BUILDINGS DON'T BOUNCE

The Design Paradox of Urban Resilience

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ABSTRACT

There is an unresolved paradox for the built environment disciplines in urban sustainability and resilience. By definition, a sustainable city must be resilient and *vice versa*. We outline the ramifications for designing vibrant urbanism in the 21st century by briefly reviewing some of the contradictions in current definitions and debate about resilience in the literature. We argue a conceptual ground-clearing exercise is necessary to reposition the design of buildings and places at the center of a more rigorous theoretical framework, which better unites issues of urban resilience and sustainability because cities are by and for people with a cultural and social dimension that is rooted in the physical object (Jacobs, 1961; Hillier, 1996). We conclude that if we want to design and plan resilient, sustainable cities in the future, then we need to look to some of the oldest, continually-inhabited cities in the world to better understand how and why they have endured as dynamic urban systems over a thousand years or longer, where one common denominator appears to be humanistic design.

THE SUSTAINABILITY-RESILIENCE PARADOX

Over the last three decades, sustainability and resilience have become increasingly part of the – often, ill-defined – jargon of the built environment disciplines (e.g., architecture, town planning, urban design, and so forth) in academia and practice (Cumming, 2011; Hassler & Kohler, 2014;

Mehmood, 2015). To one degree or another, both sustainability and resilience as terms trace their origins to the study of biological ecosystems, arising out of the environmental protection movement of the late 1960s and 1970s (Jabareen, 2013; Mehmood, 2015) The former initially appeared in the late 1980s but gained widespread usage during the 1990s. The latter initially appeared in the late 1990s but increasingly gained use over the last 10-15 years, especially in urban planning (Mehmood, 2015). When sustainability first emerged, architects and planners eagerly embraced the initially ill-defined concept. This was because they could intuitively understand sustainability as a concept and its implications for the built environment. Generally, we can characterize their intuitive understanding as maximizing your efficiencies while minimizing your resources for the greatest number of people. This seems especially true of movements such as the Congress for New Urbanism (CNU), which first emerged in the late 1970s/early 1980s but formally organized concurrently with the spread of sustainability as a concept in the profession (Talen, 1999). In fact, organizations like CNU were instrumental in spreading the concept of sustainability to the profession by promoting common sense, time-tested design solutions for the built environment, i.e., compact urban form, walkability, active frontages, humanistic design, environmental stewardship, and so forth.

Resilience began to gain traction in the built environment disciplines (especially urban planning) in the aftermath of two events in the United States. First, the terrorist attacks on the World Trade Center in New York and Pentagon in Washington, D.C. on September 11, 2001. Second, the devastation caused by the flooding of New Orleans as a consequence of Hurricane Katrina in 2005. The collective cost of these events in terms of human life, economy, and livelihood were staggering, especially the first (**Table 1**).

Table 1: Estimated cost of 11 September 2001 attacks and Hurricane Katrina in fatalities, property damage, and approximate loss of U.S. Gross Domestic Product (GDP).

Event/Estimated Cost	**Fatalities**	**Damage** ($) (2017, adjusted for inflation)	**GDP** (%)
11 September 2001 Attacks	2,977	+$13.8 billion	-2.0%
Hurricane Katrina	1,200-1,850	$154 billion	-2.0%
Total	**4,177-4,827**	**+$167.8 billion**	**-4.0%**

These events seem important for understanding the emergence of resilience as a topic of debate both within and outside the built environment disciplines during the early 21st century. This includes what appears to be the most commonly-accepted layman's definition of resilience, which is *engineering resilience* as defined by Holling (1973, 1986) in terms of the ability of a system to return to a state of equilibrium (or steady-state) after a disturbance. In this sense, the 'system' can be broadly defined to mean either a city, economy or both. As Davoudi (2012) points out, it is seen that "the faster the system bounces back, the more resilient it is (with an) emphasis on return time" (300). This definition is fraught with contradictions for the built environment and its professions, which is – or, at least, should be ethically and morally – troubling for architects and planners. First, it reinforces the dominant design and planning paradigm of the 20th century, which treats cities as static entities (return to what was before, e.g., steady-state) instead of dynamic spatial-formal systems with widespread design implications for a multitude of social, economic, and cultural factors in generating vibrant urbanism (Jacobs, 1961; Boyer, 1983; Hillier, 1996; Batty, 2008; Major, 2018). There is a well-established track record of the results, too numerous to recite in detail here, which we can briefly summarize as:

