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The City as Resilient Organism: the Sustainability Route of Social Innovations and Adaptive Structures for Quality of Life and Social Justice

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1 ABSTRACT

This paper invites you on a sociological journey, conceptualizing cities as resilient organisms and exploring how social innovation and adaptive structures can improve quality of life and promote social justice. Based on the metaphor of the "resilient organism", cities are seen as complex, dynamic systems that must constantly adapt to new challenges. But what makes cities resilient and sustainable? How can they improve the quality of life of their residents and promote social justice? In the light of sociological theories by Luhmann, Lefebvre and Latour, a multi-layered picture of urban resilience emerges. It, the sustainable urban reslience, appears as an emergent property that arises from the interplay of social, ecological, economic and technical factors. Particular attention is paid to social innovations and adaptive structures as the key to renewal and adaptability. Resilience is not a value-neutral concept, but is closely linked to issues of power, participation and justice. The example of medium-sized cities is used to illustrate how a manageable size, strong networks and civic engagement can strengthen resilience. The journey culminates in a plea for resilience research and practice that incorporates sociological perspectives and breaks new ground including interdisciplinary work. The conclusion is that resilience must be measured by whether it enables all city dwellers to lead a good life. It requires adaptive, heterarchic governance, experiments, unusual alliances and a vision of the city as a learning, constantly renewing organism.

Keywords: Sustainability and Justice, Adaptive Structures, Social Innovation, Medium-Sized Cities, Urban Resilience

2 DYNAMIC CITIES AS RESILIENT ORGANIZATIONS

Cities, settlement areas in general, are challenged by climatic, demographic and socio-economic changes and migratory movements. Utopian and dystopian prospects alternate – especially at a time of social upheaval and geopolitical rearrangements. Three things are obvious. Firstly, current developments are serious and are setting powerful forces of transformation in motion – at both global and regional level. Secondly, settlement areas must adapt to changes, and cities even play a central role in the transformation process. Thirdly, the adaptations can be shaped; although not everything can be planned, urban developments are possible that depend on the cities' capacities and abilities to adapt and align the development paths in corridors in the long term. From a sociological perspective, settlement areas – villages, cities and megacities – are dynamic systems that adapt to circumstances and have a lasting impact on living conditions. They can be understood as a “resilient organism”.

This is an invitation to a sociological perspective on the understanding of cities and sustainability. The narrative approach invites us to think about cities not only rationally, but also creatively and emotionally. The article begins with the consideration that cities, and in particular the 'sustainable city', need a broader concept and therefore draws on the metaphor of 'organism' to make the complexity more accessible. Despite being aware of the sometimes misleading conclusions of such a metaphor, a "city" is seen as a "resilient organism" to make a connection to something that everyone intuitively understands – the human body or a living organism. The whole system depends on and exists in many elements (smaller systems). Such imagery not only helps to visualize the complexity of urban systems, but also makes their dynamics, vulnerability and adaptability more tangible. In systems there exist chains-of-causality, i.e. small peaces can break down the general functionality.

In the meantime, initiatives and networks have been established that explicitly address the resilience of cities. The "Resilient Cities Network", for example, has existed since 2013 and formulates urban resilience as "The capacity of individuals, communities, institutions, businesses and systems within a city to survive, adapt and grow no matter what kinds of chronic stresses and acute shocks the experience." Resilience is about capacity, capacity building. On the one hand, the connotation of urban resilience is often emphasized in terms of the ability of cities to survive crises and disasters – resilience as a stress test (e.g. blackout tests). On the other

hand, urban resilience is predominantly reduced to ecological, environmental, engineering aspects and challenges – resilience as a technical, infrastructural, structural function.

As a comprehensive concept, urban resilience can be understood as the subject of sociology. In the perspective of urban and spatial sociology (Dell 2023, Friedrichs 1995, Häußermann et al. 2004, Löw 2008) it is deeply embedded in the urban social fabric of cities. The concept of the "city as a resilient organism" emphasizes the interplay of human and non-human actors by applying sociological theories and drawing specifically on the systems theory of Niklas Luhmann (1984), the urban sociology of Henri Lefebvres (1991, 2016) and the actor-network theory of Bruno Latour (2007). The concept of the city as a resilient organism understands the city as an open, dynamic system in which control processes create “states of equilibrium” and as a space of emergent dynamics in which the availability and distribution of opportunities to access resources largely determine how sustainably resilient the city is. Thus, quality of life and social justice become central signposts for how resilient cities are in the long term, in which they manage transformations through permanent renewal and adaptation. Social innovations such as participatory governance and co-living initiatives enable communities to jointly develop solutions to urban challenges. Adaptive structures such as multifunctional buildings and green infrastructure enable cities to respond dynamically to ecological, economic and social changes.

