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# Socio-ecological resilience and urban design: defining the common ground and a way forward for practice

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## Abstract/Resumé

The macro-trends revolving around urbanisation call for revising current approaches to urban development. In this context, the concept of resilience, originally developed in system ecology, has been deemed as a useful framework to address to these challenges and as an explanatory method to describe the complex dynamics regulating urban systems. However, while resilience science has gained importance in the academic debate in vulnerability and risk management, urban planning and governance, it is only superficially investigated in the field of urban design. This paper aims at bridging the gap between urban design and socio-ecological resilience, advocating a resilience-based approach to the design of urban systems. Currently, existing literature addressing the relationship between urban design and resilience focuses on two main issues: 1) the need for a common ground upon which to build the bridge between socio-ecological resilience and urban design; 2) the need for a clear and solid conceptual framework for urban designers to foster resilience in the built environment. The paper formulates suggestions on how these issues could be addressed. These are: 1) the definition of urban morphology as the common ground upon which the bridge between resilience in system ecology and in urban design should be built, and 2), on this common ground, the definition of a research route to link approach to sustainable urban design to socio-ecological resilience. The paper concludes by presenting possible future research steps.

**Keywords:** Urban Design, Resilience, Sustainability, Urban Form.

**Category of the article:** Conceptual Article

## Introduction

In the next future, influenced by the global macro-trends of climate change, economic instability, demographic and lifestyle change, and technological innovation, urban areas will grow in scale, number and complexity (United Nations 2014). Simultaneously resources to build and maintain them will diminish (UN-Habitat 2012). To respond to these pressures, urban planners and designers will have to deal with problems largely different from those they dealt with over the last 150 years (Dunham-Jones and Williamson 2011; Rudlin and Falk 2009). This calls for new approaches to urban development conducive to environments that are gifted with identity on the ground of their ability to welcome change over time by the hands of their users (Porta and Romice 2014). However, many of the places created since the post-war years seem unable to display this crucial capacity (Tachieva 2010). In fact, these appear more prone to prevent change from taking place rather than to support it. By the end of the century, in Global North's cities much of the post-war buildings and infrastructure will undergo extensive maintenance or refurbishment, and even more will be built afresh in the expanding centres of the Global South (Novotny et al. 2010). Hence, rediscovering this ability will be crucial for the prosperity and, indeed, the very survival of our cities.

### 1.1. Introducing Socio-ecological resilience

Contemporary urban problems are characterised by great complexity (Roggema et al. 2011). Additionally, the socio-economic, environmental and physical processes taking place in cities are highly interdependent and interlinked at multiple scales (Pickett et al. 2013). Hence in order to find more effective ways to study, manage and design cities, a system-wide holistic approach was advocated (Wilkinson 2012). To answer this need, research in system ecology on socio-ecological systems started to permeate the discourse on cities (Pickett et al. 2004; Walker and Salt 2006). Socio-ecological systems are complex, nested and interconnected bio-physical systems co-evolving across spatial and temporal scales (Folke et al. 2002). They share many similarities with urban systems (Chelleri 2012; Holling and Goldberg 1971; Marcus and Colding 2014; Novotny et al. 2010; Walker and Salt 2006). Consequently, urban systems have recently been studied as a particular type of socio-ecological systems (Alberti and Marzluff 2004; da Silva et al. 2012;

Moench 2014). In particular, the associated concept of resilience gained attention as a way for understanding the multilevel complexity, unpredictability and non-linearity characterising dynamics of change in urban systems (Davoudi et al. 2012). The concept of resilience firstly appeared in the field of system ecology in the seminal work of Holling (1973). He identified resilience as “*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*” (p.14). Over the decades several definitions of resilience were coined to describe its many facets (Olazabal et al. 2012).

