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Urban resilience for local government: Concepts, definitions and qualities



CITY OF MELBOURNE

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1. Executive Summary

Urban resilience has emerged and rapidly developed as a concept to assist cities to prepare for, and respond to, shocks and stresses. This paper, and an accompanying [Briefing Paper](#), provide an overview of the concepts, definitions, and qualities of urban resilience to better understand how to address the challenges of the future with the ideas of today. We specifically consider how resilience applies to local government in Australia, but the findings may be relevant to other jurisdictions in Australia and internationally.

Governments, communities, businesses and non-government organisations involved in building resilience, are asked to consider fundamental questions including *resilience to what?*, *resilience of what?*, and *resilience for whom?* (Meerow and Newell 2019). Early conceptions of resilience as the capacity for a system to ‘bounce-back’ from shocks and stresses have matured to consider opportunities to ‘bounce-forward’. ‘Evolutionary resilience’, the concept adopted in this paper, goes further to consider potential for transformation of dynamic systems such as cities (Davoudi 2012, Ferguson, Wollersheim et al. 2021).

This paper defines urban resilience as:

The capacity of individuals, communities, institutions, businesses and systems within a city to adapt, survive, and thrive no matter what kind of chronic stresses and acute shocks we experience, and to positively transform as a result.

From an evolutionary perspective, resilience has four aspects or characteristics: recovery, persistence, adaptive capacity and transformative capacity (Gunderson and Holling 2002). Resilient urban systems have 10 core qualities: prepared, robust, spare capacity, diverse, reflective, integrated, inclusive, flexible, future-focused, and innovative. Sustainable development—meeting the needs of the current and future generations—provides a purpose for resilience, seeking thriving, equitable and ecologically robust urban outcomes (Redman 2014, Kuhlicke, Kabisch et al. 2020).

Resilience-building focuses on processes and approaches to designing, delivering and evaluating urban systems and programs, to ensure sustainable cities can persist, adapt and transform in the face of growing ecological, economic and social uncertainty. A framework for urban resilience consisting of the definition, characteristics and qualities provides the basis for implementing resilience across local government policy, projects and operations, and in partnership with communities and stakeholders.



Photo credit: City of Melbourne. A meadow of flowers, planted by City of Melbourne to provide co-benefits for biodiversity, stormwater runoff, pollinators and aesthetic beauty.

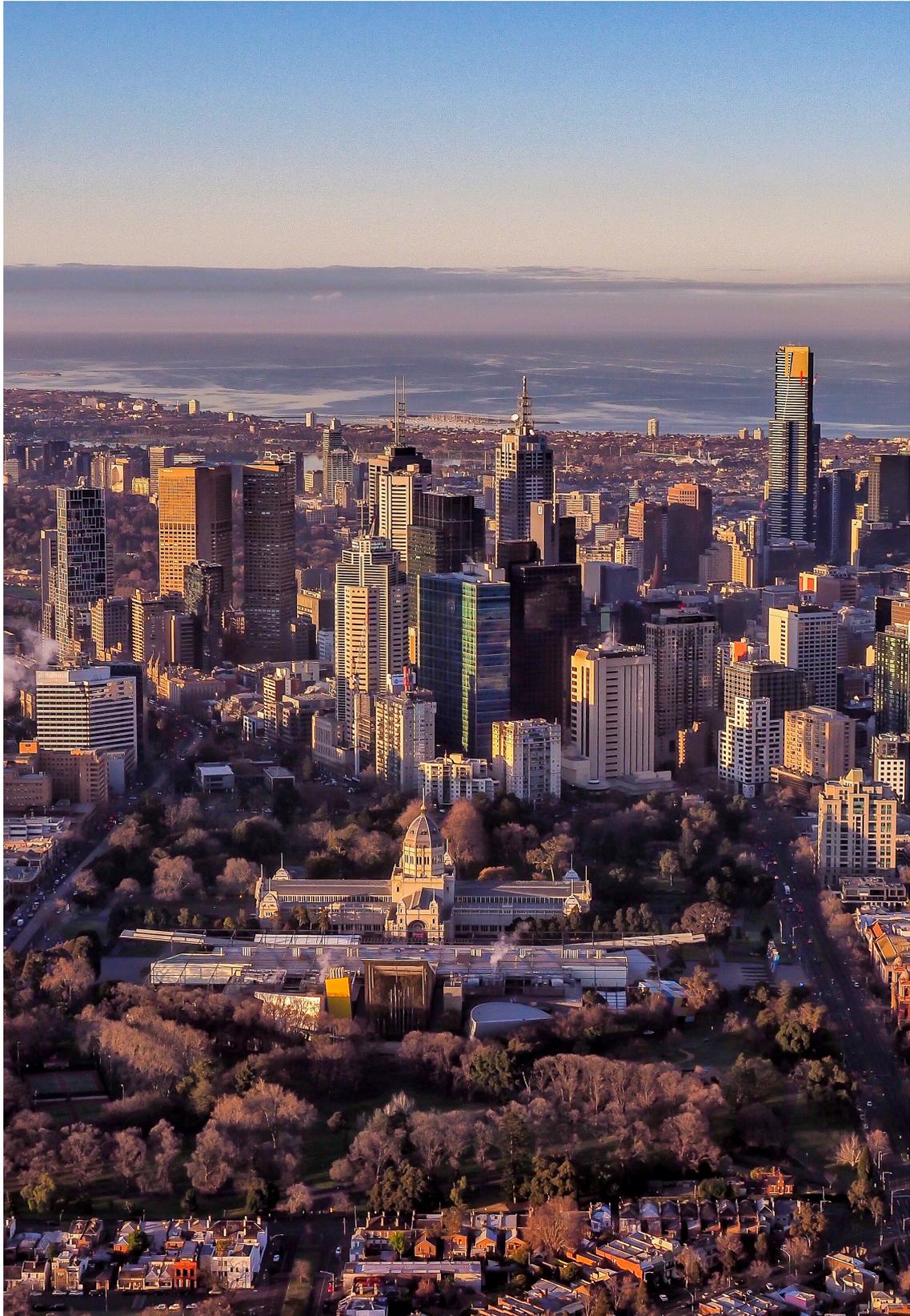


Photo credit: City of Melbourne. An aerial view of Melbourne.

