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MCR 2030 Making Cities Resilient

From Smart to Resilient:
Future-Proofing Our Cities

Making Smart Cities Disaster Resilient





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Executive Summary

Cities are increasingly adopting Smart City approaches to improve the efficiency, sustainability and quality of urban life. At the same time, Smart Cities are facing increasingly complex and interconnected risks from natural hazards, climate change, technological failures, rapid urbanisation and other disruptions. These developments highlight the need to consider how Smart City approaches can contribute to, rather than undermine, urban disaster resilience, embracing its own unique characteristics.

This briefing paper draws on research undertaken through the PhD study *Making Smart Cities Disaster Resilient* with extensive input from the MCR2030 stakeholders. The research examined how disaster resilience can be integrated into Smart City development across theory, policy and practice. The findings indicate that technology and digital infrastructure alone are not sufficient to create resilient Smart Cities. Effective Smart City resilience requires a broader, people-centred and context-sensitive approach that considers governance, people, infrastructure, the environment, the economy and quality of urban life.

The research identified several challenges to achieving this integration, including techno-centric approaches, fragmented governance, limited policy coherence, gaps in skills and capacity, digital inequalities, privacy concerns, cultural resistance and the potential for cascading impacts when interconnected systems fail.

The research therefore highlights the importance of moving from the idea of a "smart" city as primarily a technologically advanced city towards one that is also capable of anticipating, responding to, adapting to and recovering from disasters and other disruptions.

For cities and practitioners, this means embedding disaster resilience within Smart City planning and investment from the outset, strengthening coordination across sectors and institutions, ensuring that technological solutions respond to local needs, and establishing mechanisms for continuous assessment and improvement.

1. What is a Smart City?

Smart Cities emerged as an innovative response to the complex urban challenges associated with rapid urbanisation. However, they are no longer merely a concept; Smart City development has become a real-world urban agenda attracting significant global attention, investment and implementation. Despite this, there remains no universally accepted definition of what constitutes a Smart City, with different disciplines and institutions emphasising different dimensions of "smartness".

While many definitions emphasise ICT and technological solutions, technology should be understood as an enabler rather than the defining characteristic of a Smart City. While some early scholarly definitions are monocentric towards ICT and digital technologies, a Smart City is more appropriately understood as *a city that uses technology as an enabler to improve how it operates, delivers services, engages society and uses information, while pursuing economic, social and environmental sustainability.*

This broader understanding is particularly important for disaster resilience, as a city's ability to anticipate, respond to and recover from disasters depends not only on technology, but also on its people, governance, institutions, infrastructure, economy and environment. Therefore, understanding Smart Cities in the context of disaster resilience requires a multidimensional perspective that recognises the interactions between these elements.



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2. Why Does Smart City Disaster Resilience Matter?

Smart City approaches are increasingly being used to address complex urban challenges. Smart City technologies can support cities in monitoring conditions, improving services and making better-informed decisions, which have significant potential for disaster resilience. More importantly, real-time information can support early warning, digital communication can improve emergency coordination, and data-driven analysis can help cities understand risks and vulnerabilities.

However, increasing reliance on interconnected digital and physical systems can also create new vulnerabilities. Failure of one system may affect other infrastructure and essential services, creating cascading impacts.

Given the absence of a universally agreed definition of a Smart City, cities may identify themselves as "Smart Cities" despite significant differences in their levels of technological development, governance arrangements and approaches to urban innovation. This conceptual ambiguity leaves considerable room for further development and raises an important question about the extent to which cities understand and address their vulnerabilities while pursuing Smart City development. Smart City development and disaster resilience should therefore not be treated as separate agendas.

Therefore, understanding what it means to be both "smart" and "resilient" should be considered alongside, rather than after, Smart City development. However, this understanding is itself only the tip of the iceberg, as the relationship between Smart City development and disaster resilience is neither linear nor straightforward. It involves complex interactions between technology, people, governance and policy, infrastructure, and disaster risk. A technology that strengthens resilience in one context may create new vulnerabilities in another, while the effectiveness of any Smart City solution ultimately depends on the people, institutions, policies and systems that support and govern it.