Among these, socio-ecological resilience (Wilkinson 2012) describes a system’s property “to absorb disturbance and reorganize while undergoing change so as to still retain essentially the *same function, structure, identity, and feedbacks*” (Walker et al. 2004 p.2). In this notion of resilience, the element of change – internal or external, gradual or sudden – is seen to have a positive rather than negative connotation and is considered as “*necessary for renewal and novelty*” (Marcus and Colding 2014 p.7); this is one of the reasons why, this particular definition seems to be most popular in the context of urban studies. Indeed, according to Wilkinson (2012), socio-ecological resilience provides a useful problem-setting and problem-solving framework that planners can use when confronted with non-linear and relational urban dynamics. In this sense, resilience thinking can help driving urban development towards desirable trajectories, recognising the possibility of occurrence of future shocks and leaving room for novelty and innovation.

## **1.2 The missing link between resilience and urban design**

Currently, resilience thinking is most commonly encountered in relation to emergency planning (Liao 2012), climate change mitigation (Brown et al. 2012), community vulnerability to catastrophic events (Paton and Johnston 2001) and disaster recovery (Vale and Campanella 2005). Moreover, in the last few years, resilience theory has increasingly been discussed in urban theory (Davoudi et al. 2012, Chelleri 2012).

However, in urban design, the concept of resilience is just starting to be investigated (Ahern 2013; Allan and Bryant 2011; Marcus and Colding 2014; Pickett, Cadenasso and McGrath 2013; Roggema 2014). When treated, the prevailing line of research is still on risk prevention/mitigation strategies and recovery from catastrophic events (Allan and Bryant 2011; Garcia 2013). Another recent strand of research looks at the role of the hard physical infrastructure in deploying resilience-enhancing strategies (Novotny 2010). However, as noted by Roggema (2014) most references to the spatial form of cities seem limited to sewage systems, water management, energy production or communication lines. There is still very little reference to fundamental morphological elements of the built environment, as plots, buildings, streets, blocks and public spaces. This sharply contrasts with urban designers’ approach which is in return strongly focused on such aspects. On their hand, urban designers may well recognise how cities are characterised by complexity (Carmona 2010; Jacobs 1961), but they rarely embed in their projects knowledge developed in disciplines such as system ecology (Ahern 2013; Pickett, Cadenasso and Grove 2004; Roggema 2014). Too often, in the vocabulary of urban designers, the term resilience remains little more than a buzzword (Stumpp 2013), it lacks a clear definition and “*is rarely discussed in much depth*” (Allan and Bryant 2011 p.38-39).

## **2. A research approach to bridge the gap between resilience and urban design**

From analysis of available literature addressing the relationship between urban design and resilience, two fundamental issues emerge:

- 1) The need to identify a common ground upon which to build a bridge between socio-ecological resilience and urban design (Davis and Uffer 2013; Garcia 2013; Marcus and Colding 2014); and
- 2) The need to provide a clear and solid conceptual framework to urban designers to foster resilience in the built environment (Anderies 2014; Marcus and Colding 2014; Pickett, Cadenasso and McGrath 2013; Roggema 2014; Wilkinson 2012).

The next two sections will explain how these two issues could be respectively addressed.

## 2.1 A common ground

The model of socio-ecological resilience and urban design share the basic assumption that through intentional intervention it is possible to transform existing situations into preferred ones (Wu and Wu 2013). The first aims at influencing the resilience of ecosystems via the manipulation of their geometric and functional characteristics (Garcia 2013; Marcus and Colding 2014). The second is largely about driving socio-economic and environmental change towards desired goals via the manipulation of elements constituting the built environment (Carmona 2010; Rudlin and Falk 2009; Tarbatt 2013). These, according to urban morphology (Conzen 1969), can be identified as plots, buildings, streets, blocks, up to larger aggregates, as sanctuary areas (Dibble et al. 2015), neighbourhoods, districts, cities, regions and so on.