The thesis is also introduced that medium-sized cities in particular serve as laboratories for urban innovation due to their balance between complexity and manageability. Cities of this size in particular are characterized by increased adaptability and a moderate and resilience-promoting ratio of resource availability, regional or local cohesion and manageable structures. They are better able to manage dynamics and implement transformation requirements more quickly and sustainably. So, the argument.

3 URBAN RESILIENCE FROM A SOCIOLOGICAL PERSPECTIVE

Resilient originally means “resistant”, “robust” or “adaptable”. The term is used in various contexts, for example in ecology to describe the ability of ecosystems to return to a state of equilibrium after disturbances, or the same in engineering, i.e. the ability of technical or infrastructural systems not to fail completely in the event of crises or failures, but to maintain essential system services or quickly restore full functionality. The social sciences understand resilience more broadly as the ability of individuals, communities and systems to cope with adversity, adapt and emerge stronger. A key aspect of the concept of resilience is that it encompasses learning and development skills inherent to the system. Resilience means coping, regeneration, learning and the ability to transform in the sense of long-term regulation and re-stabilization of the system or society.

In the urban context, resilience refers to the capacity of cities to absorb shocks, adapt to changing conditions and transform and thrive in the face of crises (Meerow et al., 2016). Resilience can be understood as a multidimensional concept, with social, ecological, technical and economic aspects. Social resilience in cities refers to the importance of community networks, social capital, participation and equity for the resilience and adaptive capacity of cities. (Aldrich & Meyer, 2014). Ecological resilience refers to the ability of urban ecosystems to maintain essential functions and services in the face of disruption, for example through biodiversity, green infrastructure and sustainable resource use (McPhearson et al., 2016). Economic resilience can be translated into the capacity of urban economies to withstand shocks, recover and transform, for example through diversification, innovation and adaptability (Brinkmann et al., 2017).

Resilience overlaps with related concepts such as sustainability, vulnerability and adaptability (Folke, 2006). Sustainability aims to meet current needs without compromising the ability of future generations to meet theirs (WCED, 1987). While sustainability describes a desirable target state, resilience emphasizes the ability to achieve and maintain this in the face of disruption. Vulnerability refers to the susceptibility of systems to damage from external stressors based on their exposure, sensitivity and coping capacity (IPCC, 2007). Resilience and vulnerability are complementary concepts, with resilient systems being considered less vulnerable. Adaptive capacity refers to the ability of systems to adapt to changing environmental conditions in order to mitigate potential damage and take advantage of new opportunities (Engle, 2011). Adaptability is a central component of resilience. Despite conceptual overlaps, resilience is characterized by its focus on dynamics, uncertainty and transformation. Resilience emphasizes not only resistance and recovery, but also the ability to emerge from crises stronger and transformed (Keck & Sakdapolrak, 2013). This requires a shift

away from understanding urban systems as stable equilibria towards a view of complex adaptive systems on the “edge of chaos” (Folke, 2006).

3.1 Resilience from a systems theory perspective

From a systems theory perspective, cities can be understood as complex, functionally differentiated social systems (Luhmann, 1984). Like biological organisms, they consist of interdependent subsystems such as the economy, politics, law, science and education, each of which fulfills specific functions for the system as a whole. The resilience of the urban system depends on the ability to organize the interactions between the subsystems and to process externally induced irritations. Luhmann (1984) argues that complex systems cope with uncertainty and contingency by reducing complexity. They make selective decisions based on system-internal distinctions and expectation structures. Resilient cities are therefore characterized by flexible, adaptable decision-making structures that allow disruptions to be used as an opportunity for systemic learning processes and transformation. From a systemic perspective, this requires a high degree of “variety” (Ashby, 1956), i.e. a diversity of possible courses of action and functional equivalents. It can be assumed that governance structures that distribute decision-making power and have redundant functions are better suited to this because they react more flexibly to disruptions than hierarchical, centralized systems. Such polycentric or heterarchic governance structures require cross-system communication and cooperation between the subsystems in order to pool resources and enable collective learning processes.