- High-speed vehicular corridors, hostile to any alternative mode of movement, separating fragmented neighborhoods facilitated by early 20th century zoning concepts;
- Urban networks subject to instant dysfunction due to the smallest of temporary shocks to its equilibrium, i.e. traffic crashes, road closures, construction activities, etc.;
- Minimal interaction and activities on many urban streets, contributing to decline in the self-organizing, organic solidarities of a civil society due to the lack of contact or need to interact with your neighbors (Durkheim; 1893); and,
- A sprawling land pattern consuming land at an alarming rate and accelerating a decrease in biodiversity.

This not only occurs in the United States. Due to the (often, very profitable) exportation of this paradigm's failures to rapidly-developing nations experiencing urbanization over the last 20-30 years, it is now a worldwide phenomenon in many cities (Duany et al, 2000; Tachieva, 2010; Speck, 2013; Major, 2018) (**Figure 1**).

Figure 1: (far left) 2016 Thanksgiving weekend traffic in Los Angeles, California, USA (Image: KABC-TV); (left center) suburban sprawl in Phoenix, Arizona, USA (Image: Wikipedia); (right center) smog and traffic jam at a 10-lane road intersection in Beijing, China (Image: South China Morning Post); and, (far right) April 2011 traffic jam on the Al Corniche in Doha, Qatar (Image: Alexey Sergeev/Texas A&M University).

At the same time, the insertion of an economic factor into the concept of a 'resilient system' ferments, even institutes a reactionary approach to the design and planning of settlements. In fact, the very idea of reaction is inherent in the definition – the ability of a system to bounce back, rebound, or spring back – especially as applied by political leaders and government bureaucracies. This has the unfortunate tendency to conflate events involving horrific loss of life (such as 9/11 or Hurricane Katrina) with an out-of-proportion response to the economic factor of resilience. This is done by emphasizing the 'return time', i.e., we must not only return to a 'steady-state' but do so *quickly* (UNISDR, 2009; Lucini, 2014). This approach does not lend itself well to the practice of thoughtful design and planning. In fact, it circumvents it for a more immediate, perceived outcome, usually a quick return to profitability in economic activities.

As horrific were the events of 9/11 and Hurricane Katrina for loss of human life (approximately 4,000 to 5,000 total fatalities), the shock to the economic system seems small and temporary in relative terms. In both instances, Gross Domestic Product (GDP) of the United States experienced a decline of 2.0% in the 3rd quarter (3Q) 2001 and 4th quarter (4Q) 2005, which, in part, can be attributed to these events. In addition to an incalculable cost associated with lost livelihood and economic activity, property damage was an estimated $168 billion (2017, adjusted for inflation) (refer to Table 1). However, US GDP quickly recovered in the subsequent quarter after each event (**Figure 2**). This would seem to indicate that the US economy is an extremely resilient system in its ability to 'bounce back' from catastrophic events. In comparison, the US economy experienced a net decline of 12.0% in GDP due to the collapse of the housing market and Financial Crisis in 2008-2009 (1Q 2008 through 2Q 2009) with an incalculable cost in lost livelihood and economic activity. Zero fatalities and no property damage can be *directly* attributed to the events of 2008-2009. Broadly, this suggests the shock of the 2008-2009 events were three times greater and longer than the combination of 9/11 and Hurricane Katrina. There seems little doubt that the Financial Crisis accelerated interest in the topic of resilience, especially its economic dimensions, across a variety of fields including the built environment disciplines. Crucially, for the built environment professions, this conflation of horror and economy in the applied definition of resilience might raise the disturbing specter of architects and planners being seen (whether fairly or not) as profiteering on such catastrophic events; particularly those involving massive property

