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URBAN RESILIENCE: DEFINITIONS, UNDERSTANDING AND CONCEPTUALIZATION

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Abstract. *Sustainability and resilience are the two main paradigms of planning and policy making in the past decades. Fostering resilience in the face of environmental, socio-economic and political uncertainty and risk has captured the attention of academics and decision makers across disciplines, sectors and spatial scales. Urban resilience has become an important goal for cities, especially from the point of view of adapting to climate change and reducing their ecological footprint. Urban resilience is conventionally defined as the measurable ability of any urban system, with its inhabitants, to maintain continuity through all shocks and stresses while positively adapting and transforming towards sustainability. However, in theory and practice there are different definitions that are often in conflict. This paper first provides an overview of existing definitions of urban resilience and highlights their main determinants. Then, the paper discusses definitions from the perspective of ways of incorporating key concepts found both in resilience theory and urban theory. In the following, similarities and mutual tensions are recognized between the key concepts. Finally, the paper concludes that a clearer conceptualization is needed to improve this developing field and create conditions for its further operationalization.*

Key words: *urban resilience, definition, resilience conceptualization*

1. INTRODUCTION

The two main challenges and risks at the global level today are rapid urbanization and climate change. By 2050, two thirds of the total population, which is about 6,5 billion people, will be urban. At the same time, the potential risks of climate change at the global level are: a) an increase in the average temperature by 3°C by 2070; b) reduction of

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average amounts of precipitation by 20-40% by 2070; c) an increase in sea level in conjunction with an increase in storm events, and d) an increase in the frequency and intensity of stormy periods in regional framework. Although urban areas (at least 50,000 inhabitants) cover less than 3% of the Earth's surface, they are responsible for about 71% of global energy-related carbon emissions [1]. With all that in mind, it is understandable why the UN (2010) recognized the following as three key challenges/goals at the urban level: 1) improving the quality of life in cities; 2) reducing their ecological footprint, and 3) adapting them to climate change. A few years later, they were translated and incorporated into the 11th Millennium Goal - Sustainable Cities and Communities [2].

In the broader discussions on urban sustainability and climate change adaptation, the promotion of urban resilience amidst environmental, socio-economic, and political unpredictability and vulnerability has garnered the interest of scholars and policymakers spanning various fields and urban levels. Urban resilience has become an increasingly favored concept [3] [4] and an important goal for cities. Its popularity has exploded, with numerous explanations for this dramatic rise [5]. However, the meaning of urban resilience remains malleable, allowing stakeholders to come together around a common terminology without necessarily agreeing on an exact definition [6]. In addition, this vagueness can make it difficult to operationalize urban resilience or develop generalizable indicators [7].

Therefore, the two objectives of this paper are as follows:

- systematize and provide an overview of current definitions of urban resilience and highlight their main determinants; and
- analyse and consider mutual similarities and tensions between key determinants and aspects of urban resilience at a conceptual level.

2. METHODOLOGY

The analytical framework in this research is based on the application of the descriptive method, analysis method and the comparative analysis method. The descriptive method and the analysis method were applied in the process of researching and systematizing the definitions of urban resilience, while the comparative analysis method was used in the research of similarities and tensions between the key determinants of urban resilience at the conceptual level.

3. URBAN RESILIENCE: DEFINITIONS AND UNDERSTANDING

According to Klein et al. [8], the term resilience is etymologically rooted in the Latin word *resilio*, which means "to bounce back". As an academic concept, its origins and meaning are more ambiguous [9], [10], [11], [12], [13]. Although the concept has a long history of use in the engineering, psychology and disaster literature [14], Meerow et al. [9] state that the research work of ecologist C.S. Holling's (1973) on the resilience of ecological systems is considered the originator of the modern theory of resilience. [1]

[1] "Holling used resilience to describe the ability of an ecological system to continue to function, or to "persist" when it changes, but does not necessarily remain the same. This contrasts with "engineering resilience", which

There are different definitions of urban resilience in the literature and practice. They are an expression of the multitude of disciplines dealing with the phenomenon of urban resilience, as well as the complexity of urban resilience itself. An overview of the most common current definitions is given in Table 1.