From a systems theory perspective, the development of resilient cities requires a co-evolution of social and physical structures. Technical and structural infrastructures are to be understood as artifacts of decisions (Luhmann, 1984) that enable certain options for action and exclude others. In this sense, adaptive infrastructures such as multifunctional buildings and digital platforms are to be understood as “enablings constraints” (Juarrero, 1998) that structure urban complexity and open up spaces of possibility for innovation and resilience.

3.2 Resilience as a dimension of urban space

The French philosopher and sociologist Henri Lefebvre developed an influential theory of the social production of space (Lefebvre, 1991). According to this theory, (urban) space is not a container, but a social construct that is produced and shaped by the space-structuring actions of social actors. Lefebvre distinguishes between three dimensions of spatial production. Firstly, spatial practices, the physical-material production and reproduction of space, for example through urban planning and architecture. Secondly, the representations of space, i.e. the "thought", abstract spatial concepts and discourses as they prevail in science, planning and politics. Thirdly, spaces of representation, i.e. lived space, which is constituted by symbols and meanings and opens up possibilities for resistance, appropriation and alternatives. Lefebvre argues that capitalist modernity is characterized by a dominance of abstract concepts of space that colonize concrete, lived space. Cities are planned as homogeneous, functionally zoned and exchange-value-oriented spaces, which leads to alienation, segregation and exclusion (Lefebvre, 2016). In contrast, Lefebvre formulates the “right to the city” as a claim to participation and appropriation, i.e. the right of all city dwellers to participate in the design of urban space and to use it according to their needs. Lefebvre's spatial theory offers important insights for understanding resilient cities. Accordingly, resilience cannot be reduced to technical and organizational measures, but requires emancipatory urban development "from below".

As Kendra et al. (2008) show in their study on cooperation and improvisation in crises, the local expertise and creativity of residents are often decisive in responding to disruptions in a situational manner. Examples such as the "informal urban development" in Orangi Town (Karachi) through local self-organization (Hasan, 1995) or the participatory reconstruction strategies in New Orleans after Hurricane Katrina (Irazábal & Neville 2007) illustrate the transformative power of bottom-up initiated resilience strategies. At the same time, Lefebvre's critique points to the need for a "right to a resilient city" that gives all residents access to resources and opportunities to participate in the sustainable and equitable design of urban space. In this context, Harvey (2006) speaks of “spatial justice”, which can be seen as the basis for the development of resilient cities. This brings power structures and social inequalities into focus, which can stand in the way of inclusive resilience. Following Vale (2014) and the example of the gentrification of “resilient” neighborhoods in Boston after natural disasters, resilience strategies often go hand in hand with the

displacement of low-income population groups. The findings of Letelier & Irazábal (2018) for the city of Talca, Chile, after the 2010 earthquake are similar.

Lefebvre"s perspective emphasizes the importance of participatory approaches geared towards social justice in the development of resilient cities. Inclusive governance structures that include marginalized groups as actors and not just as beneficiaries of urban resilience are crucial. Examples such as the "community resilience" strategy in Medellin with a focus on co-production of public services (Castro & Echeverri, 2011) or the establishment of polycentric "urban living labs" as experimental spaces for sustainable urban development (Voytenko et al., 2016) suggest possible paths to emancipatory resilience.

3.3 Cities as socio-technical networks

The actor-network theory (ANT) of the French sociologist of science Bruno Latour offers an approach to understanding urban systems that accentuates society as a network of human and non-human actors ("actants") that mutually influence and stabilize each other (Latour, 2007). Cities thus appear as complex socio-technical "assemblages" (Farias & Bender, 2010) of infrastructures, artifacts, forms of knowledge, routines and power relations. Latour's perspective draws attention to the active role of technical objects and infrastructures in structuring urban spaces and practices. For example, Hommels (2005) on the development of the Parisian metro network shows how technical persistences make social relationships permanent and influence urban resilience. New technologies such as autonomous vehicles or digital "smart city" infrastructures are therefore not simply tools, but co-actors of resilience that open up and limit the scope for action. Latour (2001) argues that the stability of networks is based on their ability to create and translate connections between heterogeneous elements. Applied to resilience, this means that cities must be able to mobilize and coordinate a variety of actors and resources in order to cope with disruptions. This requires a "diplomacy" (Latour, 2007) between different forms of knowledge, interests and logics of action. As an example, participatory adaptation strategies to climate change in Barcelona (Camps-Calvet et al., 2016) can be mentioned here, which require participatory approaches – e.g. development groups, hybrid forums, etc. – that involve citizens, scientists, urban planners and local businesses. In this way, diverse knowledge is integrated and socially robust solutions are developed. The resilience of the city here is based on the ability to build networks that combine social and ecological aspects and create a collective capacity to act.