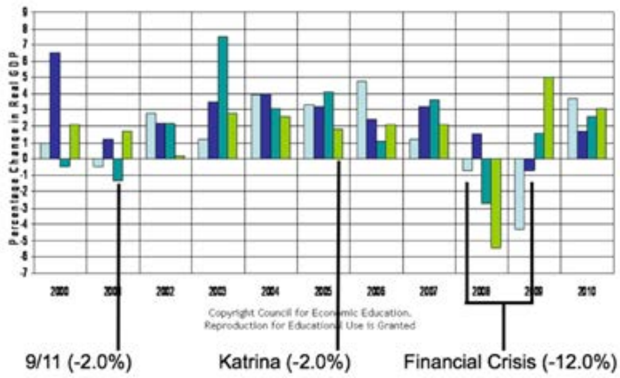

Figure 2: Quarterly changes in US Gross Domestic Product (GDP), 2000-2010 (Image: US Council for Economic Education).

damage. In the aftermath, the construction industry usually becomes a principal beneficiary of reconstruction efforts, mostly funded by government intervention.

However, the emergence of resilience over the last 10-15 years has also created a paradox for the built environment disciplines (Ahern, 2011). It brings into question the very meaning of their now commonly-derived, accepted definition of sustainability for one simple reason. By definition, a sustainable city must be resilient and *vice versa*. The only unsustainable, non-resilient cities are dead ones; or, at least, will die soon enough without drastic change. By elevating the debate about urban resilience, we are implicitly conceding that some of our cities are not sustainable today. To date, academia and practice seem to navigate around this paradox by positioning resilience as all about process planning and management systems, i.e., paper planning. This renders urban resilience into a mostly interpretative, subjective debate – usually of a regulatory nature – where convenient flexibility is, simultaneously, its greatest practical strength *and* theoretical weakness. In effect, resilience can mean anything we might want it to mean (Davoudi, 2012; Shaw, 2012; Wilkinson, 2012). There are several problems with this approach. It effectively excludes those (like New Urbanists) primarily concerned with physical design solutions for neighborhoods, cities, and metropolitan regions in promoting healthy, vibrant urbanism from current debates about urban resilience. In doing so, it gives preference to those professionals (especially urban planners) who are much less concerned about such things. It does not seem like a coincidence that such professionals continue to (implicitly or explicitly) operate based on the dominant paradigm of more than a century with its static view of cities and reactionary approach to design (Boyer, 1983; Major, 2018). The only way to resolve this paradox is to briefly review the literature about resilience in a conceptual ground-clearing exercise to expose the theoretical flaws and contradictions of this subjective approach. Only then, can the design and function of the built environment emerge as one of the critical factors in issues of urban resilience.

THE RESILIENCE DEBATE TO DATE

Cities are the lifelines of today's society. They serve as economic engines, centers of technology and innovation, and living proof of our cultural heritage (UNISDR, 2010). Cities are complex adaptive systems. Planning attempts to bridge the social, economic, and environmental aspects of cities in spatial planning. To date, resilience planning attempts the same by seeking to help mitigate disasters and reduce risk by discouraging development and construction of key installations in hazard-prone areas including the consideration of service routes for transport, power, water, sewage, and other critical functions (UNISDR, 2009; Mehmood, 2015). In general, resilience has been broadly defined in two ways. First, as a desired outcome(s) or, second, as a process leading to a desired outcome(s) (Kaplan, 2002). Holling (1973) first suggested that resilience from an ecological point of view is the "persistence of relationships within a system" and "the ability of these systems to absorb changes… and still persist" (17). Brand and Jax (2007) argue resilience promotes research efforts across disciplines in terms of science and policy but recent studies tend to stress the social, political, and institutional dimensions of resilience, which are rare in ecology.[1] Eraydin and Taşan-Kok (2013) suggest resilience has become more visible in the planning literature due to a deficit of new perspectives in the discipline. However, there are gaps between the theoretical and practical elements in the literature, which often lacks multifaceted theorizing and typically overlooks the complex, multidisciplinary nature of urban resilience (Jabareen, 2013). The far more common approach today is to view resilience as about regulatory gaps in governance for reducing underlying risks including: 1) organizational, legal, and policy structures; 2) risk identification, assessment, monitoring, and early warning; and, 3) knowledge management, education, and preparedness for effective response and recovery (UNISDR, 2007). Increasing economic, social, and spatial vulnerabilities in cities, rapid depletion of natural resources, increasing frequency of ecological events, and other causes of environmental degradation are seen as necessiating thinking about resilience in cities (Eraydın & Taşan-Kok, 2013).

