspective, urban resilience has a strong link with the ecological view in terms of patterns of connectivity (Mitchell and Townsend, 2005). The same could be said after the new economical perspectives of resilience (Hassink, 2010), because of the well known economics cross scale effects of (and on) the regional urbanized systems (for instance when a surge in community mortgage foreclosures disrupts the broader regional economy).

From all these evidences when looking at short term resilience (of building a more robust and resistant system as a city, network, or economy) we can recognize two elements that transcend the recovery principle itself: change and transformation. Even in those examples of short term resilience, systems must change (thanks to social learning or networks and economies configuration) to recover (previous) equilibrium (or functions). In the next section we will try to address the second framework of urban resilience, in which sustainability patterns are expressed toward systems transformations at different scales in order to adapt to changes in the long term.

Sustainable Resilient Cities

In the last section we have related the capacity of the cities to last over time, throughout different strategies and disciplines, with different resilience perspectives. However, there was a neglected element in that analysis: the natural environment. According to the SESs framework (Folke, 1998) in cities the link between the two nested systems, co-evolving in one, is crucial and has been identified since Plato in 400 BC and strongly underlined also from Mumford when he argued that «the shaping of the earth was an integral part of the shaping of the city» (Mumford, 1961: 17). In this coupled systems, societies (or cities) success or collapse was determinate by the availability of natural resources, and human capacities (technology and/or behavioral changes) to adapt to different environmental situations. Although societal adaptations and cities transitions were induced by changing environmental or technological conditions they also, and always, have been associated with some social (more or less utopian) model theories that drove and try to deal with new spatial configuration of different areas (for example, Letchworth Garden City of Howard, 1903; Tony Garnier's Industrial city, 1917; or the work of other utopians such as Owen or Fourier). Such new cities and societal configurations represented somehow the ideal theoretical definitions of different relations between societies (functions such as the economy, infrastructures and services) and the feedback given from the natural environment for local human wellbeing. From a social-ecological perspective we can consider those configurations as different (historically demonstrated to be ecologically unsustainable) equilibriums of flows and tradeoffs when transforming natural services in commodities for human wellbeing (Turner, 2010). The anthropocentric vision of the transformations and evolution of cities contributed to foster environmental concerns , mainly in terms of city design and planning perspectives. In fact from Geddes (1915) to Park (1925), or from social ecologists such as Mumford (1960) and Dubos (1956), toYan Mc Harg (1969) or Lyle (1985) theorists have delved into the ecology of human systems, relating cities to ecological systems, in which urban metabolism (Wolman, 1965) represented energy and material flows requested and consumed by the system. The assumption that humans exists wholly within nature and its processes is shared by geographers (like Zimmerer, 1994), anthropologists (Redman), planners (Beatley and Manning, 1977) and the concept of studying ecology in cities (analyzing environmental stress and humans pressures) shifted to the study of the ecology of cities (Grimm et al 2000), toward some human ecosystem models in which social and ecological processes are integrated (Pickett et al, 2008). Definitely, the interplay between cities and social ecological systems is described from Alberti as «humans are the dominant driving force in urbanizing regions, and changes in ecological conditions also control humans decisions» (Alberti, 2008: 70).

Thus far in the article we have reviewed different perspectives of resilience, ranging from a linear (equilibrium state) to a multi equilibrium point of view. We will follow the same path here, beginning with the linear relationship between cities and the (local) natural environment to the concept of contemporary urban landscapes, spammed with almost no spatial limits into the entire planet with many complex influences (Rockstrom et al., 2009). In fact, as far as we know from regional thinkers (since the beginning of 20th century) regions are in a dynamic equilibrium and constant evolution, with not clearly definable boundaries. Therefore they should be always ready to adapt to changing conditions. Such a description was also a first and surprising preamble of the next complex adaptive system theory view (Levin, 1998), expressed in multi-equilibrium states (no linear trajectories of evolution). Cities can be considered and defined as complex adaptive systems within its regions, following resilience in the SESs concept and perspectives (Alberti, 2008). Throughout such a new theoretical framework, patterns of sustainability emerge (Norberg and Cumming, 2008). Within this assumption we could begin to argue that urban resilience operates definitely within «no predictable» patterns, where collapse and transformation of subsystems is desirable for the resilience and survival of upper systems (Folke, 2010), and where path dependency is almost a negative and not resilient influence for the future of cities and their citizens. In the light of these principles many policies and urban plans should be carefully revised and some planning paradigms changed because unfortunately (oil and many other) path dependences fixed long term urban design and social-economical system organizations through efficiency and not flexibility thanks to the functional redundancy of the system. These conclusions lead to a necessary link between the resilience perspective and transition theory (Hopkins, 2008; Rotman et al, 2010). Both theoretical frameworks look at the long term sustainability patterns of systems evolution, throughout adaptation, self organization and learning (resilience theory) or transformation steps (transition theory). Increasing evidence is calling for a new framework aiming at promoting (urban) systems transformations across new paradigms of development. In fact for the first time, in 2008 urban population surpassed rural population (UN, 2008) and the number of cities with over a million people grew from 11 in 1900 to 378 in 2000, this number expected to increase to 599 by 2025 (UNEP, 2009). Moreover close to 80 per cent of these 479 cities will be in developing countries. In such a scenario where cities occupy just 2 percent of the world's terrestrial surface, but contain almost 50 per cent of its population and consume over 75 per cent of its natural resources (UN-Habitat, 2006), calls for global sustainability are coming from the most important institutions worldwide. Hence there are two sides of resilience theory that should be translated into city governance and planning for sustainability: the bouncing back principle (of recovery), that should act in the very short term (for example in saving human lives from a disaster), and the learning loop and sub-system transformations acting as milestones of any mid or long term decision. In the second case resilience thinking teaches that the redundancy principle (that is not being organized toward functional efficiency) and the emphasis on cross scales may be vehicles for translating system thinking into cities and societal (re)organizations.

