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Organic growth as a process to reach a resilient and sustainable city

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Abstract

From the beginning of the year 2000, cities are in continuous development at an unprecedented speed, hosting every year larger populations. In this urban horizon of constant growth, cities play a crucial role in affecting or improving the living quality of human beings and the successful interaction among social, environmental and economic systems. As a living organism, the city acts as a complex system of shapes and functions able to evolve in time to stay alive. The term 'resilience' means the ability to resist or survive by changing those features of every organic system including the city. The resilience of urban form represents a method to guide the growth of contemporary cities, also included in the ninth and eleventh Sustainable Development Goals (SDGs) respectively. Nowadays, most towns are featured by uncontrolled urbanisation that seems not compatible with the natural city's inclination towards resilience and sustainability. These terms are often used interchangeably, while they are complementary. If associated with urban form, these terms are still unexplored avenues of research as well as a preliminary investigation. In particular, there is a gap in the field literature matching urban morphology, resilience and SDGs. This paper aims to reply to the following question: how can urban morphology actively enhance the city's adaptability and its sustainable processes of change? Merging the City Resilience Framework from the Rockefeller Foundation in cooperation with Arup and the Global Indicator Framework for the SDGs from the 2030 Agenda, it provides a theoretical and methodological contribution to translate them into urban fabrics and typologies, by hypothesising a set of new requisites enable to comply with resilience science and sustainable development. The research results will foster advancements in spatial morphology to further direct urban policy and practice towards a more organic approach to city evolution.

Keywords: *city as organism, urban morphology, resilience, SDGs.*

Introduction

Urbanisation is one of the most important and unavoidable trends of the 20th and 21st centuries. From the beginning of the year 2000, cities are in continuous development at an unprecedented speed, hosting every year larger populations. Currently, 55% of 7.7 billion people live in urban areas, a rate that is expected to grow to 68% (9.7 billion) by 2050 due to a natural population increase and rural-urban migration motivated by the higher standard of living since cities account for 80% of total global GDP (UN DESA, 2019). Despite the urban footprint occupies only 2% of the Earth's land surface, rapidly rising populations forced an unprecedented urban expansion at all scales and forms. City-Regions and Megacities have developed anywhere in the world, but the largest cities are located in the Global South where the fastest urban growth is projected as medium-sized cities, especially in Asia and Africa, while the low fertility rates in Europe results in significant densification of the capital city centre and a decreasing population in suburbs (UN DESA, 2018). Accelerated urbanisation not only leads to new urban forms and definitions such as functional urban areas,

but it also brings related global challenges including poverty and unemployment, conflicts and inequalities. Continuous urban growth along with locked physical form and sprawl puts pressure on natural resources and affects land consumption. Being the main contributors to energy use and CO2 emissions, cities play a crucial role in tackling climate change while improving urban liveability.

As a living organism, the city acts as a complex system of shapes and functions able to evolve in time to stay alive. The term 'resilience' means the ability to resist or survive by changing those features of every organic system including the city. It constantly adapts its form to environmental, social, cultural and climatic needs. In this regard, the resilience of urban form represents a method to guide the growth of contemporary cities. Indeed, the issue of resilience occurs in the Sustainable Development Goals (SDGs) as well. However, uncontrolled urbanisation seems not compatible with the natural city's inclination towards resilience and sustainability. The larger and uneven a city becomes, the more the mutual balance between the inner parties weakens: this increases its vulnerability to change. Sustainability and resilience are terms often used interchangeably, while they are complementary. If associated with urban form, these terms still remained unexplored avenues of research as well as a preliminary investigation. In particular, there is a gap in the field literature in matching urban morphology, resilience and SDGs. We need to better explore urban patterns of change faster and more precisely and to understand the meaning of sustainable and resilient urban form. From this perspective, urban morphology holds a central role in the design and management of urban form. In line with the UN 2030 Agenda, this paper aims to investigate how urban morphology can actively contribute to the city's adaptability and its sustainable evolution. By merging and comparing the global drivers of resilience and sustainability (City Resilience Framework, SDGs), it provides a theoretical and methodological contribution to translate them into urban fabrics and typologies. It suggests a set of new requisites enable to comply with resilience science and sustainable development.