2. Introduction

Given the rapid urbanisation of countries around the world, cities have become a focus for building resilience. Now home to the majority of the world's population (United Nations 2018), urban areas are the source of 70 per cent of global greenhouse gas emissions, consume two thirds of the world's energy, and are major contributors to waste-generation, and environmental and biodiversity degradation (Münzel, Sørensen et al. 2021, Watts, Amann et al. 2021). Australia is one of the world's most urbanised countries with almost 90 per cent of its population living in urban areas (Australian Bureau of Statistics 2019). This means that more people than ever before are dependent on interconnected city systems to survive and thrive. Cities face an increasing likelihood of disruption and change, including from global warming and the COVID-19 pandemic, and are a crucial part of local mitigation, response and adaptation efforts (Watts, Amann et al. 2021). Urban resilience—the focus of this paper—concentrates on responses to disruptive events or issues that impact cities and towns (Ferguson, Wollersheim et al. 2021).

The concept of resilience is used in many different fields—from ecology, to geography, psychology, engineering, economics, politics, international relations, community development, environmental management, sustainable development, public health, urban planning and urban studies (Davoudi 2012). Resilience refers to the capacity to respond to disturbances, such as extreme weather events, health crises, environmental degradation and growing social inequalities. Yet there is no agreed definition or approach (Meerow, Newell et al. 2016, Sanchez, van der Heijden et al. 2018), despite recent efforts to create a consistent understanding (eg the 100 Resilient Cities program (Rockefeller Foundation 2021)). The ways in which the concept is used depends on the discipline or viewpoint adopted. In the policy and academic literature, resilience is often linked to sustainability in some way. For example, climate resilience is widely discussed as important for sustainable development, in terms of future-proofing urban areas, assets and neighbourhoods (Ferguson, Wollersheim et al. 2021). However, the distinction between resilience and sustainable development is often unstated or unclear.

In this paper, we review the main concepts, definitions and qualities of resilience and its relationship to sustainable development. We specifically consider how resilience applies to local government in Australia—the closest level of government to community, with a leading role in local resilience planning. However, the findings may be relevant to other jurisdictions in Australia and internationally. This paper defines urban resilience as:

The capacity of individuals, communities, institutions, businesses and systems within a city to adapt, survive and thrive no matter what kind of chronic stresses and acute shocks we experience, and to positively transform as a result.

To begin, we summarise the rise of urban policy and research interest in resilience, as well as key considerations and criticisms of resilience-building. Next, we outline the main ways that urban resilience is conceptualised, and the rationale and process of developing an urban resilience definition for application in local government in Australia. The relationship between sustainable development and resilience, including their key differences and synergies, is clarified. We develop a list of recommended resilience qualities for use by local government, in alignment with the chosen definition. The example of building resilience in a transport system and broader resilience dimensions provides an insight into what resilience might look like when implemented on the ground. Finally, a comprehensive framework for urban resilience is presented, which brings together the definition, characteristics, and qualities of resilient cities. This work is also published in summary form, as a [Briefing Paper](#).

3. The rise of urban resilience

Resilience has become a prominent topic for urban policy, practice and research since the turn of the millennium (Davidson, Nguyen et al. 2019). It emerged at the intersection of urban sustainability, urban security, risk and disaster management, and infrastructure systems engineering. Urban resilience considers how cities can best avoid, prepare for, and respond to things that might go wrong. The relatively recent policy interest in resilience is partly a response to the rising rate of ecological disruption and heightened risk of disasters such as extreme weather events (Gleeson 2013). Resilience has been increasingly embedded in security policy and politics, including managing risks to urban areas and infrastructure (Gleeson 2013, Ferguson, Wollersheim et al. 2021). However, resilience has gained traction across a range of sectors that shape urban systems and at all levels, from global agencies through to local governments, and in the community and private sectors.

The Rockefeller Foundation's 100 Resilient Cities (100RC) program represents one considerable effort to improve the urban resilience of cities and regions. Starting in 2013, this global program provided member cities with 'resources necessary to develop a roadmap to resilience' (Rockefeller Foundation 2021, unpaginated). 100RC was based on the premise that three converging global megatrends—climate change, urbanisation, and globalisation—are impacting local communities, right across the world. In Australia, Melbourne and Sydney were both part of 100RC and now participate in its legacy, the Resilient Cities Network (2021). The program helped revitalise urban resilience efforts and promoted resilience thinking across different levels of government in Australia. For example, Melbourne produced, among other things, a number of key resilience policies and resources, including the *Resilient Melbourne* metropolitan-wide, intergovernmental strategy (Resilient Melbourne 2016), *Living Melbourne: our metropolitan urban forest* strategy (The Nature Conservancy and Resilient Melbourne 2019), and resilience training and workshops. This work has helped to share and build knowledge on resilience across metropolitan Melbourne and beyond.