It is here suggested that the bridge between the science of resilience and urban design can be built on the common ground offered by urban morphology. The discipline of urban morphology studies dynamics of evolution and change in the form of urban settlements across space and time (Whitehand 1981). Conzen (1969), founder of the morphogenetic approach, believed that urban fabric and society were deeply inter-linked and co-evolving. In this urban morphology is not too dissimilar to socio-ecological resilience, whose focus is on how ecosystems are structured, how they respond to disturbance and how their physical and biological dimension are linked together (Chelleri 2012).

There is already some interest (Davis and Uffer 2013; Garcia 2013; Marcus and Colding 2014; Roggema 2014) in understanding “how urban systems and more specifically their spatial form can be understood in terms of a resilience framework” (Marcus and Colding 2014 p.10). By using urban morphology as a common ground, it might be possible to guide urban designers in the adoption of particular spatial patterns that could help increase the system’s capability to respond to change and uncertainty.

Few works that target the link between resilience and urban form in cities already exist. Initial attempts to conceptualise and evaluate resilience in the urban form were recently made by Davis and Uffer (2013) and Marcus and Colding (2014). The firsts tried to preliminarily explore the resilience of urban form by suggesting ‘*measures*’ of environmental, physical, economic and social resilience through the comparison of 8 case studies. The seconds tried to translate general properties of resilience into spatial form using Space Syntax Theory (Hillier and Hanson 1984). Additional work was also done by Garcia (2013): he applied the textural discontinuity hypothesis used by Holling (1992) to describe lumps in size of mammals in an ecosystem, to describe discontinuities in elements of the urban form. In particular, in his work he specifically refers to the Conzen’s morphogenetic approach (Garcia 2013). These efforts are valuable however they appear still too episodic. More research needs to be built upon these contributions.

It must be stressed that this paper is not advocating for any deterministic causality between urban form and other social, cultural, environmental, economic urban dynamics. Cities are embedded in unique socio-economic, institutional and environmental contexts (Davoudi et al. 2012). Awareness of their “*many interconnections, overlaps, and backloops*” (Marcus and Colding 2014 p.4) is crucial. We acknowledge that the capacity of places to exhibit resilience does not rest solely on those aspects of urban form that can be object of design intervention. However certain resilient behaviours, which spontaneously emerge in cities, can be facilitated or impeded by the characteristics of the physical environment they are embedded in.

Evidence-based research shows how tangible elements of urban form, as land-use mix, plot grain, street network connectivity etc. correlate with non-tangible aspects of urban life, such as economic viability, adaptability, creativity, sociability and stewardship (Barton et al. 2010; Porta et al. 2012; Porta et al. 2014; Wood and Dovey 2015). A link exists between the capacity of places to adapt to contextual change and particular spatial patterns. Evidence shows that

(Tachieva 2010) when facing contextual change (i.e. economic recession), there are urban forms that can change almost seamlessly while others require highly expensive intervention in natural, organisational, economic and social terms. Hence, whilst resilience of urban systems cannot be determined by the design of urban form, this can still play a fundamental role in producing “*more or fewer opportunities for present and future developments in the same urban landscape*” (Garcia 2013 p. 68).

