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TRAILING SOLUTIONS FOR SUSTAINABLE (SUB)URBAN DEVELOPMENT BASED ON URBAN RESILIENCE CONCEPT

Abstract

Sustainability as one of the "buzz" concepts most often finds a true challenge within urban environment, especially when having in view that by the end of this decade, for the first time in history, more than half of the World's population lives in urban areas. The paper shifts the discourse to the relatively new concept of urban resilience, i.e. introspection into ability of a system (city) to accommodate shocks before it transforms into something fundamentally different. With starting point that no city today could survive on its own resources, the foreseeable ways for urban adaptation and sustainability have been interpreted. The paper draws conclusions by exploring the adaptive capacity as a process of "learning to adapt" vs. "forced adaptation".

Key words: *urban resilience, adaptation, sustainability, city.*

INTRODUCTION

In the year 2008, for the first time in history, more than half of the World's population lived in cities, and the UN estimates a global rise of urban population to almost 5 billion (more than 60% of total population) by 2030, all of which has a profound impact on global and local economies, environment and society (Montenegro, 2010, Romero-Lankao and Dodman, 2011). Anthropogenic pressures on the Earth

System have reached a scale where the planetary boundaries are severely pushed, and the relatively stable environment of the Holocene seems to be taken over by Anthropocene (Rockström *et al.*, 2009). Although urbanised area accounts for approximately 1-6% of the total Earth surface (Meyer and Turner, 1992), at the same time, a dominant urban population relies on a wide range of resources from outside their geographical boundaries, imposing environmental pressure on distant locations.

There is no doubt that sustainability has been in general focus of attention, steering a debate for more than 30 years now, and that the sustainability of cities is still a complex problem of particular urgency in today's world. Highlighting the functional, social, economic and environmental problems of today's cities puts forward objectives towards a more sustainable urban environment. As Frey and Yaneske (2007:34) point out, the focus on characteristic of 'sustainable' city invigorated an intense and rather hectic debate on sustainable urban form. As a result of a debate, sprawl is commonly perceived as the least sustainable urban form (Petrić, 2003). It is claimed that the 'Short Cycle City' model, a further development of the polycentric city, is associated with local environmental sustainability through more effective local use of natural resources and recycling, greater local economic autonomy and a smaller "ecological footprint" (Lloyd-Jones, 2004:19). However, this perspective seems to lack in 'social dimension', particularly when having in view that urban areas and their (un)sustainable forms are the product of the complex interaction between natural growth, the impact of changing transport, people's preferences and planning. It can be argued that the urban form is not measurable in terms of sustainability because the form is a snapshot of process – a static condition at any point of time, whereas the urban truth is in the flow, i.e. 'if the city is to survive, process must have the final word' (Kostof, 1992:305).

The purpose of this paper is to examine a tool for promoting linkage between urban design, planning and ecology, which could be sublimated in a concept of "resilient city". As a metaphor new to both urban planning and ecology, which better links these two disciplines, urban resilience brings connotation of 'staying power', or 'flexibility', or 'adaptability'. As Pickett *et al.* (2004:370) put it, 'thinking of cities in these terms is compelling and provocative because it emphasizes dynamics'. In order to increase their capacity for resilience, cities should increase their abilities to better respond and adapt to the economic, social, and physical stresses as they confront the challenges of climate change, energy scarcity, and population change. Thus, a resilient city is considered as the one that can more effectively withstand external shocks and rebuild itself after experiencing those shocks no matter if those are wildly unexpected events and processes, or something easier to predict (www.resilientcity.org). Quintessentially, cities are complex adaptive systems, and that makes them, in many ways, an ideal polygon for exploring resilience.

With initial hypothesis that no city today could survive on its own resources, more or less foreseeable ways for urban adaptation and sustainability should be examined. In that respect, many boundaries already seem to have been breached between wealthy and poor cities and nations, and it is not only that 'rich' are to mitigate and 'poor' are to adapt, but instead both do both – one or neither of these. By exploring the notion of human adaptive capacity as a process of "learning to adapt" or "enforced

adaptation", and by looking it in parallel with different types of state of sustainability reflected on cities, the results should lead to better understanding which is the way forward to resilient (sub)urban development and sustainability on the broader levels.