As discussed below, to track the rise and purpose of urban resilience thinking, it is necessary to ask: resilience to what, of what and for whom?

3.1 Resilient to what?

Urban resilience focuses on the impact and responses to shocks and stresses in cities and towns. Shocks are acute or sudden events, including heatwaves, bushfires, floods, pandemics, and extremist acts (Resilient Melbourne 2016). Stresses are long-term and chronic 'challenges that weaken the fabric of a city on a day-to-day or cyclical basis. Examples include sea level rise, increasing pressures on healthcare services, unemployment, and deeper social inequality' (Resilient Melbourne 2016, p.11). Shocks and stresses can be linked (eg bushfire leading to increased mental health issues) and co-occurrences can exacerbate challenges or generate new ones. For example, the COVID-19 pandemic is a shock that has exposed and intensified existing issues such as homelessness, area-level disadvantage, and lack of access to green space.

Timeframes are important, because a focus on resilience to short term disruptions may emphasise survival and persistence, while a longer-term perspective may require some form of system transition (Meerow and Newell 2019). Also, urban systems can be made resilient to specific shocks and stresses (eg heatwaves, bushfires, flooding, pandemics, social inequalities) or have a more general capacity to adapt and respond to all known and unknown disruptions. A balance between the two is key. Systems need to effectively respond to specific threats and current conditions, without this limiting general capacity to adapt to future conditions (Meerow, Newell et al. 2016, Meerow and Newell 2019).



Photo credit: Bryony Jackson. Future Proof by Fair Share Fare and Jen Rae, Arts House Refuge 2017: Heatwave.

3.2 Resilient of what?

This is a key question when building resilience in specific urban contexts, and often without an easy answer. Cities are increasingly understood as complex adaptive systems, with a series of parts that are both independent (self-organising) and interdependent (interacting with other parts) at the same time (Walker and Salt 2006, Dovey 2016). There is great diversity in the structure, form, governance, function and experiences of cities. Resilience-building can focus on different urban systems and sub-systems (discussed further in Section 7) depending on the aims and scope of strategies or projects, the specific urban context, as well as the concept of resilience adopted. Nevertheless, the complexity and interdependence of urban systems must be considered and planned for (da Silva, Kernaghan et al. 2012).

It can be difficult to define which aspects of geographic regions, populations, infrastructures, social systems and/or resource flows are included in the 'urban' or the 'city' (Meerow, Newell et al. 2016, Meerow and Newell 2019). Urban resilience may be heavily influenced by a city's interdependence with its hinterland or peri-urban areas. Cities are more connected than ever to distant places through exchange of materials, food, water, energy and capital (Meerow, Newell et al. 2016), so planning according to formal city boundaries may not reflect the way that urban systems operate or are impacted by shocks and stresses. Likewise, sub-areas of cities (eg local governments or suburbs) cannot be separated from their wider context. For example, Melbourne and other Australian state capital cities, are made up of multiple local governments, so building resilience across the metropolitan region requires an understanding of the interconnections between local governments and the need for cross-government coordination (Fastenrath and Coenen 2021).

Moreover, both desirable system-states (such as productive farmland, healthy ecosystems) and undesirable system-states (polluted waterways, institutionalised racism) can be highly resilient (O'Connell 2015), so the overarching societal aims of resilience-building activities need to be clear. Sustainable development provides one key purpose for resilience, as discussed further in Section 4 below.



Photo credit: Bryony Jackson. Recovery Centre Community Breakfast by Dawn Weleski and Jen Rae. Arts House Refuge 2017: Heatwave

3.3 Resilience for whom?

To address issues of social equity and justice and ensure a human-centred approach within resilience frameworks it is necessary to ask: whose resilience are you building (Cretney 2014)?

If equity is not adequately considered within resilience frameworks, it is likely to reproduce unjust and inequitable outcomes within and between communities (Biermann, Hillmer-Pegram et al. 2016). Urban resilience efforts should carefully consider potential equity impacts, including unintended negative effects, and prioritise the needs of the most vulnerable. For example, resilience approaches that place the burden of responsibility for risk management on communities, in alignment with neoliberal policies to reduce government responsibility, have the potential to increase inequities (Meerow and Newell 2019). This is because the most disadvantaged groups may be at greater risk and have the least resources to respond to shocks and stresses. Local governments therefore need to work with communities to ensure responses are inclusive and reduce inequities. Another important consideration for intergenerational justice and sustainability is how resilience-building for the present might impact future generations.

Resilience is often criticised for creating barriers to preventing future crises from occurring, by downplaying the underlying social causes of disturbances (eg climate change-related extreme weather events, economic recession, housing affordability crisis). For example, a need for climate mitigation through reducing greenhouse gas emissions is under-acknowledged in the urban resilience literature (Borquez, Aldunce et al. 2017). Disasters and inequalities are sometimes framed as inevitable, with a focus on communities adapting to these conditions rather than resisting or addressing the cause (Reid 2012, Wamsler 2014). This can exacerbate social inequities. However, concepts of resilience that see the possibility for systems to transform, better incorporate the need for mitigation alongside adaptation to shocks and stresses (see discussion of evolutionary resilience in Section 5.3).

Box 1: Key messages

- Urban resilience concentrates on responses to disruptions or issues that impact cities and towns. These may be sudden shocks (eg fire, economic recession, pandemics), or long-term stresses (eg sea level rise, social inequality).
- Urban systems must effectively respond to current threats without this limiting general capacity to adapt to future conditions.
- The complexity and interdependence of urban systems should be considered and planned for.
- Local governments need to work with communities to ensure responses are inclusive and reduce inequalities.
- Resilience approaches that place the burden of responsibility for risk management on communities have the potential to increase inequities.
- Resilience-building should incorporate mitigation alongside adaptation to shocks and stresses.