In one simple formulation, urban resilience refers to the ability of a city or urban system to withstand a wide array of shocks and stress (Leichenko, 2011). Mehmood (2015) argues that urban resilience can – and perhaps should – be defined as a proactive rather than reactive vision of planning, policy-making, and strategic stewardship of urban systems in which societies play a vital role through their capacity for active learning, robustness, ability to innovate, and adaptability to change. Urban systems are defined as "systems where emerging

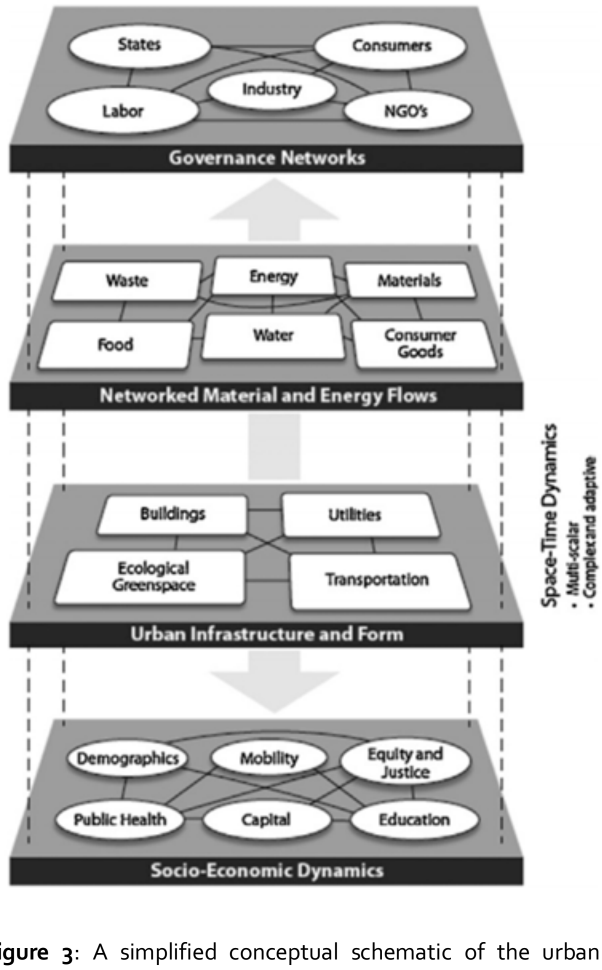

Figure 3: A simplified conceptual schematic of the urban system (Image: Meerow et al, 2016).

[1] German biologist Ernst Haeckel invented term 'ecology' in 1866. He defined ecology as the comprehensive science of the relationship of the organism to the environment (Boersema, 2009).

properties are produced at mainly two levels of observation through the interactions between 'agents' occurring at a lower level: the morphological and social structures of a city are emerging from the multiple interactive decisions of residents and/or groups of citizens, while the spatial organization, hierarchical, and socio-economic differentiation at the scale of a system of cities are created by adaptive strategies and mainly competitive relations between cities, (which are) considered as 'agents' as this level of analysis" (Bretagnolle et al., 2006). According to Meerow et al (2016), urban resilience also refers to the ability of an urban system – and all of its constituent socio-ecological and socio-technical networks across temporal and spatial scales – to maintain or rapidly return to desired functions in the face of a disturbance, adapt to change, and rapidly transform systems that limit current or future adaptive capacity (**Figure 3**).