PAVING THE WAY FOR URBAN RESILIENCE

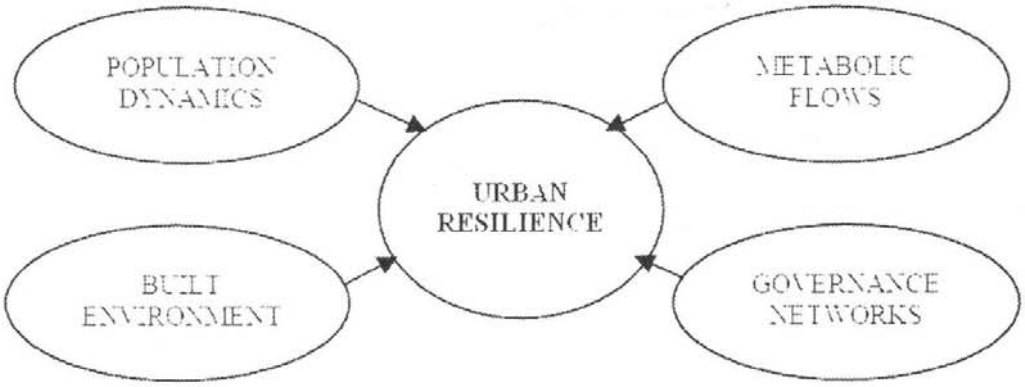
Origins of the term "resilience" (in the way we are using it) may be traced to the science of ecology, where it has been described as capacity of an ecosystem to tolerate disturbance without collapsing into a qualitatively different state, i.e. the ability of a system to absorb disturbance and still retain its basic function and structure (Walker and Salt, 2006). It can mean the capacity for adaptation within a system and, in relation to human systems, the ability to learn and adapt. According to Pickett *et al.* (2004:373) 'resilience is seen as the ability of a system to return to its stable equilibrium point after disruption.' Sometimes the changes affecting a system are slow (like population growth or climate change) and we seem not to be so good at responding to things that change slowly. That is partly due to our flaw of not noticing slow changes, and partly to the fact that we often think there seems little we can do about things that experience slow changes. On the other hand, rapid changes (like price of food and fuel) typically involve our immediate noticing and response. The argument built here is that, in its essence, change is neither bad nor good. As Walker and Salt (2006:10) observe 'change can have desirable or undesirable outcomes, and it frequently produces surprises'. Among changes, "outliers" or extremely low probability but high in impact events and processes are so-called "black swans". They come as new information or events entirely outside our expectations and predictions, and despite being so rare, they mark a milestone in history having a huge effect on our lives (impact of the mortgage crisis, unprecedented rise of Google, etc.). On the other hand, slow but high in probability changes are something we could more easily predict in the future upon the induction principle. These changes are linked to evolutionary hypothesis, describing how species continually adapt to keep their relative place in an ecosystem which is similarly in a state of continual change. This idea is also referred to as 'Red Queen Hypothesis' or 'Red Queen Effect' deriving from the Red Queen's race described in the Lewis Carroll's famous book "Through the Looking Glass". In the book, the protagonist Alice encounters the character of The Red Queen, who invites her to join a race where all the runners stay in the same spot. When Alice complains that "in (her) country...you'd generally get to somewhere else - if you run very fast", the Red Queen replies: "Now, here, you see, it takes all the running you can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!"

The complex interactions between humans and ecosystems have particular poignancy in urban settings. A resilient city is the one 'that has developed systems and capacities to be able to adsorb shocks and stresses, to be changed and then to re-organise so as to still maintain essentially the same function, structure, identity, and feedbacks' (www.resilientcity.org). At the same time, resilient city is able to learn from

the disturbance and implement strategies to mitigate future shocks and stresses.