Background

The 21st-century cities are complex systems whose infrastructural, economic and social components are strongly interrelated and whose physical dimension impacts everyday life (Jacobs, 1961). One of the toughest challenges Urban Morphology faces today is to describe contemporary cities, analysing their form and spatial processes from an ecological perspective. It is time for a science of how city growth affects the environment and society, just as an integrated, quantitative, predictive understanding of the growth dynamics of cities is urgently needed (Bettencourt and West, 2010). As a science of urban form, Urban Morphology has provided several theoretical advancements to explain city complexity or patterns of development, but they have been criticised for their anachronistic methods, inability to generalise and to be applied in practice for addressing environmental issues (Oliveira, 2021). Actually, Muratori proposed an ecological viewpoint in Urban Morphology as early as the '60s by defining territory as the joint action by man and nature as well as an environmental organism that is the stable heritage of civilisation (or space-time synthesis) in a variety of

sustainable settlement patterns (Lombardini, 2017). Thus, the Muratorian research came to an inevitable urban organicism. For him, the city is not only a living organism that is an individual in a conservative and historical sense, homogeneous in fabric and unitary in system, integral-integrative and inseparable from its natural environment, but it is also the result of an organic process of permanence and continuity; it proceeds in its cyclic evolutions through internal modifications of its components in structural meaning of space and functional meaning of time (Muratori, 1967). After a few years, Caniggia confirmed the same organic vision at the building scale: "urban organism comes from the typological process where interrelation between the parts, and between the parts and the whole by establishing more complex links of necessity and hierarchy" (Caniggia and Maffei, 1989: 62). Starting from the hypothesis of 'city as organism', as the XXII Isuf International Conference was titled, this study puts forward the concept of organism on which both the geographical perspective by Muratori and the architectural scale by Caniggia are based respectively, associating it with resilience and sustainability allow the city to preserve a dynamic equilibrium (Van Timmeren and Henriquez, 2013). Yet, there is a large overlap between the meaning of *urban resilience* and *urban sustainability* that the literature tried to make it clear via conceptual and empirical framework using research trends or scale and emphasising their mutual contribution to the city development: on one hand, urban resilience is the passive process of maintaining a virtual cycle between ecosystem services and human beings; on the other hand, urban sustainability is the active process of synergetic co-evolution between the urban subsystems without compromising human life and biosphere, now and in the future (Zhang and Li, 2018). Recent studies argue the increasing value of the relationship between resilience and sustainability in guiding urban planning, especially as resilience belongs to various research fields. Indeed, we can group it under three main conceptualisations: Engineering Resilience (ability to return to initial equilibrium after a disturbance); Ecological Resilience (ability to restore the internal functionality after a shock); Evolutionary Resilience (process of adaption of an unstable system in permanent change) (Rega and Bonifazi, 2020). As an organism made nonlinear dynamics of natural and anthropogenic functions, cities include them all as they have considerable internal resilience within a certain domain of ecological stability (Holling, 1973). Hence, Urban Resilience is the capacity of cities to survive, adapt and grow throughout any stress they experience while protecting and enhancing people's lives (JRC, 2019). Regarding the specific interrelation among spatial morphology, resilience science, and sustainable urban form, the research has taken its preliminary steps by merging some morphological aspects with resilience thinking, social equity and ecological systems. However, the related investigations underline the need to develop a new research frontier based on morphology for addressing urban design (Marcus and Colding, 2014). As to urban sustainability, we refer to the official notion and targets including in the UN 2030 Agenda for Sustainable Development Goals (UN, 2015). Nevertheless, some insights underline the complexity and difficulty to use such indicators as a tool for evaluating progress towards sustainable and inclusive urban areas, due to the unavailability of open and standardised datasets, not comparable urban scales in widely different cities, and over-generalisation coupled with lack of locally appropriate benchmarks (Klopp and Petretta, 2017; Thomas *et al*., 2020). Although many applications in optimising urban form and socio-environmental quality by typological

performance, shape factors, energy analysis, and sets of urban morphology indicators (Morganti *et al*., 2017; Natanian *et al*., 2019), it is still unclear how morphology fits with the SDGs. This paper intends to bridge such a knowledge gap by updating the morphological thought with a mix of parameters of resilience and sustainability and fostering its advancement towards a more organic approach to city planning.

Methodology

Through an integrated approach, we try to reply to the following research questions: What is the role of Urban Morphology in designing and managing future urban forms? How can Urban Morphology actively enhance the city's adaptability and its sustainable processes of change?