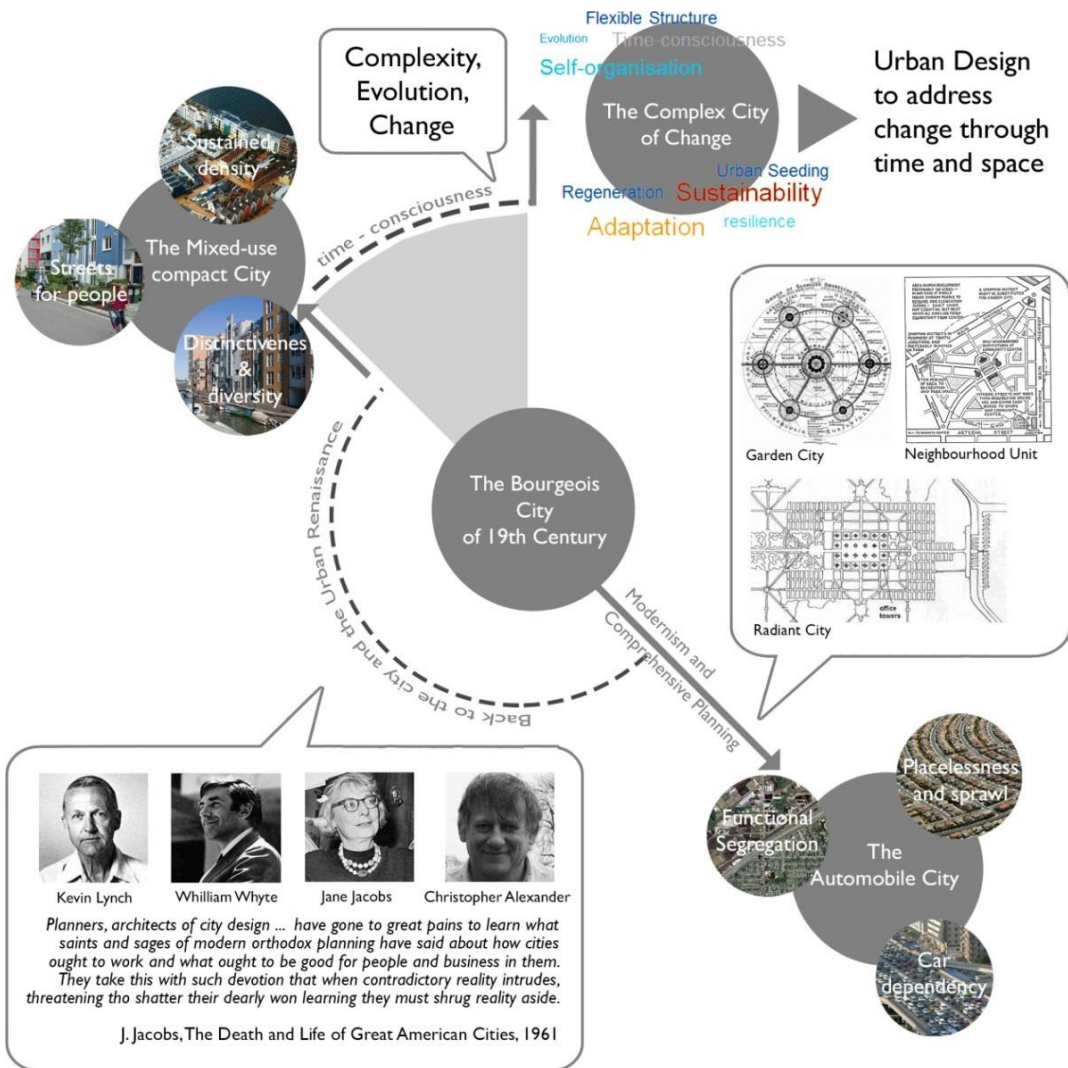
## **2.2 A conceptual framework for resilient urban design**

If urban designers aim at shaping places able to meet effectively the challenges of future urbanisation, a solid conceptual framework that links urban design to socio-ecological resilience is needed. However, in order to achieve this goal, it seems appropriate that we refrain from simply transplanting the system-ecology approach to resilience into urban design. We should rather integrate it with existing and consolidated urban design research methods and paradigms.

Over the last three decades the sustainability agenda brought about in urban design an important paradigmatic shift (Porta and Romice 2014). This led to the adoption of new guiding principles that better reflected values of those practitioners, scholars and communities unhappy of the trajectories of post-war urban development (Beatley 1999; Carmona 2010; Rudlin and Falk 2009). These principles were accompanied by new methodologies and implementation strategies that were subsequently tested, discussed, revised and tested again over the last twenty years. Urban designers started advocating for diverse, inter-connected, transport-oriented and pedestrian-friendly places, catering for varied forms of ownership, encouraging energetic and economic self-sufficiency, stimulating new forms of appropriation and use of the space (Beatley 1999; Carmona 2010; Rudlin and Falk 2009). This transition led to what Porta and Romice (2014) refer to as the “*Sustainable compact counter-revolution*” (p.84) (figure 1).