4. Links between resilience and sustainable development

Sustainable development is another prominent concept in urban policy (World Commission on Environment and Development 1987, Meerow and Newell 2019). Like resilience, the definition of sustainable development is contested (Kuhlicke, Kabisch et al. 2020). The most common and widely accepted definition comes from the 1987 Brundtland Report: ‘development that meets the needs of the present without compromising the ability of future generations to meet their own needs’ (World Commission on Environment and Development 1987, p.43). Often conceptualised in terms of the ‘three pillars’ or the ‘triple bottom line’ of economy, society and environment (Dempsey, Bramley et al. 2011), sustainable development seeks to address the major challenges facing human society and the healthy function of ecological systems upon which society depends (Derissen, Quaas et al. 2011, Wheeler 2013).

SUSTAINABLE DEVELOPMENT GOALS



Image credit: United Nations

In some instances, sustainability and resilience are used interchangeably, in others they are distinct concepts (Derissen, Quaas et al. 2011, Meerow and Newell 2019). Resilience has been heralded as a new and improved paradigm (Meerow and Newell 2019), but is more commonly presented as an important component of the broader sustainable development framework (Marchese, Reynolds et al. 2018).

For example, it is explicitly included in the UN Sustainable Development Goals (United Nations General Assembly 2015):

Goal 9 - Build *resilient* infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Goal 11 - Make cities and human settlements inclusive, safe, *resilient* and sustainable.

The primary objective of sustainable development is to identify the specific conditions needed for a sustainable future and then act to achieve these conditions (Derissen, Quaas et al. 2011, Redman 2014). Resilience more clearly recognises that things will go wrong along the way, with the objective to increase capacity to handle and learn from disturbance ‘without predetermining the specific outcome of these actions’ (Redman 2014, p.34). In short, resilience prioritises process, while sustainable development focuses on outcomes (Redman 2014).

Of the two concepts, sustainable development also has a clearer future orientation, being focused on meeting the needs of current and future generations (Kuhlicke, Kabisch et al. 2020). This demands intergenerational and intragenerational justice on a global scale. Resilience, on the other hand, emphasises a more pressing need to deal with disruptions that can occur at any time (Kuhlicke, Kabisch et al. 2020). However, this should not preclude long-term planning to prevent shocks and stresses and adapt and transform urban systems.

Combining resilience and sustainability policy actions can work synergistically to meet both objectives, if well considered (Redman 2014). For example, to achieve co-benefits, sustainable development (ie providing for current and future generations) should involve making cities resilient to shocks and stresses that threaten its sustainability. Building resilience should involve sustainable use of social and natural resources, which in turn will help mitigate human-made shocks and stresses.

Box 2: Key messages

- Sustainable development provides a key purpose for resilience.
- Resilience is explicitly embedded within UN Sustainable Development Goals 9 and 11.
- Sustainable development focuses on outcomes, and resilience prioritises processes for handling and learning from disturbance, recognising that things will go wrong along the way.
- Resilience and sustainability policy actions can work synergistically to meet both objectives. For example, building resilience should involve sustainable use of social and natural resources, which in turn will help mitigate human-made shocks and stresses.

5. Urban resilience concepts

Urban resilience has been conceptualised in three main ways in the academic and policy literature: original concepts of ‘bouncing back’ resilience have progressed to ecological resilience, and more recently, evolutionary resilience (Ferguson, Wollersheim et al. 2021). The main tenets of these concepts are discussed below and summarised in Table 1.

5.1 Bouncing back resilience

Bouncing back resilience, originally termed ‘engineering resilience’, emphasises the importance of urban systems rebounding from a shock or stress (Holling 1996). Success is measured in terms of how quickly the return to a previous state can be achieved (Davoudi 2012, Sanchez, van der Heijden et al. 2018, Suárez, Gómez-Baggethun et al. 2020). The key characteristics of bouncing back resilience are persistence under stress and efficient recovery (Holling 1996, Gunderson 2000, Davoudi 2012). This is reflected in resilience definitions such as, ‘The ability of a system or organisation to withstand and recover from adversity’ (Cabinet Office 2011, p.10)

Bouncing back resilience focuses on making urban populations and physical infrastructure (eg buildings) more resilient, through reactively managing specific, identified risks such as an extreme weather event or terrorist attack (Davoudi 2012, Funfgeld and McEvoy 2012). This perspective does not address whether returning to a pre-disruption state is desirable or achievable, which may not be the case, especially in the face of chronic issues such as climate change and social inequality (Sanchez, van der Heijden et al. 2018, Ferguson, Wollersheim et al. 2021).

Bouncing back remains a common feature of resilience discourse in urban policy and disaster management (Davoudi 2012, White and O’Hare 2014, Meerow and Stults 2016). This threatens to hinder the transformative potential of urban resilience as bouncing back resilience does not capture the dynamic complexity of cities, including the potential for urban areas to beneficially evolve in response to disruption (Ferguson, Wollersheim et al. 2021).