These views about spatial urban system resilience are of particular interest. They still represent something of a radical discourse in urban planning, suggesting not a lack of new perspectives in the profession but the failure of many planners to listen; mostly because these fresh perspectives such as New Urbanism and Space Syntax emerge from the realm of architecture (Eraydin & Taşan-Kok, 2013; B. Hillier, 1996; Talen, 1999; Major, 2018). Jean Hillier (2011) offers spatial navigation as a means of exploring new ways of conceptualizing and practicing planning in conditions of uncertainty, where resilience planning would stress the significance of assuming change and explaining stability in urban systems. Mehmood (2015) argues this view understands that planning theory and practice require dynamic adaption by not only responding to shifting contexts and circumstances but also creating and shaping change. This seems consistent with the comprehensive approach offered by Davoudi (2012) in terms of an evolutionary resilience framework composed of the dynamic interaction between transformability, adaptability, preparedness, and persistence through multiple scales and timeframes. Finally, Cumming (2011) refers to the ways in which spatial differences in relevant variables influence *and* are influenced by resilience across multiple spatial and temporal scales in elements both internal and external to the system. Cumming (bid) views these primary internal elements as: 1) the spatial arrangement of system components and interactions; 2) spatially relevant properties such as size, shape, and the number/nature of system boundaries (i.e., hard or soft, temporarily variable or fixed over time); 3) spatial variation of internal phases such as successive stages that might influence resilience; and, 4) unique system properties that are a function of a location in space. On the other hand, the primary external elements of spatial resilience include: 1) context, i.e., spatial surroundings defining the scale of analysis; 2) connectivity including spatial compartmentalization or modularity; and, 3) the resulting dynamics with spatially-driven feedbacks and subsidies. These internal and external elements must be considered in relation to one another (Cumming, 2011).

A different perspective focuses on system identity where resilience equates to the maintenance of key components, their relationships, and their continuity through time (Lombardini, 2015). Resilience is defined in relation to a given perspective and problem. Defining identity requires a clear statement of what exactly constitutes the system and which of its components and relationships – social, economic, and ecological – are the subject of interest (Cumming, 2011). Armitage et al (2012) argue this necessitates a move towards interdisciplinary research and governance for complex systems. The emergence of resilience planning in discourses about urban development and its widespread adoption across regulatory agencies had led to an explosion of resilience-focused frameworks (Schipper et al, 2015). According to the Hyogo Framework for Action (UNISDR, 2012), among the most significant risks to urban resilience are: 1) growing urban populations and increased density; 2) concentration of resources and capacities at national levels; 3) weak local governance; 4) insufficient contribution by local stakeholders in planning and urban management; 5) inadequate water resources management; 6) the decline of ecosystems; 7) decaying infrastructure and insecure building stock; 8) uncoordinated emergency services; and, 9) the adverse effects of climate change. Of this laundry list, it could be fairly argued that half of these risks are a consequence of the second (e.g., concentration of resources and capacities at national levels) and the fear about 'increased density' regurgitates a well-known and well-documented lie of the dominant planning paradigm of the last century (Jacobs, 1961). In the end, this system identity approach can be taken to mean that if resilience is low, identity may be lost. Correspondingly, if identity is lost, then we can conclude resilience was low. This type of circular logic is very troubling, which brings us right back to the central paradox of resilience in this paper.

THE IMPLICATIONS FOR CITY DESIGN

As we have seen, others offer an alternative definition of resilience that seems much more promising for the role of the built environment in the debate without necessarily excluding the economic factor (Berkes & Folke, 1998; Carpenter et al, 2005; Folke et al, 2010). Davoudi (2012) defines *evolutionary resilience* as "the ability of complex socio-ecological systems to change, adapt, and, crucially, transform in response to stresses and strains." Derived from Scheffer (2009), evolutionary resilience "challenges the whole idea of equilibrium" because "systems may change over time with or without an external disturbance" (Davoudi, 2012). This concept of resilience more accurately accounts for the reality of cities as complex, dynamic spatial-formal systems with widespread design implications for their functioning as social, economic, and cultural objects (Jacobs, 1961; B. Hillier, 1996). Davoudi (2012) reviews the potential pitfalls of this approach; mostly in terms of professional ethics and political expediency. However, introducing the idea that it is not how a system bounces back but how it might 'spring forward', she re-opens the door to thoughtful design and planning choices in cities instead of the counter-productive, reactive alternative. Crucially, this shifts the debate about urban resilience from mere fashionable trend to a subject of significant interest for researchers. By definition, evolutionary resilience enables researchers to look further back in time to better understand how cities have 'sprung forward' (e.g., evolved) in the past, whether in response to slow changes or abrupt disturbances. By necessity, the case studies for resilience research will have to become some of the oldest, continually-inhabited settlements in the world (**Table 2**).