In Latour's view, resilience is not a property, but a precarious process of networking and stabilization that has to be re-established again and again (Latour, 2007). In order to be resilient, cities must continuously work on their networks, create border objects between different social worlds and mediate conflicts. This requires a high degree of reflexivity and the ability to learn in order to recognize weaknesses and enable innovation. Resilient cities can be described as "distributed preparedness networks" (Collier & Lakoff, 2008); they are organized decentrally and learn to deal with uncertainty through continuous experimentation during operation. This requires open spaces for cooperation and improvisation, urban future labs, innovation workshops or similar; "enablers" in which citizens, researchers, students, entrepreneurs and local politicians work together on specific challenges.

Latour's theory underlines the importance of socio-technical networks for the resilience of cities. Hybrid strategies that integrate technical and social innovations and involve a wide range of actors are crucial. Digital platforms for the coordination of resources and activities in crises illustrate possible approaches; e.g. the "Ushahidi" application opened in Kenya in 2008 (Gutiérrez 2018; Boersma et al 2014), or applications for participatory mapping of disaster management. At the same time, Latour's perspective points to the need to open up the black box of technical systems and critically reflect on their political implications (Latour, 2007). As the technological disasters in Fukushima or Beirut show, socio-technical networks can also amplify risks if interactions and cascading effects are not sufficiently taken into account (Molyneaux et al., 2019; Hatoum et al., 2022).

3.4 Core elements of urban resilience from a sociological perspective

The sociological perspectives presented converge in a view of cities as complex adaptive systems whose resilience is based on the interplay of social, technical and ecological factors. In contrast to engineering approaches, which understand resilience primarily as the ability to absorb shocks and maintain functions (Hollnagel et al., 2006), sociological perspectives emphasize the importance of adaptability, learning and transformation. Accordingly, resilience requires a high degree of diversity and connectivity in urban systems

in order to be able to react flexibly to disruptions and open up new development paths. The ability to integrate heterogeneous actors and forms of knowledge and to create a collective capacity to act is crucial. This requires participatory governance structures that enable all city dwellers to participate in the design of resilient cities, particularly in order to realize humane living conditions and social justice in the long term. Resilience is therefore not a value-neutral concept, but is closely linked to issues of balancing interests (Loidl, 2013), power and justice. Resilience strategies are not neutral in terms of their social effects; they can exacerbate social inequalities if they ignore the needs and perspectives of marginalized groups. Vulnerable groups that are less able to formulate their interests are at a structural and long-term disadvantage when it comes to shaping processes and their ability to resist. Emancipatory resilience therefore requires critical reflection on the political implications and the active shaping of inclusive urban development processes geared towards social justice. Finally, sociological perspectives point to the central importance of socio-technical networks and infrastructures for urban resilience. Technical systems are not simply neutral tools, but co-constitute urban spaces and practices. Resilient cities are characterized by adaptive, adaptive infrastructures that open up spaces for experimentation and innovation. At the same time, it is important to critically reflect on the political implications and unintended consequences of technical systems.

In summary, sociological theories offer important impulses for a holistic, normatively sound concept of urban resilience. They complement engineering and scientific perspectives with the social and political dimension and open up new ways of designing sustainable, just and future-proof cities. On this basis, a sociologically informed theory of urban resilience can be formulated that comprises the following core elements:

- Resilience as a multidimensional, relational concept that integrates social, ecological, economic and technical aspects.
- Resilience as an emergent property of complex adaptive systems based on diversity, redundancy, modularity and connectivity.
- Resilience as a process of learning, adaptation and transformation that requires proactive action and anticipation.
- Resilience as a normative concept that raises questions of power, justice and inclusion and requires emancipatory urban development.
- Resilience as a result of co-production by human and non-human actors in socio-technical networks and infrastructures.
- Resilience as a context-specific, locally situated phenomenon that requires participatory, bottom-up approaches and the integration of different forms of knowledge.

4 SOCIAL INNOVATIONS AND ADAPTIVE STRUCTURES IN URBAN DEVELOPMENT

Social innovations and adaptive structures conceived as potential for renewal and adaptation play a key role in the resilience and sustainability of cities, particularly in terms of quality of life and social justice.