5.2 Ecological resilience

Ecological resilience recognises the possibility of ‘bouncing forward’ to a new steady-state in response to disturbances (Leichenko 2011, Davoudi 2012, White and O’Hare 2014, Meerow and Newell 2019, Adil and Audirac 2020). The focus is not just on recovery, but also some degree of adaptation and change of urban systems, ‘accepting that it is not always possible or desirable to return to previous conditions’ (Meerow and Stults 2016, p. 5). Originating in ecology, when applied to urban areas, this perspective focuses on making urban-based ecosystems and human-environmental systems more resilient, in keeping with contemporary understandings of cities as complex systems (Leichenko 2011, da Silva, Kernaghan et al. 2012, Davoudi 2012, Adil and Audirac 2020). However, it does not recognise the dynamic, ever-changing quality of urban systems such as housing, transport and land uses, and the potential for them to be transformed (Sanchez, van der Heijden et al. 2018, Ferguson, Wollersheim et al. 2021). Rather, the frame for this is evolutionary resilience (discussed in Section 5.3 below) (Davidson, Nguyen et al. 2019).

Ecological resilience is articulated in a range of policy and urban research fields (Meerow, Newell et al. 2016, Borie, Pelling et al. 2019, Ribeiro and Pena Jardim Gonçalves 2019, Ferguson, Wollersheim et al. 2021). Examples include the UN Sendai Framework for Disaster Risk Reduction 2015-2030 with its

concept of ‘Build Back Better’ (United Nations 2015). The UN New Urban Agenda also commits to ‘... support shifting from reactive to more proactive risk-based, all-hazards and all-of-society approaches [to]...build resilience’ (United Nations 2016, p. 11).

5.3 Evolutionary resilience

Evolutionary resilience, referred to by some as socioecological resilience, most fully reflects the idea of cities as complex, dynamic, emergent systems, ‘constantly changing in an often-unforeseeable way’ (Sanchez, van der Heijden et al. 2018, p.5). This perspective is inherently future-oriented, seeing the possibility for urban system adaptation and transformation—in addition to persistence and recovery—in response to current or predicted disturbances (Gunderson and Holling 2002, White and O’Hare 2014, Ferguson, Wollersheim et al. 2021). Disruption is therefore viewed as ‘an opportunity to re-build the city into an optimised or improved system’ (Sanchez, van der Heijden et al. 2018, p.5). This can include re-building and transforming cities and towns in ways that prevent or mitigate shocks and stresses, where possible. Evolutionary resilience encompasses the multi-level, interconnected, social, institutional, cultural and physical urban systems, with a greater focus on societal aspects than the other concepts of urban resilience (White and O’Hare 2014, Ferguson, Wollersheim et al. 2021).

Evolutionary resilience is increasingly prominent in the academic literature (eg Meerow, Newell et al. 2016) and has been embraced by some institutions such as the Resilience Alliance (Sanchez, van der Heijden et al. 2018), and the Transition Towns movement (Shaw 2012). The Rockefeller Foundation’s 100RC program developed a definition of resilience that was at least partly evolutionary in nature (Sanchez, van der Heijden et al. 2018, Allen, Twigg et al. 2020). UN-Habitat (2021, unpaginated) understands resilience as ‘the ability of any urban system to maintain continuity through all shocks and stresses while positively adapting and transforming towards sustainability.’ Based on an extensive review of the resilience literature, Meerow et al. (2016) developed a comprehensive (and somewhat complicated) evolutionary-type resilience definition:

Urban resilience refers to the 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.



Photo credit: Adzventurers/City of Melbourne. Flinders Lane, Melbourne.

Table 1: Main concepts of urban resilience in the international literature (adapted from Ferguson, Wollersheim et al. 2021)

Definition	Primary objective	Key characteristics	Implied desired state	Resilience of what?	Resilience to what?
Bouncing back resilience	Bouncing back	Persistence Recovery (quick)	Single, stable state	Built environment, infrastructure, urban populations	Specific shocks
Ecological resilience	Bouncing forward	Persistence Recovery Adaptive capacity Transformative capacity	Multiple possible stable states	Urban-based ecosystems, human-environment systems	All shocks and stresses, known and unknown
Evolutionary resilience	Bouncing forward	Persistence Recovery Adaptive capacity Transformative capacity	Multiple possible system states that are dynamic (not static)	Many and interconnected urban systems, with greater emphasis on social aspects	All shocks and stresses, known and unknown

5.4 A resilience definition for local government

The discussion above has demonstrated the various ways that resilience has been conceptualised and defined in research and practice, with evolutionary resilience being the most dynamic and holistic understanding. We sought to identify a resilience definition suitable for local governments in Australia and their key role in resilience planning and responding to local community needs. After reviewing definitions in the research and practice literature, workshops were held with researchers and the City of Melbourne’s City Resilience and Sustainable Futures team, to determine a definition that reflects the resilience evidence-base; is applicable to the multi-sectoral work of local government; and could facilitate clear communication of the concept to diverse internal and external local government stakeholders.

This resulted in a definition adapted from the global Resilient Cities Network (2021) of cities that are committed to building and investing in urban resilience. The final definition was:

The capacity of individuals, communities, institutions, businesses and systems within a city to adapt, survive and thrive no matter what kind of chronic stresses and acute shocks we experience, and to positively transform as a result.

Supporting commentary was developed for this definition, foregrounding the link with sustainable development:

Resilience thinking enables us to learn from past experiences as well as prepare for known or unknown future risks, so that we can positively transform towards a more sustainable and just future.