Conclusion: challenges for the theoretical framework on Urban Resilience

Both resilience and sustainability science focus on the global dimension of human environmental impacts and the possible responses, as suggested by the last program of the Ecological Society of America launched in 2009 «Planetary Stewardship for Global Sustainability» (Power and Chapin 2009). In fact, recent contributions in the literature (Reid et al 2010) emphasize the growing concern on the identification and evaluation of planetary safety boundaries, inside which humanity should stay in order to avoid dangerous (but possible) global regime shifts (Rockström et al, 2009). Obviously cities play a key role in this process (Andersson, 2006) as human dominated systems are considered the main responsible of global diffuse impacts (Folke and Grunderson, 2010). Furthermore, as Miller points out, the lifestyles of a globalized economy are increasingly disconnecting people from their natural environment and the related ecosystem services (Miller, 2005). The extreme examples of this separation and artificiality are the so called 'resort cities' (Koolhaas, 2006), such as Dubai or Singapore where the demand for leisure dictates the form and essence of the urban landscapes. This panorama helps making sustainability even a more ambiguous concept to lead governances and policies, underlining as the main challenges in building sustainable cities the political and power networks issues (Swyngedouw, 2004). In fact the political and social-economical frameworks play a key role in this globalized world to tackle the very inceptions of some SESs changes, moving a step beyond the (even if essential) urban ecology studies of patterns and relationships between some built environment patches and the natural, biological and landscapes consequences. Resilience identifies, understands and provides clear and useful insights from system dynamics, that constitute a large potential for urban systems, although tools to bridge and put urban resilience anal-

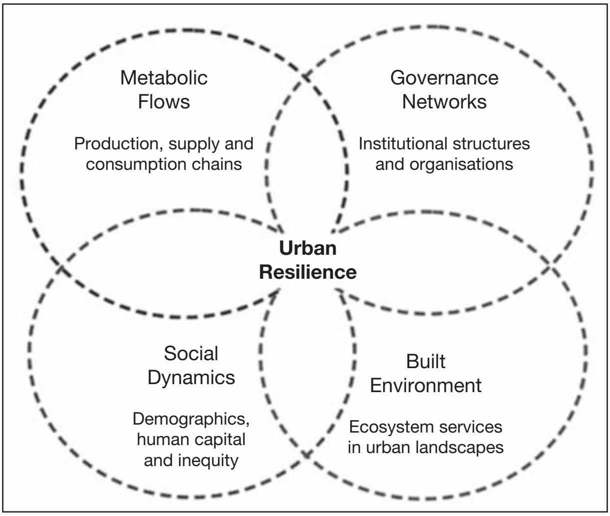

Figure 3. The four themes interrelated in the Urban Resilience Research.

Source: Urban Resilience framework from Resilience Alliance Project prospectus 2007.

ysis findings into urban planning, economy, and policy realms and practices are needed. Urban transitions from present regimes to more sustainable scenarios will be therefore the objective of putting resilience into practice (Loorbach, 2010). As adaptive management for SESs, transition management practices offer useful insights for urban systems (Van der Brugge and Van Raak, 2007). Some current examples could be drawn from the last Dutch water and energy transition cases (Loorbach and Rotmans, 2010).

In conclusion, if from one side urban resilience need tools for the translation in practice of the systems understanding and possible evolution, from the other side its theoretical framework (as firstly introduced by the Resilience Alliance in 2007, see Figure 3) still needs much more implementation. Many questions in fact arise from here to understand how will all the different fields contributing in the framework deal with one coherent urban resilience perspective analysis of Cities? How will urban resilience be related with planning in practice or governance? How far we could expect from the descriptive urban resilience framework useful insights and links with prescriptive ones (for governance, economy, climate change adaptation etc)? The debate is open.

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