Table 2: A list of twenty of the oldest, continually-inhabited cities around the world with an estimated 2017 population greater than 1 million people.

Settlement	**Location**	**Occupation Since** (approximate)*	**Founded** (approximate)	**Population** (estimated 2017)	**Age** (approximate in years)
Athens	Greece	c. 10-6th Millennium BC	5-4th Millennium BC	+/- 3.7 million	+6000
Gaziantep**	Turkey	c. 3650 BC	c. 3650 BC	+/- 1.5 million	+5600
Aleppo**	Syria	c. 3650 BC	3650 BC	+/- 1.8 million	+5600
Beirut	Lebanon	c. 3000 BC	3000 BC	+/- 2.0 million	+5000
Damascus	Syria	c. 6300 BC	3000 BC	+/- 1.7 million	+5000
Jerusalem	Israel/ Palestine	c. 5000 BC	2800 BC	+/- 1.5 million	+4800
Varanasi	India	1800 BC	1800 BC	+/- 1.2 million	+3,800
Luoyang	China	c. 1600 BC	c. 1600 BC	+/- 1.7 million	+3,600
Lisbon	Portugal	4500-2000 BC	c. 1200 BC	+/- 2.8 million	+3,200
Beijing	China	23rd Millennium BC	1045 BC	+/- 21.5 million	+3,000
Xi'an	China	c. 4700 - 3,600 BC	1100 BC	+/- 12.9 million	+3,000
Tripoli	Libya	c. 700 BC	700 BC	+/- 1.1 million	+2,700
Rome	Italy	c. 12-8th Millennium BC	753 BC	+/- 4.3 million	+2,700
Istanbul	Turkey	c. 6th Millennium BC	685 BC	+/- 14.6 million	+2,700
Benghazi	Libya	c. 525 BC	525 BC	+/- 1.1 million	+2,500
Peshawar	Pakistan	c. 400 BC	c. 400 BC	+/- 4.2 million	+2,400
Alexandria	Egypt	332 BC	332 BC	+/- 4.5 million	+2,300
Seville	Spain	c. 700 BC	c. 700 BC	+/- 1.5 million	+2,200
Paris	France	c. 4200 BC	52 BC	+/- 12.4 million	+2,000
London	UK	c. 4500 BC	43 AD	+/- 14.million	2,000

** Not necessarily continuous inhabitation.*
*** There is some debate in the literature about the site of the ancient city (Antiochia ad Taurum) associated with these two settlements.*

These cities *are* resilient, sustainable cities because they have endured for thousands of years. At the center of this research will be some simple questions: what do these cities have that others do not, how have these cities responded to changes (slow or abrupt) in the past, and, what do they have in common that has allowed them to flourish as urban centers for so long? More simply, what makes them resilient and sustainable?

Shifting the focus to evolutionary resilience will have consequences. It will remove the ideological aspect that has grown around the resilience debate onto more objective, scientific grounds. For example, the fallacy that the 2017 flooding of Houston, Texas in the aftermath of Hurricane Harvey was caused by its lack of a zoning code even though that city is still subject to the environmental, flood insurance, and stormwater requirements of the National Environmental Quality Act, National Flood Insurance Program, and Clean Water Act, which jointly regulate navigable waters, stormwater runoff, and the 100-year floodplain (1% chance of flooding every year) under the jurisdiction of various Federal agencies. What happened in Houston was caused by a 500-year flood (0.2% chance of flooding every year). It will also raise some uncomfortable questions. We have been building cities for around 10,000 years. Why has this focus on resilience and sustainability suddenly emerged over the last 40 years? What are we doing differently that we were not doing during the previous 8,000-10,000 years? Certainly, the rapid growth of human population is a factor, from an estimated 1.5 billion in 1850 to a projected 9.8 billion in 2050, representing a nearly seven-fold increase with 66% of this population growth expected to live in cities (90% in Africa and Asia) (Source: United Nations Department of Social and Economic Affairs) (**Figure 4**).