The Resilient Cities Network definition was chosen as a foundation, given its clear communication of the concept and widespread use and acceptance by city governments internationally. It also reflected evolutionary resilience, which aligns with contemporary understanding of the complexity and dynamism of cities, and the multi-sectoral nature of local government planning. However, while the Resilient Cities Network definition incorporated key characteristics of evolutionary resilience (Gunderson and Holling 2002)—persistence/recovery (captured by the term ‘survive’) and adaptive capacity (‘adapt’)—transformative capacity was only implied by the word ‘grow’. ‘Thrive’ had replaced ‘grow’ in the metropolitan-wide Resilient Melbourne (2016) strategy, and we preferred this term for the local government context as it emphasised transformation towards community and environmental wellbeing, over economic growth agendas. ‘To positively transform as a result’ was also added to the definition to explicitly state and underscore the transformative potential of urban resilience and its relationship to sustainable development, aligning with the UN 2030 Agenda, Transforming our world (United Nations General Assembly 2015).

Box 3: Key messages

- Resilience has been conceptualised and defined in various ways.
- 'Evolutionary resilience' is the most holistic concept, incorporating the potential for transformation of urban systems.
- Based on the literature and researcher-practitioner workshops, we developed a resilience definition suitable for local governments in Australia.
- Our definition, adapted from the Resilient Cities Network, reflects contemporary understanding of the complexity and dynamism of cities, and the multi-sectoral nature of local government planning.

6. Qualities of resilience

The key characteristics of evolutionary urban resilience—persistence, recovery, adaptive capacity and transformative capacity—are enabled by system attributes or qualities (Gunderson and Holling 2002, Meerow and Stults 2016) (see Figure 1). Urban sub-systems (eg energy, housing, parks), and complex city systems as a whole can exhibit these qualities.

In the resilience literature, a range of resilience qualities are proposed. The various attempts by organisations and researchers to summarise and distil these qualities have resulted in different but overlapping lists of qualities and their definitions. For example, Wilkinson’s (2012, p.162) urban planning-focused ‘strategies for resilience’ framework incorporated 13 system qualities, ranging from buffering and redundancy to strategic foresight, ecological diversity, and multiscale networks and connectivity. A 2016 review of the academic literature identified 16 qualities of urban systems that foster resilience (Meerow and Stults 2016), with a survey of US local government officials indicating that all of these qualities were important (Meerow and Stults 2016). A subsequent literature review by Ribeiro et al. (2019) selected 11 qualities that make urban systems more resilient: redundancy, diversity, efficiency, robustness, connectivity, adaptation, resources, independence, innovation, inclusion and integration.

Based on extensive research, the Rockefeller Foundation’s 100RC program developed a list of seven qualities demonstrated by resilient urban systems (see Table 2 below) (Rockefeller Foundation and Arup 2015). While concise, these qualities are reasonably comprehensive, and map to the key characteristics (see Table 3 below) and our definition of urban resilience. However, based on the wider literature, we determined that there were some gaps in these qualities, which we address in the next section.

6.1 Resilience qualities for local government

Using the 100RC qualities as a starting point, workshops were held with researchers and the City of Melbourne’s City Resilience and Sustainable Futures team, to define a list of qualities aligned with the literature and chosen definition of resilience outlined above; and which could facilitate resilience work and communication to local government stakeholders. For this latter objective, we aimed for the

Figure 1: System qualities enable the key characteristics of evolutionary urban resilience



qualities' definitions to focus on urban systems and structures and avoid deflecting responsibility to individuals. We also wanted them to be comprehensive but also mutually exclusive to avoid confusion caused by overlap between qualities. Before finalisation, the relevance and application of the draft qualities to real-world policy challenges was workshopped and tested by the City of Melbourne team.

The result was an expanded list of 10 resilience qualities (see Table 2). To improve comprehensiveness, four qualities were added: prepared, diverse, innovative and future-focused. The latter two round out the qualities, to enable 'transformative capacity' more strongly. 'Redundant' was replaced by 'spare capacity', while still retaining the essential idea of having surplus capacity in urban systems. 'Resourceful' was not included as a separate quality, as it was deemed to overlap with other qualities. However, this term was explicitly mentioned in the definition of the new 'innovative' quality, emphasising resourcefulness of institutions and systems rather than individual responsibility during times of crisis. Table 3 below summarises our finalised definitions of the 10 qualities, how they map to the key characteristics of evolutionary resilience and provides examples of their relevance to building the resilience of a local transport system.

Table 2: Adaptation of the 100RC program's resilience qualities

100RC resilience qualities	Adapted resilience qualities for local government
Reflective	Reflective
Robust	Robust
Redundant	Spare capacity
Flexible	Flexible
Inclusive	Inclusive
Integrated	Integrated
Resourceful	-
-	Prepared
-	Innovative
-	Diverse
-	Future-focused

Table 3: Definitions and examples of resilience qualities

Qualities of resilient systems	Definition of resilience qualities (adapted from Rockefeller Foundation and Arup 2015)		Resilience characteristics enabled	Example: resilient transport system
Prepared	Ready to respond in the face of uncertainty	Communities, services and institutions are aware of, and ready to act appropriately in the face of, expected or unexpected shocks and stresses	Persistence	Transport system authority has planned and prepared for extreme weather interruption, and key actors know what they need to do in such an event
Robust	Fail safe, and safe to fail	Systems, structures and critical services are able to withstand external shocks. Any failure is safe, predictable and proportionate	Persistence	Transport infrastructure can withstand extreme weather events
Spare capacity	Sufficient reserves to continue to function when disrupted	There are sufficient reserves or spare capacity within urban systems in addition to built-in system redundancy so that core systems can continue to function even when disrupted	Persistence Recovery Adaptive capacity	The train system can add services to accommodate additional passengers during an emergency
Diverse	Variety of components, so no single system is relied upon	A city is comprised of a variety of social, geographic, ecological, economic, governance and other elements, so there can be diversity in threat response, and no single sub-system is relied upon	Recovery Adaptive capacity	Diverse transport options are available, so there are alternatives when one transport mode is disrupted
Reflective	Lessons learned can inform current and future actions	Feedback loops and monitoring are built into system components and governance structures so that real-time information and lessons learned can inform current and future actions and approaches	Adaptive capacity	New bus routes are established based on what people currently need