However, in the last decade the very idea of sustainability has changed. Contributions from urban geography and complexity theory (Batty 2013; Portugali 2011), started percolating the urban design discourse (Bettencourt 2013), supported by the influential ideas of Jane Jacobs (1961). Intuitive understanding of the concept of resilience started to be embedded in many guidelines and principles as a corollary to sustainability (Carmona 2010). Even when the term resilience is not explicitly used, there is considerable overlap of scope between sustainability in urban design and resilience thinking (Cruz et al. 2013). This seems to suggest that a proto-shift from sustainability to resilience might be already happening. To make this explicit it is suggested that we re-read the current tenet of sustainable urban design through the lens of resilience, formalising a new “*paradigm shift*” from place-making to time-conscious place-making (Porta and Romice, 2014).

In a previous article, Feliciotti et al. (2015) tried to preliminarily explore this research direction. In that occasion they tried to make a transition from sustainability-driven urban design to resilience-driven urban design. They did so by identifying in literature fundamental attributes of resilience for different types of socio-ecological systems and by integrating them with sustainability-driven principles of urban design. At the end of the paper, they presented a series of fundamental guiding normative principles for resilient urban design to be potentially translated and adapted in case-by-case intervention.



Picture 1 - 150 years of paradigm shifts in Urban Design: from Rationality to Resilience, elaboration by the author from Porta and Romice (2014), and Thwaites et al. (2007).

### 3. Conclusions and next steps

#### 3.1 Challenges in transferability of concepts

There are still many challenges to the transfer of the concept of socio-ecological resilience into urban design. While the ecological analogy is tempting, cities are not natural systems. They are governed by principles of self-organisation and emergence, as much as they are planned and controlled by outside authorities (Kostof 1991; Portugali 2011), an aspect that the resilience literature has yet to fully address (Davoudi et al. 2012, Wilkinson 2012).

Nevertheless, we strongly believe that a resilience framework could help designers creating places, streets and neighbourhoods able to retain their identity and to endure culturally, socially and environmentally over time, while continuously evolving and dynamically adapting to contextual conditions. In a context characterised by accelerated pace of urbanization, urban designers need not to underestimate the importance of studying the resilience of the places they contribute shaping. Embracing the dimension of time and change in the context of uncertainty of future outcomes and unpredictability of events is paramount if they seek to shape places able to endure culturally, socially and environmentally, but also to “learn” and innovate. This requires designers to find ways to devise structures resilient enough to accommodate needs and choices of society over time.

This work presented the state of research on the relationship between urban design and resilience. It then exposed two fundamental issues standing in the way of bridging the gap between them. Finally, it presented in some detail how the author will try to address them in her wider PhD research. In the intentions of the author, this will require, on one side adopting an urban morphological approach and, on the other, defining a conceptual framework and normative guiding principles for resilient urban design.

A further step, would be to identify a set of resilience-driven indicators that can be deployed to analyse urban environment and assess urban design projects. These indicators could be identified among those developed in urban sustainability and system ecology research (Cruz et al. 2013; Davis and Uffer 2013). The deployment of such indicators could represent a major contribution for informed, evidence-based design intervention and for post-implementation monitoring of urban design projects, whose lack is lamented by both system ecologist (Ahern, 2013) and urban designers (Carmona, 2014). There are challenges to this, particularly as “*it is difficult to define the most adequate degree of compactness, density, connectivity and heterogeneity*” as “*there is evidence that the supporting ecological systems react differently in different contexts and scales*” (Cruz et al. 2013 p. 65).

However, it is hoped that by offering a perspective coming from a still poorly explored field, important steps ahead can be made in the development of an advocated multidisciplinary and integrated approach to urban resilience (Olazabal et al. 2012).

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