This study is carried out by comparing and integrating two conceptual frameworks for resilience and sustainability respectively: City Resilience Framework (CRF) and SDGs from the UN 2030 Agenda (Figure 1). Promoted by Arup in cooperation with the Rockefeller Foundation, the City Resilience Framework was launched in 2012 as a research project applied to 100 cities worldwide, including the Asian Cities Climate Change Resilience Network. It provides a lens to identify critical areas and actions for increasing their resilience in withstanding shocks and living better in good times. This framework is based on multiple drivers, 4 Dimensions (people, health and wellbeing; place, urban systems and services; organisation, economy and society; knowledge, leadership and strategy), 12 key goals or drivers (minimal human vulnerability, livelihoods and employment, safeguards to human life, community identity, comprehensive security, sustainable economy, reduced fragility, provision of critical services, mobility, effective management, empowered stakeholders, integrated development planning) which are elements of a city's immune system and complemented by 7 qualities (Flexibility, Redundancy, Robustness, Resourcefulness, Reflectiveness, Inclusiveness, Integration) that distinguish a resilient city from another simply liveable or prosperous. Its innovative approach lies in the awareness that every city is unique and the way resilience manifests itself plays out differently in different places, thus a global thought is translated into numerous local factors. Moreover, it is applicable to both disaster risk reduction and chronic stresses (OAP, 2014). The CRF was the first step to index the urban resilience in a preliminary list of variables: that is its main limitations. The UN 2030 Agenda was adopted by the Member States in 2015 as an ambitious blueprint to achieve a more sustainable future for shaping national policies to combine socio-economic demands with environmental protection. Among the 17 goals and 169 targets monitoring through 244 indicators, we focused on the 9th and 11th because they are the most closely related to the urban context. The first one aims to 'build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation' to confirm that the city is a living complex of ecosystems balanced on tangible and intangible networks. The second one proposes to 'make cities and human settlements inclusive, safe, resilient and sustainable'. Particularly, the specific target 11.8 calls for a substantial increase in the number of cities implementing adaptive urban policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change (UN, 2015).

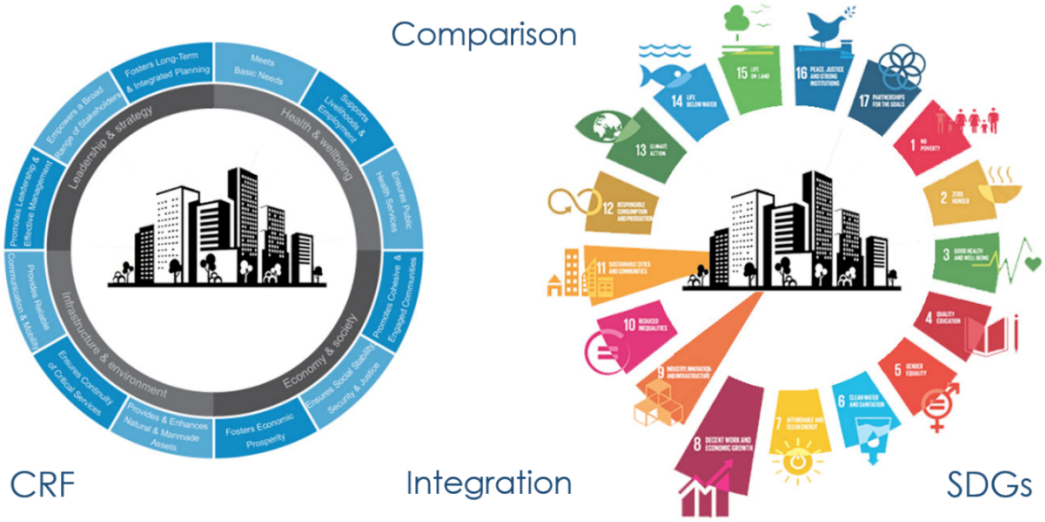

Figure 1. *Applied method graphics.*

Results and Discussions

Comparison of the two indicators frameworks gives an indication of two-way synergies and divergences. It is remarkable that the terms 'resilience' and 'sustainability' are explicitly mentioned in both of them: against separatist literary trends, once again we find two concepts joint among the relevant categories. Instead, the word does not appear in either, but the CRF 7 qualities are perfectly suited to a living organism. The SDGs provide strategies at three progressive levels: built environment; green and cultural environment; and their connection by transport systems. Although we have advanced architectural techniques, there is a lack of indicators to support developing countries in upgrading slums and constructing adequate, sustainable and resilient buildings. Despite this, the CRF shares many commonalities with the SDGs: they pay special attention to people's health and security (vulnerable situations, disaster death, economic loss, environmental impact); common identity (cultural and natural legacy); resources and land consumption; basic services (mobility, ICT); management and inter-sectoral/disciplinary approach to policy decisions responding to population and territorial dynamics. Indeed, long-term and integrated urban plans are the main instruments that cities use to regulate urban growth and development, guiding future investments as well as the interactions and trade-offs between the environment and economy. Both hold that the planning process requires ongoing monitoring of urban trends, coordination at all scales and stages of different projects across a city, a paradigm shift towards new environmentally conscious (climate change, risk reduction strategies) and inclusion through the direct participation of residents in urban programmes. Merging drivers from CRF and targets from SDGs, we can summarise them into a unique framework built on the three dimensions of sustainability: *Society*, *Economy* and *Environment* sharing a fundamental prerogative of resilience, *Strategy* (4th CRF dimension) that is how anthropogenic and natural systems prevent breakdown and timely take action to protect city together with citizen from real or future risks (Figures 2-3).

