

Spatially Explicit Resilience Evaluation Framework for Effective Planning

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For the past few years, the concept of resilience has become one of the main buzzwords entering the international scientific (and not) debate on engineering, architecture, psychology, sociology, and urban planning (Brunetta & Caldarice, 2020). Mainly, this diffusion was the first prompt response to increased natural hazards, climate change effects, social inequalities, and political uncertainty. Nevertheless, scholars, practitioners and politicians do not agree on a single definition but share the opinion that resilience can be improved by the combination of both physical and non-physical assets. The absence of a common definition is due to different theoretical backgrounds and fields of research of each discipline.

Traditionally, mainly in engineering, resilience has been conceptualised as the ability to resist, recover and adapt to disturbances. However, this linear view fails to capture the dynamic and transformative nature of urban and regional systems (Giovannini, 2020). A more complex understanding of resilience recognises its potential to go beyond mere recovery and transform cities into more sustainable, innovative and inclusive places (as required by SDG no. 11 of the United Nations 2030 Agenda).

In this view, starting from the more traditional conceptualisations of resilience, our research (developed within the RETURN project¹) attempts to deepen the understanding of the concept of

¹ The project Return - Multi-risk science for resilient communities under a changing climate - funded by the European Union Next-GenerationEU (National Recovery and Resilience Plan – NRRP, Mission 4, Component 2, Investment 1.3 – D.D. 1243 2/8/2022, PE0000005), involves 26 different entities between public universities and public research institutes, government agencies, territorial authorities and private entities, with the purpose of building urban and territorial resilience. Through a better understanding of environmental, natural and anthropogenic risks and their interrelationship with the impacts of climate change, it aims to improve risk forecasting and methodologies for prevention, adaptation and mitigation, and to develop new methodologies and technologies for monitoring.

resilience with reference to urban and regional studies and planning disciplines. To determine the extent of the concept in these fields of study, we undertook a literature review that had a twofold objective. On the one hand, we aimed to frame the concept within the abovementioned fields of study and, on the other hand, we wanted to understand which methods and indicators international scholars are using to measure resilience. The final goal, as urban planners, is to find the best planning and design strategies to operationalise urban and territorial resilience with the aid of evaluation methods.

Our literature review resulted in quite an extensive repository of international references that showed how resilience is a recent topic in urban and regional studies and planning disciplines that needs further exploration and more precise conceptualisation and application. Indeed, the literature review brings out a fragmented and fuzzy understanding of resilience in these fields of study, and only recently have international scholars attempted to define it (Davoudi, 2012; Meerow et al., 2016; Brunetta et al., 2019). First attempts to conceptualise it within these fields of study appear to be mainly related to the necessity to prevent natural hazards in urban and regional contexts.

Nevertheless, the continuous increase of urban population (UN, 2018) turns cities and urban regions into complex social-ecological systems (Botequilha-Leitão & Díaz-Varela, 2020) where physical, environmental, institutional and social assets coexist. This situation makes conceptualising urban and territorial resilience quite challenging as it must compare itself also with the scale of intervention.

Briefly retracing the different conceptualisations, it is possible to identify a shift in the field of resilience towards recognising the complexity and interconnectedness of cities and territories as socio-ecological systems. Socio-ecological resilience emphasises the ability of a system to adapt and transform in response to perturbations, recognising that these perturbations can lead to changes in system behaviour and potentially result in a completely different state. This approach is based on the idea that complex systems follow non-linear trajectories with multiple equilibria, suggesting that they can change over time regardless of external perturbations (Folke, 2006; Holling, 1996). This perspective highlights the dynamic nature of systems and underlines adaptation and transformation as essential components during change. Resilience goes beyond recovery; it includes transformation. The concept developed further with the introduction of the temporal aspect to resilience by recognising its non-linear and dynamic nature. Resilience is now seen as an ongoing process in which systems continuously adapt and learn from disturbances to improve their capacity to withstand future shocks.

This understanding of resilience emphasizes the dynamic nature of systems and highlights the importance of adaptation and transformation in the face of change. Resilience goes beyond recovery, involving transformation. In the context of urban planning, this means a shift towards

Within this context, this research focuses on the development of a method/tool for evaluating the effectiveness of adaptation and mitigation planning as well as design solutions, and the consequential transformation of a territory, in terms of territorial resilience.

approaching resilience not just as the ability to bounce back from adversity, but also as an opportunity for positive change and growth (Yamagata, 2018).

Transformative resilience involves harnessing disturbances as catalysts for positive change and innovation (Giovannini, 2020; Asadzadeh et al., 2022). By incorporating the concept of transformative resilience into planning practices and interventions, a more comprehensive and forward-thinking approach to building resilient urban environments can emerge.

Given the complexity of urban systems and their relationships, measuring and evaluating urban resilience poses a significant challenge. It needs to be considered holistically rather than in terms of individual risks. Current measurement approaches often lack a comprehensive spatial perspective and fail to capture the diverse dimensions and spatial dynamics of urban systems. Many evaluation models and indicators aim to measure resilience but often end up assessing vulnerability and exposure to risks and hazards instead. Additionally, the lack of consensus and clarity in defining urban resilience makes it difficult to establish standardised evaluation methods.

To address these challenges, the second objective of our literature review was to find indicators to evaluate a territory's response to the transformations and challenges it is currently facing. These indicators are categorised and organised into a comprehensive catalogue based on the dimensions of resilience they measure and the capacities they influence. A major challenge identified in the literature is the prevalence of lists of indicators that lack concise definitions and explicit calculation methods, or are not spatialised. Our research aims to provide a comprehensive framework for assessing urban and territorial resilience by creating a set of measurable and spatially specific indicators.

Such a systematic and interdisciplinary perspective to resilience allows for promoting a holistic approach to planning characterised by place-related and people-centred actions (ICCROM, 2015). To pursue a place-based approach, we will test the selected indicators in a specific territorial context of the City of Turin: the course of the Po River. This river context is quite an exceptional case study as it is going through the drafting and implementation of various planning tools (such as the revision of the plan of the Piedmontese Po River and, considering the metropolitan context, the drafting of the Metropolitan General Plan of Turin – PTGM). These plans constitute a fundamental step in constructing our resilience framework as they consider hazards and risks as one of the principal territorial assets and provide technical and normative solutions. Furthermore, the Po River provides an invaluable territorial context for examining the interactions between urban systems, natural resources, and social dynamics. The final step will be the downscaling at a mesoscale in some urban transformation areas along the Po River.

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