4.1 Cities as socio-technical networks

Social innovations are defined differently, depending on the disciplinary approach and level of analysis (Howaldt & Schwarz, 2010). A common definition comes from Zapf (1989), who distinguishes seven groups of social innovation and understands them as new ways of achieving goals through organizational forms, new regulations, new services, new social technologies, new lifestyles, political innovations, new inventions by or with the participation of those affected, new patterns of satisfying needs. These new ways change the direction of social change, solve problems better than previous practices, and are therefore worth imitating and institutionalizing (Zapf, 1989). Social innovations are characterized by three core features (Gillwald, 2000; Howaldt & Jacobsen, 2010). These are, firstly, novelty: social innovations are new, unprecedented practices that deviate from established routines and thought patterns. They can include technical, organizational, institutional or cultural innovations. The second core characteristic of this concept is intentionality: in contrast to emergent social changes, social innovations are consciously and purposefully initiated by individual or collective actors in order to solve specific problems or fulfill needs. The third core characteristic is improvement: social innovations promise an improvement on the status quo by offering

more effective, efficient or sustainable solutions to social challenges. They aim to improve the quality of life and the common good.

Social innovations can be found in all areas of society, from the world of work and the education system to consumption and lifestyles (Rückert-John, 2013). They are becoming increasingly important in the context of urban development, as cities act as a focal point for social problems and a laboratory for new solutions (Gerometta et al., 2005). Social innovations are embedded in their era. Parks, libraries, baths and kindergartens were just as much social innovations of their time as today's concepts of car-free neighborhoods, community gardens or solidarity agriculture (Reinhardt, 2020). A distinction can be made between "top-down" and "bottom-up" innovations in terms of their origin (Mortensen & Bloch, 2020). While the former are initiated by politics, administration or science, for example in the form of model projects or real-world laboratories (Reinermann & Behr, 2017), the latter are the result of the initiative of citizens, companies or civil society organizations (Seyfang & Smith, 2007). Social innovations often develop in niches and open spaces far removed from the mainstream, where they are shielded from established rules and constraints (Geels, 2019).

For the diffusion and institutionalization of social innovations, it is important to recognize and strategically use windows of opportunity (Westley, 2013). Crises, political upheavals or technological breakthroughs can open "windows of opportunity" to test and anchor innovative practices on a broader scale (Olsson et al., 2006). This requires change agents and institutional entrepreneurs who are adept at mobilizing resources, forging alliances and challenging the dominant system (Westley et al., 2013). Learning processes and capacity building are also crucial in order to build skills for the development and implementation of social innovations (Moulaert et al., 2005). Through networks, intermediaries and support structures, experiences can be exchanged, synergies exploited and a joint capacity for action established (Moore & Westley, 2011). Social innovations often require the co-production of knowledge and solutions by various actors from science, politics, business and civil society (Voorberg et al., 2015).

4.2 Adaptive structures

Adaptive structures are a central concept in resilience research that describes the ability of systems to react flexibly to changes and disruptions (Folke, 2006). In contrast to conventional structures geared towards stability and control, they are characterized by openness, diversity and the ability to learn (Meadows, 2008). The aim is to design systems in such a way that they can absorb unexpected events and shocks, adapt and, if necessary, transform themselves (Walker et al., 2006). Adaptive structures typically have the following characteristics (Carpenter et al., 2001; Folke et al., 2010):

- Diversity and redundancy: A variety of elements, functions and feedback mechanisms avoid one-sided dependencies and enable alternative development paths. Redundant structures increase reliability and buffer capacity.
- Modularity: Instead of hierarchical management and centralized control, adaptive structures rely on loosely coupled, decentralized units that can act autonomously and recombine as required. This avoids cascade effects and increases adaptability.
- Connectivity and networking: Adaptive structures are based on networking and cooperation between different actors, levels and sectors. By sharing information, resources and experience, synergies are utilized and collective learning processes are initiated.
- Self-organization and distributed governance: Instead of top-down planning and central coordination, adaptive structures rely on self-organization and polycentric governance. Local actors are empowered to make situational decisions and develop context-specific solutions without jeopardizing overall coherence.
- Experimenting and learning: Adaptive structures see uncertainty and surprises as an opportunity for innovation and further development. Pilot projects, monitoring and reflective learning loops generate new knowledge and identify successful practices that can be adaptively adopted on a larger scale.