Table 1 Definitions of urban resilience – short overview

	Author/ year	Discipline	Definition
1.	Alberti et al. (2003) (15)	Agricultural and biological sciences; Environmental science	"… the degree to which cities tolerate alteration before reorganizing around a new set of structures and processes"
2.	Godschalk(2003) (16)	Engineering	"... a sustainable network of physical systems and human communities"
3.	Campanella (2006) (17)	Social science	"... the capacity of a city to rebound from destruction"
4.	Wardekker et al. (2010) (18)	Business management and accounting; Psychology	"… a system that can tolerate disturbances (events and trends) through characteristics or measures that limit their impacts, by reducing or counteracting the damage and disruption, and allow the system to respond, recover, and adapt quickly to such disturbances"
5.	Ahern (2011) (19)	Environmental science	"…the capacity of systems to reorganize and recover from change and disturbance without changing to other states...systems that are "safe to fail""
6.	Leichenko (2011) (5)	Environmental science; Social science	"... the ability...to withstand a wide array of shocks and stresses"
7.	Tyler and Moench (2012) (20)	Environmental science; Social science	"…encourages practitioners to consider innovation and change to aid recovery from stresses and shocks that may or may not be predictable"
8.	Liao (2012) (21)	Environmental science; Social science	"…the capacity of the city to tolerate flooding and to reorganize should physical damage and socioeconomic disruption occur, so as to prevent deaths and injuries and maintain current socioeconomic identity"
9.	Brown et al. (2012) (22)	Environmental science; Social science	"…the capacity to dynamically and effectively respond to shifting climate circumstances while continuing to function at an acceptable level. This definition includes the ability to resist or withstand impacts, as well as the ability to recover and reorganize in order to establish the necessary functionality to prevent catastrophic failure at a minimum and the ability to thrive at best"
10.	Meerow et al. (2015) (9)	Environmental science; Urban studies; Social science	"…ability of an urban system-and all 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, to adapt to change, and to quickly transform systems that limit current or future adaptive capacity"

focuses on a single state of equilibrium or stability to which a resilient system would revert after disruption" [10].

4. URBAN RESILIENCE: CONCEPTUALIZATION AND DISCUSSION

The meaning and use of the concept of resilience in urban research and in the context of policy derives from the way of considering the following key relationships and determinants: 1) equilibrium vs. non-equilibrium resilience; 2) positive vs. neutral (or negative) conceptualizations of resilience; 3) mechanisms of changing the system into a resilient state; 4) specific adaptation vs. general adaptability; and 5) time and spatial scale of action [9].

Regarding the first relationship, there is a division in urban resilience between single-state equilibrium, multi-state equilibrium, and dynamic non-equilibrium. Their disciplinary orientations, as well as key characteristics are shown in Table 2.

Table 2 Notion of urban resilience equilibrium

	Type of equilibrium	Discipline	Key characteristic
1.	Single-state equilibrium or "*engineering resilience*"	Disaster management; Psychology; Economics	Refers to the capacity of a system to revert to a previous equilibrium post-disturbance
2.	Multi-state equilibrium or "*ecological resilience*"	Environmental science	Posits that systems have different stable states and, in the face of a disturbance, may be transformed by tipping from one stability domain to another
3.	Dynamic non-equilibrium	Ecology; Urban planning and design	Suggests that systems undergone constant change and have no stable state

Some of the definitions take an explicit position on this issue. Thus, Liao [21] argues that engineering resilience is an "outdated equilibrium paradigm" for communities exposed to risk from natural hazards, while Ahern [19] claims that resilient urban systems are "safe-to-fail" which is opposed to "fail-safe", reflecting an unbalanced perspective. Some definitions suggest that a return to a previous equilibrium may be possible, focusing on the city's ability to "renew" and "recover" [17]. Other definitions do not take an explicit position, but nevertheless recognize that cities are constantly changing and may not return to their previous state [9].

Regarding the second relationship - positive vs. neutral (or negative) conceptualization of urban resilience, the findings of a comparative analysis of existing definitions indicate that urban resilience is predominantly viewed as a positive concept. The idea that resilience is a positive feature that contributes to sustainability is widely accepted [3], [22]. However, there is debate as to whether resilience is always a positive concept. Within equilibrium focused definitions, based on the ability of the urban system to return to its original state after disturbance, doubts arise precisely as to how and for whom that original state is desirable (for example, what if it is poverty, car-dependence urban environment or dictatorship). Some social theorists consider that the concept can be used to promote a neoliberal agenda or retain systemic inequality [22] [9], and that therefore the determination of a desirable or undesirable state is a matter of political and social consensus and regulation.

The following can be recognized as key mechanisms for changing the system into a resilient state: 1) persistence; 2) transition; and 3) transformation. Their key characteristics are shown in Table 3.

Table 3 Mechanisms of urban resilience

	Type of mechanism	Discipline	Key characteristic
1.	Persistence	Engineering	Reflects the engineering principle that systems should resist disturbance and try to maintain the status quo
2.	Transition	Environmental science; Social science; Urban planning and design	Refers to the system ability to incrementally adapt
3.	Transformation	Environmental science; Social science; Urban planning and design	Refers to the system ability to more radically transform - when a system is in a robustly undesirable state, efforts to build resilience might seek to purposefully and fundamentally change its structures

The findings of a comparative analysis of this relationship indicate that definitions and concepts of urban resilience mostly focus on persistence, but there are also those those that focus on transformation and transition [19]. There are few who explicitly identify two or all three mechanisms for achieving a state of urban resilience [22]. For example, Wamsler et al. [23], recognize that actions aimed at creating a resilient city can be both transitional and transformational. Some research focuses specifically on incremental change or transition [21], while others argue for transformation [22].