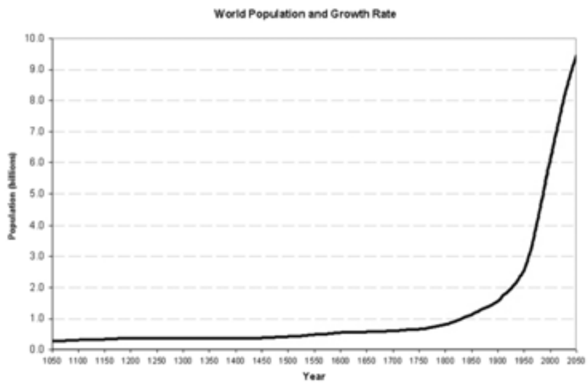

Figure 4: Estimate of world population growth rate from 1050-2050 (Image: United Nations)

However, this is only one variable in a plethora of interrelated factors affecting our cities in the 21st century. Industrialization and mass production has led to massive profits and improvements in the human condition worldwide, especially over the last 50 years. It has also led to massive consumption and massive waste. For example, more than a quarter of all food in the United States is thrown away every year (Source: US Department of Agriculture) The automobile is one of the greatest tools for social mobility ever devised by human ingenuity but auto-dependent planning comes with significant economic and environmental costs (Jacobs, 1961; Speck, 2013). Designing for things, not people bear the social costs in fragmented neighborhoods and public health (i.e., increased obesity) (Tachieva, 2010; Speck, 2013). Too often, we seem to rely on the promise of technological solutions in the near- and distant-future – what Mouzon (2010) calls "Gizmo Green" solutions – for problems that have practical, time-tested solutions today. Due to advances in computer science, we have progressed to the point where we have beginning to better understand the functioning of complex, dynamic urban systems but we still tend to only address one aspect (usually, economic) in our solutions, regardless of achieving a balance in all or most of the variables affecting sustainability of that system. These are not lapses in human ingenuity but flaws of human nature.

When we more closely examine some of the oldest, continually-inhabited cities in the world, the suspicion is what researchers will find is that humanistic design (compact blocks, walkability, alternative transport, active frontages, "eyes on the street", and public life) is a central tenet of the resilient, sustainable city (Jacobs, 1961; Whyte, 1980). In this sense, urban resilience will become better defined as the capability of cities as highly complex systems to adapt to changing conditions based on network science, which involves less interference in the functioning of cities (paraphrasing Batty, 2008 and Sharifi, 2016). Only then, as Batty (2008) argues, "the more we learn about the functioning of such complex systems, we will interfere less but in more appropriate ways." However, we have to first put in the work to learn before jumping to conclusions about resilience; no matter how convenient those conclusions might be.

CONCLUSION

The paper attempted to tackle an unresolved, rarely spoken about paradox for the built environment disciplines (architecture, urban design, town planning, and so forth) in the definitions and debate about urban resilience and sustainability. We outlined the ramifications of this paradox – by definition, a resilient city must be sustainable and *vice versa* – including the contradictions inherent in the most common definition of resilience, which tends to treat cities as static entities and design as a reactionary exercise in response to catastrophic events. We argued that this conceptual ground-clearing exercise was necessary in order to place the physical design of buildings and place in urban systems at the center of a more rigorous theoretical framework, which better unites issues of resilience and sustainability for future research. In doing so, researchers should begin to more closely examine some of the oldest, continually-inhabited cities in the world to better understand how and why they have endured as dynamic urban systems over two-thousand years or longer because these cities were built by and for people with a cultural and social dimension that is rooted in the physical object (Jacobs, 1961; Hillier, 1996). These cities offer ready-made case studies to deepen research and debate about resilience and sustainability based on time-tested, common sense solutions for the built environment. What we mean by time-tested, common sense solutions is that humans have been walking tens of thousands of years whereas modern technologies such as the automobile have only been around for a little more than a century. We should design for what has a proven track record of sustainability measured in millennia, not decades, i.e., walking. In the same way, humans have been successfully mediating for the potential dangers associated with climate and/or geological changes for a very long time. We move, e.g., migrate. If researchers do so, what we will likely find is that one of the common denominators for the resilient, sustainable city is humanistic design.

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