Adaptive structures are used in various areas of urban development, from infrastructure planning to risk management and governance arrangements (Deppisch, 2016). The concept of the "adaptive city" aims to design urban systems in such a way that they can deal with complex, dynamic changes such as climate

change, digitalization or internationalization (Schipper et al., 2022). This requires "safe-to-fail" structures that allow scope for action and learning processes without jeopardizing the functionality of the overall system (Ahern, 2011). One example is multifunctional, flexible infrastructure that can be adapted to changing usage requirements. The flooded areas of the "Benthemplein Water Square" in Rotterdam, for example, serve as retention basins during heavy rainfall, while they are used as sports and recreational areas during normal operation (Spaans & Waterhout, 2017). The modular design also allows for gradual expansion and conversion. Adaptive structures also play a central role in climate adaptation. By combining various "nature-based solutions" such as green roofs, façade greening and urban trees, heat reduction and water retention can be flexibly adapted to local conditions (Kabisch et al., 2017). At the same time, redundancy increases resilience and achieves positive side effects for biodiversity, air quality and health.

In the area of governance, adaptive structures rely on network-based, collaborative approaches that integrate different actors and forms of knowledge (Duit & Galaz, 2008). Round tables, mediation processes and deliberative forums are used as discussion forums to emphasize common ground in problem definitions, future scenarios are developed and options for action are weighed up (Linnenluecke, 2017). By collectivizing the corridors of goals, expectations and actions, they can prevent the fragmentation of interests. Examples include climate alliances in cities, which bring together administration, business, science and civil society to develop integrated climate protection and adaptation strategies (Bulkeley & Kern, 2019).

Adaptive structures require a rethink in urban planning and development. Instead of deterministic master plans and rigid regulations, we need frameworks that allow for flexibility and experimentation (Campbell, 2016). Temporary zoning, trial permits and placemaking approaches can open up spaces for innovative uses and social practices without making long-term commitments (Bishop & Williams, 2012). Continuous evaluation and adjustment is crucial in order to learn from experience and consolidate successful approaches.

4.3 Reframing social innovations and adaptive structures as social capital

Robert Putnam (1993, 2000) defines social capital as the networks, norms and social trust that promote coordination and cooperation for mutual benefit. He emphasizes that social capital has value both for the individuals involved and for society as a whole by facilitating collective action and the provision of public goods. Social innovation and adaptive structures share a common "denominator" and can be related to Putnam's social capital theory to emphasize the importance of the social urban fabric for sustainability and resilience. What are the common potentials?

- Participation and civic engagement: Putnam sees the active participation of citizens in activities oriented towards the common good as an essential source of social capital. Social innovations and adaptive structures promote precisely this type of engagement by creating opportunities for participation and empowering people to help shape their living environment.
- Networks and cooperation: For Putnam, social networks based on reciprocity and trust are a key component of social capital. Social innovations and adaptive structures are often built on or generate such networks, for example in the form of neighborhood initiatives, sharing platforms or cross-sector partnerships.
- Local anchoring and context sensitivity: Putnam emphasizes the importance of "local" social capital, which is created in manageable communities and relies on direct reciprocity and face-to-face interactions. Social innovations and adaptive structures build on this local social capital by developing context-specific solutions that are adapted to local needs and potential.
- Learning processes and building trust: For Putnam, social capital is not a fixed stock, but a dynamic phenomenon that grows through repeated interactions and shared experiences. Social innovations and adaptive structures enable such iterative learning processes in which trust is built, knowledge is shared and skills are developed.

The concepts differ in the following arguments. Putnam primarily emphasizes the positive, community-building effects of social capital, whereas the discussion of social innovations and adaptive structures also addresses possible negative effects and ambivalences, such as fragmentation, exclusion or instrumentalization. In addition, Putnam's focus is strongly on the local level and the role of traditional associations such as clubs or churches, while social innovations and adaptive structures often operate in a network-like manner, across levels and in new institutional settings. Nevertheless, Putnam's social capital

theory provides a valuable conceptual framework to first understand the importance of social relationships, networks and trust for cooperative problem-solving processes that strengthen a city's resilience potential in terms of sustainability, innovation and adaptability. Quality of life and social justice can then be read as an expression of this very social capital. Social innovations and adaptive structures can be understood as strategies to mobilize and strengthen local social capital and thus promote the resilience and sustainability of cities. Conversely, the discussion on social innovations and adaptive structures can help to further develop Putnam's concept and transfer it to new fields of application.