Presence, and probably the future will be featured by growing numbers of urban population coupled with a declining resource base and great uncertainty, where the changing climate is one key manifestation. It is observed that human population is the central core of all other problems. Highly concentrated human populations can influence more frequent and unprecedented disturbances (i.e. more frequent flooding or chronic stresses) (Alberti, 2005). However, not the whole World experiences the same problem. In contrast to Asia and Africa, where many low-income and middle income countries are located and are experiencing rapid urban population growth, some regions in Europe, North and South America have already passed the urban transition phase. For some countries, e.g. Japan, Italy, Russia, South Africa, Serbia, etc. with declining human populations, may be that their human population dilemma influencing urban resilience has already been solved, although at great "human costs". Another important factor of urban resilience concerns city metabolic flows. These metabolic flows are represented by a continuous flow of stuff – natural resources, energy, consumer products, services, etc., that enter urban metabolism either actively, through human effort, or passively, through natural processes, e.g. solar radiation, atmospheric currents, and precipitation. Ecologists often talk about these resource flows in terms of inputs and outputs, and use several models of accounting for them, including the well-known "ecological footprint". It was estimated back in 2004 that the average ecological footprint around the world was 2.2 global hectares per person, whereas there have been only 1.8 global hectares available per person. This ecological overshoot means we are using the equivalent of about 1.2 planets. Resilient cities (and their hinterland) are to meet combined "grand challenges" by reducing their urban ecological footprint. Still, with urban resilience approach, the focus is not as much on the resources that cities consume, but more on interdependencies along the chain of supply and demand, where for example a dependency on a single type of fuel as an energy source creates a highly vulnerable system. Built environment plays a pivotal, yet still understudied role in determining urban resilience. As Alberti (2005:169) points out, 'the mechanisms by which built environment (urban form) affects ecosystem functions include the change of land cover and modification of natural disturbance'. Urban sprawl is becoming increasingly expansive urban form, where in extremely low density suburban areas (particularly in North America and Australia) associated results of sprawling buildings and extensive car usage are high levels of household energy consumption and emissions. On the other hand, in many low- and middle-income countries, extremely high urban population densities are associated with locally detrimental environmental health conditions (e.g. poor sanitation) or climate risks (e.g. exposure to the urban heat-island effect) (Romero-Lankao and Dodman, 2011:114). Finally, governance networks and policies (national regulations and international instruments, knowledge, availability of funding, etc.) influence urban resilience and adaptive capacities. Here an open debate may be whether the focus should be on 'national' level adaptation and mitigation or on the collective and individual actions of cities and local governments, irrespective of the nation state (Jackson, 2010).

Figure 1. Factors of urban resilience.



Source: Modified figure from CSIRO, Australia – Arizona State University, USA – Stockholm University, Sweden, "Urban Resilience Research Prospectus – A Resilience Alliance Initiative for Transitioning Urban Systems towards Sustainable Futures", p.10, 2007, URL: http://www.resalliance.org/files/1172764197_urbanresilienceresearch prospectusv7feb07.pdf

TYPES OF SUSTAINABLE (SUB)URBAN DEVELOPMENT

The essence of urban sustainability is a balance between biospheric and anthropocentric requirements (Frey and Yaneske, 2007:79). The mainstream thoughts on sustainability could be summed up by the catch phrase "reduce (your waste); reuse (what you have); and recycle (everything else)", and they revolve around the notion that the key to sustainability lies in being more efficient with our resources (Walker and Salt, 2006:8). Mathematical analogy directs us to conclusion that biospheric and anthropocentric requirements may be either: together absent (Type 0 sustainability – state which is devoid of any life); or one (biospheric requirements) present (Type 1 sustainability – state which is organised around the process of natural selection); or both (biospheric and anthropocentric requirements) present (Type 2 sustainability – which is the one most readily identified with the current objectives of sustainable development); or one (anthropocentric requirements) present (Type 3 sustainability – represented by an engineered environment that is sustainable on its own right) (see: Frey and Yaneske, 2007).

By taking an insight into urban forms which have occurred in the course of history and process of urbanisation, it is noticeable that a 'balanced development between city and its hinterland' has always been of prime importance for development of both (Petrić, 2005). So, how does urban form correspond with different types of sustainable development?

City ruins or ancient settlements surrounded by wasteland no longer capable of supporting human life belong to Type 0 sustainability. Some of these cities were

destroyed in natural catastrophes (Pompeii) or by enemies (Machu Picchu, Babylon), and they didn't recover afterwards. Others are the ruins of the settlements that exploited their hinterland beyond its regenerative capacity, which caused their own downfall (Easter Island).

Settlements which belong to Type 1 sustainability were inhabited by people who lived within the limits of the natural renewing capacity of the bioproductive land and water areas that accommodated all their needs. Human survival was based on natural environment and energy from the sun, and this type of sustainability existed for millions of years. What characterised urban settlements was lower number of people and lower level of economic development, as well as balanced relationship between settlements and their surroundings. In the oldest urban settlements, there was not much possibility or rationale to extend the city territory on fertile land, which was the key resource. Greek polis can illustrate this type of 'equilibrium' between city and its hinterland. Also, medieval town, limited in population number and confined by city walls didn't jeopardise sustainability of its hinterland.