The understanding of the fourth relationship between so called “specific” adaptations vs. “general” adaptations also differs. Some studies argue that focusing on specific resilience can lead to undermining the system’s flexibility and its ability to respond to unexpected threats, while other definitions and conceptual approaches are based on the assumption that inherent (specific) qualities are better under normal conditions and adaptive (general) qualities during disasters [24]. A possible collision between short-term adaptation, which is highly specialized, and long-term adaptability, which is generalized, is also recognized. Scholars focusing on climate change resilience align with Brown et al. [22] in arguing that urban resilience should focus on adaptive capacity rather than specific adaptations.

Regarding the time and spatial scale of action, most definitions do not mention them. Those definitions based on the rapid recovery of the urban system as a key characteristic do not specify the meaning of "rapid" or the timescale of actions. Some definition and concepts note that the time it takes to return to a previous stable state after a disturbance can be used to measure resilience, but it also not clear what "rapid" exactly means. The spatial scale of the action - macro, meso and/or micro urban scale is also rarely mentioned.

Despite the differences in disciplinary and conceptual approaches, urban resilience can be recognized in practice through two dimensions - as "soft" resilience and "hard" resilience [25].

"Soft" resilience includes socio-economic resilience and organizational resilience of a certain urban area. Socio-economic resilience refers to economic diversity, the level and structure of employment of the population, the ability to operate economically in the

event of risks, as well as the ability of the social community to face and respond to them [26]. Organizational resilience refers to the institutional context, primarily the ability to adapt institutions, social organizations and social communities to disaster risks.

"Hard" urban resilience can be viewed through two dimensions, as physical resilience and as natural resilience. Physical resilience refers to the resilience of the urban infrastructure system in correlation with the urban system, including power and telecommunication systems, city water supply and sewage system, but also shelters, breakwaters and other elements of protection. Natural resilience includes ecological and environmental resilience [27]. As "hard" urban resilience is key in resilience simulations, there is an extensive literature on environmental resilience, risk assessment and vulnerability analysis, as well as infrastructure resilience simulation [25].

5. CONCLUSION

There is an increasing emphasis on enhancing the resilience of cities in the face of rapid urbanization and climate change. Academics and practitioners from different disciplines have adopted the term urban resilience. However, as the literature review and analysis demonstrate, definitions of urban resilience are often incoherent.

It could be said that urban resilience has certain theoretical inconsistencies and conceptual vagueness. On the one hand, that can be considered useful because it allows it to function as a link between different developmental dimensions. In this way, urban resilience can foster multidisciplinary scientific collaboration. This is especially important for cities, which are complex systems and therefore require the expertise of multiple disciplines and stakeholders. On the other hand, this conceptual ambiguity results in difficulties in operationalization, establishment of indicators and their measurability. As Klein et al. [8] consider, ‘’the problem with resilience is the multitude of different definitions and turning any of them into operational tools…After thirty years of academic analysis and debate, the definition of resilience has become so broad as to render it almost meaningless.”

Nevertheless, the importance of urban resilience is undeniable. It is considered a positive concept that contributes to urban sustainability. Building resilient urban systems requires different degrees of alteration, thus transitional, incremental, or transformational changes and types of actions may be relevant.

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URBANA OTPORNOST: DEFINICIJE, RAZUMEVANJE I KONCEPTUALIZACIJA

Održivost i otpornost su dve glavne paradigme planiranja i kreiranja politike u proteklim decenijama. Podsticanje otpornosti u suočavanju sa ekološkom, socio-ekonomskom i političkom neizvesnošću i rizikom privuklo je pažnju akademika i donosioca odluka u različitim disciplinama, sektorima i prostornim razmerama. Otpornost gradova je postao važan cilj za gradove, posebno sa stanovišta prilagođavanja klimatskim promenama i smanjenja njihovog ekološkog otiska. Urbana otpornost se konvencionalno definiše kao merljiva sposobnost bilo kog urbanog sistema, sa njegovim stanovnicima, da održi kontinuitet kroz sve šokove i stresove dok se pozitivno prilagođava i transformiše ka održivosti. Međutim, u teoriji i praksi postoje različite definicije koje su često suprotstavljaju. Ovaj rad prvo daje pregled postojećih definicija urbane otpornosti i ističe njihove glavne determinante. Zatim se u radu razmatraju definicije iz perspektive načina inkorporiranja ključnih pojmova koji se nalaze kako u teoriji otpornosti tako i u teoriji grada. U nastavku se prepoznaju sličnosti i međusobne tenzije između ključnih pojmova. Konačno, u radu se zaključuje da je potrebna jasnija konceptualizacija da bi se ova razvojna oblast unapredila i kako bi se stvorili uslovi za njenu dalju operacionalizaciju.

Ključne reči: *urbana otpornost, definicije, konceptualizacija otpornosti*