4.4 Potentials and limits for urban resilience and sustainability

Social innovations and adaptive structures offer promising approaches for resilient and sustainable urban development. Through their participatory and emancipatory character, social innovations promote the commitment and problem-solving ability of citizens – they connect people to their living environment, they activate residents to appropriate their living environment. They enable context-sensitive solutions anchored in the real world that respond to specific local needs and potential and strengthen social cohesion (Mehmood, 2016; Moulaert & Nussbaumer, 2015). Social innovations are often resource-light and cost-effective, as they utilize untapped potential, networks and creativity (Jaeger-Erben et al., 2017). They follow a logic of "empowerment" and open up experimental spaces for sustainable practices and lifestyles that can provide transformative impetus (Göpel, 2016; Pellicer-Sifres et al., 2018; Seyfang & Haxeltine, 2012).

Adaptive structures, in turn, make it possible to deal flexibly with uncertainties and risks, such as those posed by climate change or the energy transition (Wardekker et al., 2021). They promote inclusive urban development geared towards the common good through decentralized, networked forms of organization that create opportunities for participation and mobilize local knowledge (Frantzeskaki & Rok, 2018; Goldstein et al., 2015). In addition, adaptive structures act as "incubators" for social and technical innovations by opening up niches and spaces for new ideas and practices (von Wirth et al., 2019). Through integrated, cross-sectoral approaches, they help to combine the resilience and sustainability of different urban subsystems and exploit synergies (Li et al., 2020; McPhearson et al., 2016; Pisano, 2020).

Social innovations and adaptive structures sometimes also come up against limits and challenges. Social innovations often remain localized and, without supportive frameworks and resources, fail to reach a critical mass to fundamentally change dominant institutions and power structures (Avelino et al., 2019). Adaptive structures, in turn, require a high degree of coordination, communication and trust between the actors involved and entail the risk of free-rider behavior, conflicts and fragmentation if they are not embedded in overarching strategies (Duit, 2016; Loorbach et al., 2017; Ostrom, 2010).

What is needed is a reflexive, integrative governance of urban resilience that enables and promotes social innovations and adaptive structures, while at the same time providing critical support. Urban policy is required to provide conducive contexts and resources, for example through experimentation clauses, co-financing and capacity building (Bauknecht et al., 2020; Sbeih et al., 2020; Sørensen & Torfing, 2019). At the same time, social innovations and adaptive measures must be embedded in long-term urban development strategies that set normative guidelines and take equity aspects into account (Hölscher et al., 2019; Mieg & Töpfer, 2013; Sharifia & Yamagata, 2022). Last but not least, the implementation of both approaches requires a rethink in politics, administration and planning towards "adaptive governance" that relies on flexibility, cooperation and polycentrism (Chaffin et al., 2014; Pahl-Wostl et al., 2013).

5 THE ROLE OF CITY SIZE FOR URBAN RESILIENCE? – ARGUMENTS

Does size make a difference? This article is just a brief argument. It begins with the consideration that very small settlement areas such as rural villages (few resources, little capital) as well as very large settlement areas such as "mega-cities" (complexity, spatial heterogeneity) have a harder time than medium-sized cities in the governance and design of urban resilience, in the implementation of social innovations and sustainable developments. Of course, the very concept of "medium-sized" is definitionally elastic.

Cities with 50,000 to 500,000 inhabitants are usually considered medium-sized. What is considered "urban" changes over time. A significant proportion of the world's urban population lives in cities of this size: in Europe, it is around 44% (Eurostat, 2022), and the UN (2018) predicts that the population in medium-sized cities will grow by 32% by 2030, faster than in megacities (+ 25%). They are said to play a crucial role in resilient and sustainable urban development, acting as links between rural areas and metropolitan regions and

offering specific potential, but also challenges (ESPON, 2019). One of the strengths of medium-sized cities is their pronounced social cohesion. Their manageable size fosters close social networks, community building and a high level of civic engagement (Keck & Sakdapolrak, 2013). This promotes resilience in the face of crises because mutual support and collective action can be drawn on. At the same time, the proximity and accessibility of medium-sized cities make it easier for citizens to actively participate in political decisions and design processes, and neighborhood networks and civic engagement would develop more strongly.

Medium-sized cities are also characterized by their adaptability and flexibility. Thanks to their less complex administrative structures, they can test and implement innovative solutions more quickly. They are the more "real" experimental fields and laboratories for social and technical innovations that can be transferred to other cities if successful (Bulkeley & Kern, 2019). This is shown by the example of Heidelberg, for example, which was able to implement ambitious measures such as a climate protection fund or mobility management as part of the "100% Climate Protection Master Plan" (Schüle et al., 2018). It is argued here that it is not so much the size of the city that makes a difference, but the "neighborhood".