Table 3 (cont.): Definitions and examples of resilience qualities

Qualities of resilient systems	Definition of resilience qualities (adapted from Rockefeller Foundation and Arup 2015)		Resilience characteristics enabled	Example: resilient transport system
Integrated	Alignment across sectors and systems, to ensure effective management	Alignment within and across sectors, systems and levels of government to ensure urban systems can be effectively managed and creatively harnessed	Adaptive capacity	Active transport is connected to public transport and activity centres
Inclusive	Everyone has a stake and a say in the city	Urban systems, including social and governance systems are inclusive for all, transparent and participatory in nature	Adaptive capacity Transformative capacity	Transport options are available, affordable and accessible to everyone
Flexible	Quick adjustment, responsiveness, and the ability to evolve over time	Plans, actions and system components are flexible enough to allow for quick adjustment during a shock or a stress, as well as having the ability to evolve over time	Adaptive capacity Transformative capacity	Lanes and spaces for bikes are rapidly increased, to support physical distancing during a pandemic; creating car-free zones
Future-focused	Foresight about future conditions informs planning and decision-making	Evidence-based knowledge and foresight about future conditions informs planning and decision-making, to avoid unnecessary threats and inform intentional adaptations and transitions	Adaptive capacity Transformative capacity	Active and low-emissions transport are prioritised to achieve co-benefits for climate change mitigation, adaptation, and human health
Innovative	Experimentation to test alternate ideas and solutions	There is space for experimentation and innovation to test alternate ideas and resourceful solutions to shocks and stresses	Transformative capacity	New transport technology (eg e-bikes) is supported and tactical urbanism trialled to reduce car parking

7. Resilience of urban sub-systems

The 10 qualities of resilience can be embedded in the planning, policies, operations, projects and structures of urban sub-systems (eg transport, food, healthcare, emergency services) as well as across neighbourhoods and cities as a whole. To help identify and consider what elements of a city need to be the focus of resilience-building, the City Resilience Framework developed for the 100RC program described four dimensions or broad sub-systems that contribute to resilience: Health & Wellbeing (incorporating essential and public health services and livelihood support); Economy & Society; Infrastructure & Environment; and Leadership & Strategy (Rockefeller Foundation and Arup 2015).

There is no single predetermined vision of a resilient city, particularly given the diversity of urban contexts and experiences internationally. However, the urban systems' qualities paint a picture of how the elements that comprise a city can contribute to its resilience (see Box 4) (Redman 2014). There are some similarities between this notion of a resilient city in Box 4 and the concept of liveability, highlighting potential opportunities for co-benefits (Lowe, Whitzman et al. 2015).

Box 4: What could a resilient city look like?

A resilient city is socially inclusive and cohesive, with affordable, energy-efficient housing, diverse economic activity, and safe, walkable neighbourhoods where people can access open space, public transport, employment, education, and services; and where infrastructure meets basic needs, ecosystems are sound, natural resources are used sustainably, land use policy is coherent and future-focused, government leadership and management is transparent and strategic, and innovation is encouraged (Rockefeller Foundation and Arup 2015, OECD 2021). A resilient city is prepared for and prevents expected and unexpected shocks and stresses.



Photo credits: City of Melbourne.

8. An urban resilience framework

By combining the definition, characteristics, and qualities of resilience discussed in this paper, a comprehensive framework for urban resilience was developed (see Figure 2). This framework clarifies the concept of resilience, to facilitate communication to multiple stakeholders and application of the concept within the multi-sectoral work of local government.

For example, to work towards the transformative vision set out in the urban resilience definition, a local government practitioner could use the framework to consider how to develop and embed the resilience qualities in the sector(s) in which they work, including ensuring that strategic, project and operational processes reflect the resilience qualities (eg they are inclusive). Practitioners and the public need to recognise that being prepared for and dealing with change will require difficult trade-offs and decisions about resource allocation, dealing with uncertainty, and incremental through to profound alterations to how things are done now.

Initial consideration may need to be given to what needs to be made more resilient: which urban sub-systems, in which areas, and involving which communities, organisations and businesses. In keeping with the integration quality, links and interdependencies between sub-systems and areas should be considered, rather than considering sectors in isolation. Local government practitioners should also consider which shocks and stresses they need to prepare for, and respond to; being conscious of interrelationships between various shocks/stresses, and the need to build resilience to current risks but also unknown future risks. As outlined in this paper, it is also important to consider implications of resilience-building activities for sustainable development, equity, and mitigation of risks (eg climate-change).

Local governments have a key role in building resilient cities and towns, but they cannot undertake this huge task alone. Individual local governments have limited resources and remit, and comprehensive resilience-building requires integrated governance with shared commitment and responsibility across and between all levels of government, and the community and private sectors (Lowe, Whitzman et al. 2018). The urban resilience framework could assist integrated urban resilience planning at various scales, from neighbourhoods and local governments, through to metropolitan, state and national scales.