Finally, how we can translate such principles within Urban Morphology? We define the reciprocal relationship between urban form, resilience and sustainability through a set of complementary qualities ~~to~~ that orients

contemporary urbanisation at the territorial and building scale. According to theories by Muratori and Caniggia and the abovementioned 4 *Dimensions* of urbanity, city evolution has to comply with the *organic* growth model in terms of:

a) Morphological process: gradual and multiscale geographical expansion (urban, peri-urban, rural areas), land recycling and gentrification, multidimensional (society, economy, environment) development and urban metabolism, autonomy and connectivity (access to mobility), reciprocity between different functional parts and the whole, participatory processes (equity and inclusion);

b) *Typological process*: progressive evolution of building types (extensive or nature-based solutions), densification, flexible spatial configurations, integrated ICT, reuse/upgrading of existing built environment.

These specific properties guarantee that cities are reflective of past experience and resourceful in the face of future uncertainty. Resilience and sustainability are underpinned by a "shifting relationship between scales, and between autonomy on the one hand and connectivity on the other" (Allan and Bryant, 2011:43).

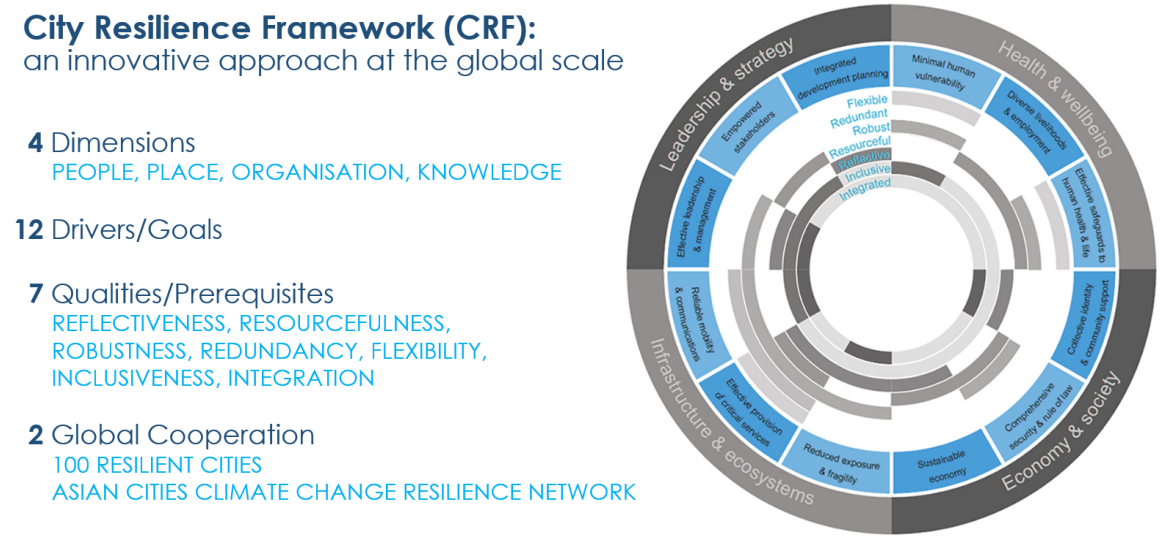

Figure 2. *Key principles of City Resilience Framework.*

Figure 3. *Key principles of SDGs.*

Conclusions

In an uncontrolled and ever-growing urbanisation trend all over the world, there is a need to promote efficient and responsible management of the expansion of our cities, with the aim of mitigating the social, economic and environmental impact that derives from this development. In order to answer the research questions, this study highlights the relevance of putting resilience and sustainability not just at the core of the global urban Agenda but at local urban planning in a complementary non-exclusive way. Like any other living organism, the city resists and survives by adapting its form to changing needs in full compliance with its own gradual evolution in structure, form and function. Thinking about the city as a living organism ensures permanence in place and continuity over time. Through their typically unitary, progressive and inter-scalar vision, Urban Morphology and Typology have an essential task in driving policy and practice towards a more organic approach to city growth. Specifically, their factual contribution in planning prosperity lay in conceiving the city as an organism, ensuring natural and cyclical urban evolution, meeting the requirements of resilience and sustainability at different scales and dimensions, safeguarding life in urban eco-systems. However, it is necessary to cross the line of the individual disciplines via a broader interdisciplinary and inter-sectoral cooperation among stakeholders and ongoing programmes.

In keeping with Whitehand's suggestion at the XV ISUF Conference, this paper is ~~just~~ an attempt to inform and renew Urban Morphology in the light of contemporaneous evaluation schemes (CRF and SDGs) by showing its potential in “taking a long view” towards new possible city futures (Ünlü, 2018:164).

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