Another advantage of medium-sized cities would be their sustainability potential. Compact settlement structures reduce land consumption and transport costs and encourage the switch to environmentally friendly forms of mobility such as walking and cycling (Reckien et al., 2015). Cities such as Münster and Copenhagen achieve cycling shares of over 30% (Harms & Kansen, 2018). The proximity to agricultural areas and ecosystems close to the city facilitates the establishment of regional economic and material cycles, of "circular economy principles", as the example of the Italian city of Faenza shows (Caputo et al., 2021). Multifunctional green structures and concepts such as the "sponge city" can increase resilience to climate risks, for which the Chinese city of Changde can serve as a model (Li et al., 2020). Medium-sized cities also have economic advantages. As specialized business and knowledge locations, they can tap into innovation and value creation potential based on regional expertise and networks (Giffinger et al., 2016). By focusing on sectors in future-oriented fields, promoting start-ups and the creative industries and connecting to supra-regional clusters, they can build economic resilience, as demonstrated by the Danish city of Sonderburg with its specialization in CO2-neutral energy systems (Thellufsen et al., 2020).

However, these potentials are not automatically given, but require strategic action and supportive framework conditions. For example, integrated, participatory urban development concepts need to combine ecological, social and economic concerns (Mieg & Töpfer, 2013). By establishing regional innovation systems and strategic partnerships, such as those envisaged by the Science Park Concept Steyr (Fraunhofer IAO, 2022), endogenous resources can be mobilized and external impetus harnessed. Last but not least, supra-local policies are also needed that specifically promote medium-sized cities and give them room to maneuver (ESPON, 2019). Medium-sized cities are not a homogeneous category, but are characterized by a high degree of diversity. Their specific strengths and weaknesses depend on their historical character, economic base and institutional capacities (Bell & Jayne, 2009). Context-sensitive, locally adapted strategies are therefore necessary. Case studies from Freiburg, Kigali and Portland show how different the paths to resilient, sustainable urban development can be. Freiburg has been consistently promoting renewable energy, energy efficiency and sustainable mobility for decades and has been able to significantly reduce its CO2 emissions as a result (Fastenrath & Braun, 2016). Participatory governance and the involvement of citizens in projects such as energy cooperatives or the "Freiburg 2030" working group are crucial (Hager & Hamagami, 2020). Kigali, on the other hand, is pursuing a consistent policy of green urbanization that focuses on compact settlement structures, the preservation of green spaces and a zero-waste concept despite limited resources (Macknick, 2016; Kabera et al., 2019). The population is actively involved through community activities and neighborhood assemblies. Portland demonstrates the potential of polycentric, compact urban development. By limiting the settlement area, promoting local mobility and strong civic participation cultures, it is possible to combine sustainability and quality of life (Hagerman, 2007; Song et al., 2021). These are just a few examples to show that there are neither blueprints nor guarantees for resilient, sustainable urban development. Ultimately, even medium-sized cities are constantly challenged to adapt to changing conditions, learn from experience and try out new solutions (Wardekker et al., 2021). However, their manageable size, adaptability and social resources offer good conditions for this.

6 CONCLUSION

The conceptualization of cities as resilient organisms opens up valuable perspectives for sustainable urban development that focuses on quality of life and social justice. The combination of sociological theories by Luhmann, Lefebvre and Latour makes it clear that urban resilience a multidimensional, relational phenomenon that emerges from the complex interplay of social, ecological, economic and technical factors. Resilience proves to be a normative concept that requires participatory, inclusive governance structures emancipatory urban development "from below". Social innovations and adaptive structures are identified as key starting points for strengthening cities' ability to adapt and transform while at the same time promoting ' engagement and opportunities for participation. It is crucial to build up social capital in the sense of networks, trust and cooperation in order toenable joint solutions to problems. The example of medium-sized cities illustrates that

that a manageable size, close social relationships and flat hierarchies provide good conditions for urban urban resilience, whereby context-sensitive strategies are required that build on the specific potentials and challenges.Overall, the article argues for greater consideration of sociological perspectives in urban resilience research and practice. They draw attention to the social embedding and political dimension of urban resilience and provide important impetus for a socially just, participatory transformation of cities in the interests of sustainability and quality of life. Resilience is not an end in itself, but must be measured by the extent to which it enables a good life for all city dwellers and leaves no one behind. This requires bold experiments, unconventional alliances and a new view of the city as a learning, constantly renewing organism.

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