Figure 2: Urban resilience framework for local government

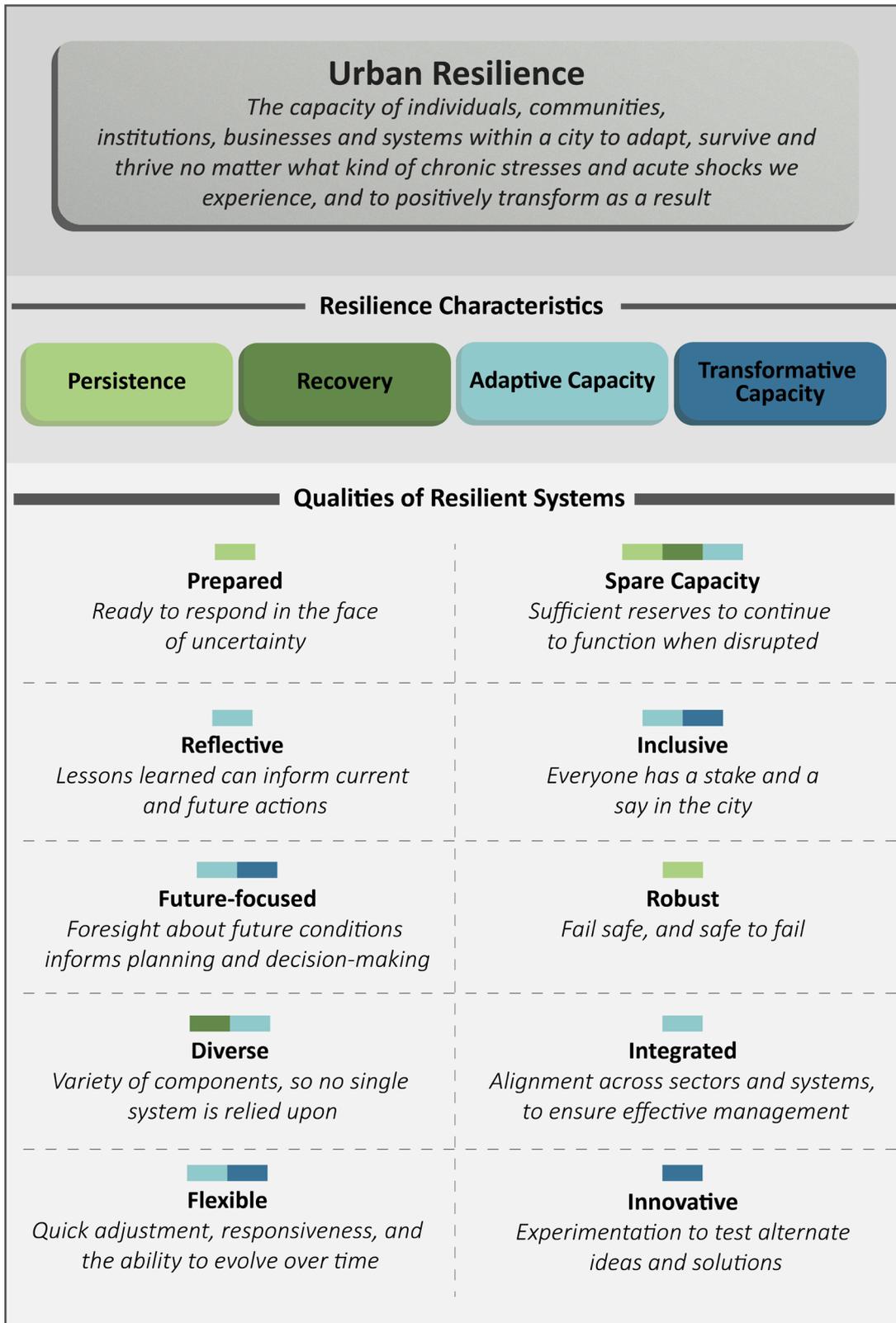




Photo credit: City of Melbourne. A meadow of flowers, planted by City of Melbourne to provide co-benefits for biodiversity, stormwater runoff, pollinators and aesthetic beauty.

9. Conclusion

Urban resilience as a concern for local government has emerged recently and developed rapidly (Gleeson 2013, Davidson, Nguyen et al. 2019). For cities to thrive through the good times and be stronger during and after tough times, there must be careful consideration of resilience to what, of what, and for whom (Meerow and Newell 2019). Early conceptions of resilience as the capacity for systems to ‘bounce-back’ from shocks and stresses, have matured to consider opportunities to ‘bounce-forward’ and transform (Davoudi 2012). This paper has provided a synthesis of current resilience thinking as it is relevant to local government in Australia. An understanding of resilience as a dynamic, evolutionary process provides the foundation for a definition that emphasises adaptation and transformation of urban systems, as well as recovery and persistence in response to shocks and stresses. Resilient urban systems demonstrate 10 core qualities: prepared, robust, spare capacity, diverse, reflective, integrated, inclusive, flexible, future-focused, and innovative.

Resilience is aligned with, but distinct from, sustainable development, which is a more established agenda for urban governance and practice. As the UN Sustainable Development Goals demonstrate, sustainability focusses on system outcomes (United Nations General Assembly 2015). Sustainable development provides a purpose for resilience, seeking thriving, equitable and ecologically viable urban futures. Resilience focuses on system characteristics and processes, to ensure sustainable cities can persist, adapt and transform in the face of growing ecological, economic and social uncertainty.

A framework for urban resilience consisting of the definition, characteristics and qualities provides the basis for implementing resilience across local government policy and operations. A shared understanding of the core concepts and purpose of resilience across local government, communities and stakeholders, grounded in international experience and research, is the foundation for ongoing conversations and actions to prepare cities for future threats and opportunities to thrive.

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