The advance of ever faster transport systems allowed city to enter the Type 2 sustainability, meaning that its hinterland expanded to wider territories, including the whole globe. These cities are sustainable as long as biospheric and anthropocentric requirements are in relative balance and the environment is not critically or irreparably damaged. Cities of Type 2 sustainability are in a state of 'much higher socio-economic activity and they require much more energy from other sources, e.g. fossil and nuclear fuels' (McDonach and Yaneske, 2002:219). This state could be easily identified with current goals of the developed world, where productivity of social-economic system should allow investment in environmental quality mitigation, accompanied with the care that environmental degradation and/or artificiality should stay within limits that are acceptable for people. The consolidation of urban development to preserve open land (and also to achieve liveable cities) seems an eminently logical and important thing to keep cities in Type 2 sustainability stage. This involves limiting the urban sprawl to privilege compact and polycentric approaches, so as to reduce transport and energy costs, retain valuable agricultural land and natural areas, and protect landscape value, while limiting the negative effects of densification (i.e. increased vulnerability to risk, noise, stress, safety).

A growing number of people also investigate the scenario of forming settlements that would belong to Type 3 sustainability. This basically replicates the idea of what Greek cities did some 2,500 years ago: to colonise areas outside their own hinterland. However, nowadays the hinterland for cities of Type 3 sustainability would extend beyond the globe – in outer space.

Discussed types/stages of sustainable (sub)urban development are affiliated with a system's resilience concept. One of the central ideas of resilience thinking is that social-ecological systems (e.g. cities) have multiple regimes (stable and unstable states) that are separated by thresholds. Cities and urbanising regions are featured by nonlinearity, which leads to multiple possible outcomes of dynamics (Alberti and Marzluff, 2004). For example, urban sprawl (suburban development) is 'unstable state because it is based on importing ecosystem services from other areas' (ibid.:243), i.e. sprawl is in between a steady state of compact and well connected land-use and another steady

state of greatly reduced and highly fragmented land-use. As urbanisation increases, the system shifts from natural (biospheric) requirements to sprawl (anthropocentric) requirements.

It is clear from the current knowledge that the interactions between urban economic, social and ecological processes are quite complex. Recognition of alternative regimes requires confronting issues of thresholds, desirability and reversibility. However, in the central position are the human adaptive capacity and the quality of the regulatory environment for urban life.

CONCLUSION

Humanity has been extraordinarily successful in modifying environment in order to meet demands of rapidly growing urban population. The debate on sustainability has come a long way in recent decades, and when looked through prism of urban sustainability and resilience, it is clear we still have a way to go. Sustainability requires a paradigm shift in our thinking, the one which will integrate technical, economic, social, and political factors holistically with aim to produce viable, sustainable urban systems, but the bottom line is that any proposal for sustainable development that does not explicitly acknowledge (urban) system's resilience is not going to keep delivering goods or services (Walker and Salt, 2006).

Assessing the resilience of urban system requires understanding how to best balance human services and ecosystem services, especially when considering that anthropogenic pressures have reached a scale where abrupt global environmental change seems unavoidable. The analysis of urban development and its correspondence with different types (stages) of sustainability indicates that cities can settle into a number of different equilibria. The question is whether certain 'equilibrium' meets human aspirations and needs. No matter if the change is something organic, natural and routine or something extraordinary and born of crisis, it requires development of human adaptive capacity. A path to better understanding resilient (sub)urban development and sustainability on the broader levels indicates that societies should seriously consider ways to explore options for deliberate transformation of cities as social-ecological systems.

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У ПОТРАЗИ ЗА МОГУЋНОСТИМА ОДРЖИВОГ (СУБ)УРБАНОГ РАЗВОЈА НА ОСНОВУ КОНЦЕПТА УРБАНЕ ПРИЛАГОДЉИВОСТИ

Сажетак

Одрживи развој, као један од свеприсутних концепата, суочен је са истинским изазовима кад је реч о урбаним срединама, посебно узевши у обзир чињеницу да је крајем ове деценије, по први пут у историји човечанства, више од половине светске популације живело у градовима. У раду се усмерава дискурс на релативно нов концепт урбане прилагодљивости, тј. на разматрање могућности система (града) да се одржи упркос ударима пре него што доживи суштински преображај. Полазећи од тога да ни један град данас не може опстати искључиво на бази сопствених ресурса, интерпретирају се очекивани сценарији урбане адаптације и одрживости. У раду су изнети закључци кроз истраживање адаптивног капацитета као процеса "учења ка адаптацији" у односу на "принудну адаптацију".

Кључне речи: *урбана прилагодљивост, адаптација, одрживост, град.*

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