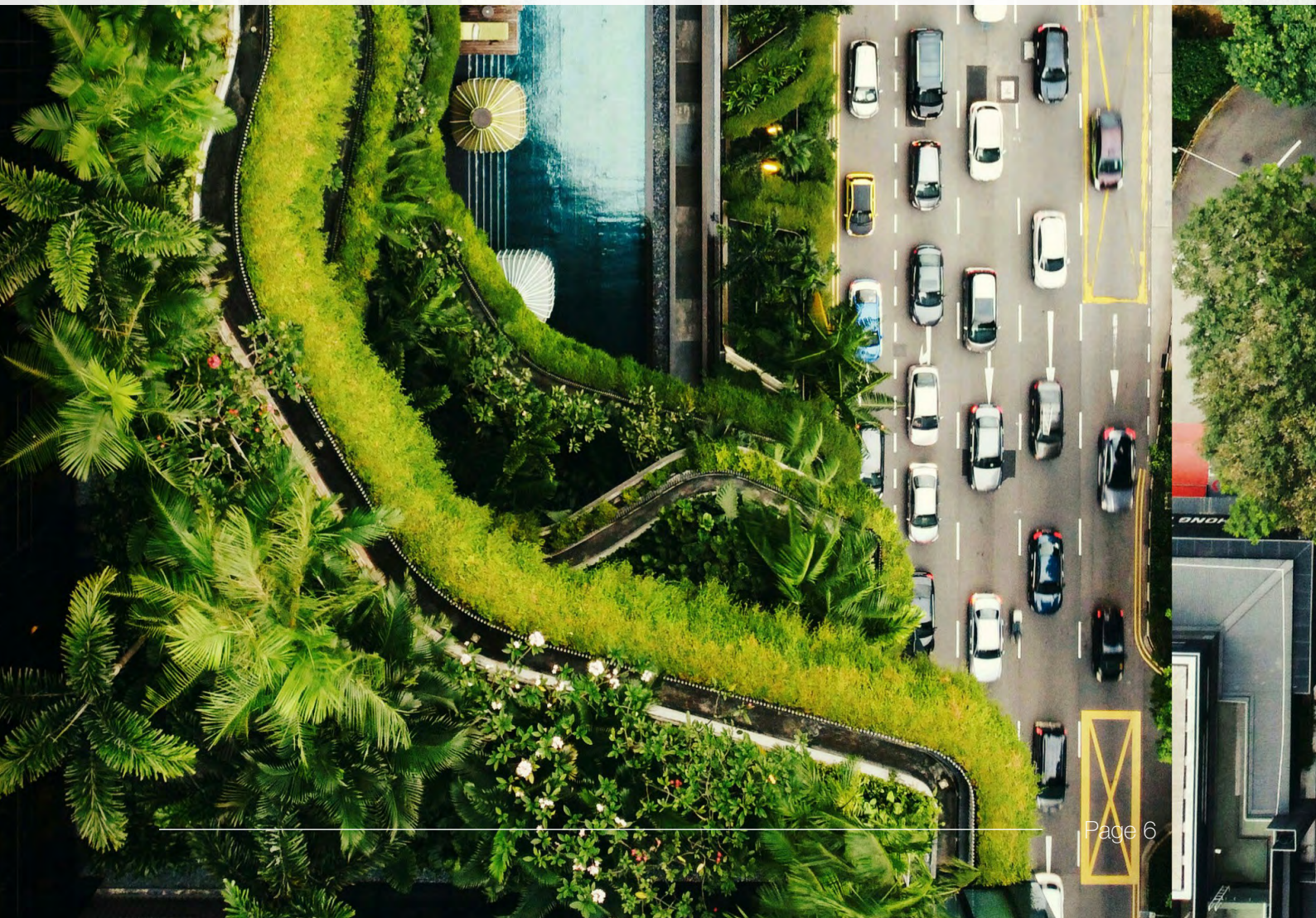
The challenge, therefore, is not simply to make cities smarter, but to understand what being smart means for resilience, what vulnerabilities may emerge through Smart City development, and how these can be anticipated and addressed. This requires a more integrated understanding of the relationship between Smart City development and disaster resilience, rather than treating them as separate agendas.

3. What Did the Research Examine?

The research, 'Making Smart Cities Disaster Resilient', investigated how to effectively and coherently integrate disaster resilience within Smart Cities, capitalising on the potential of key Smart City characteristics. The following questions were dealt with:

- How can the clarity of the conceptual framing of disaster resilience in Smart Cities be improved in a form that directly supports implementation
- How do technology solutions need to be strategised to make Smart Cities disaster-resilient?
- What is the current status of disaster resilience operationalisation within Smart Cities, and what are the key challenges and how they can be addressed?
- How to effectively integrate Smart Cities policy and disaster resilience policy?

The research ultimately developed an assessment mechanism to help cities assess the extent to which disaster resilience is integrated within Smart City development.



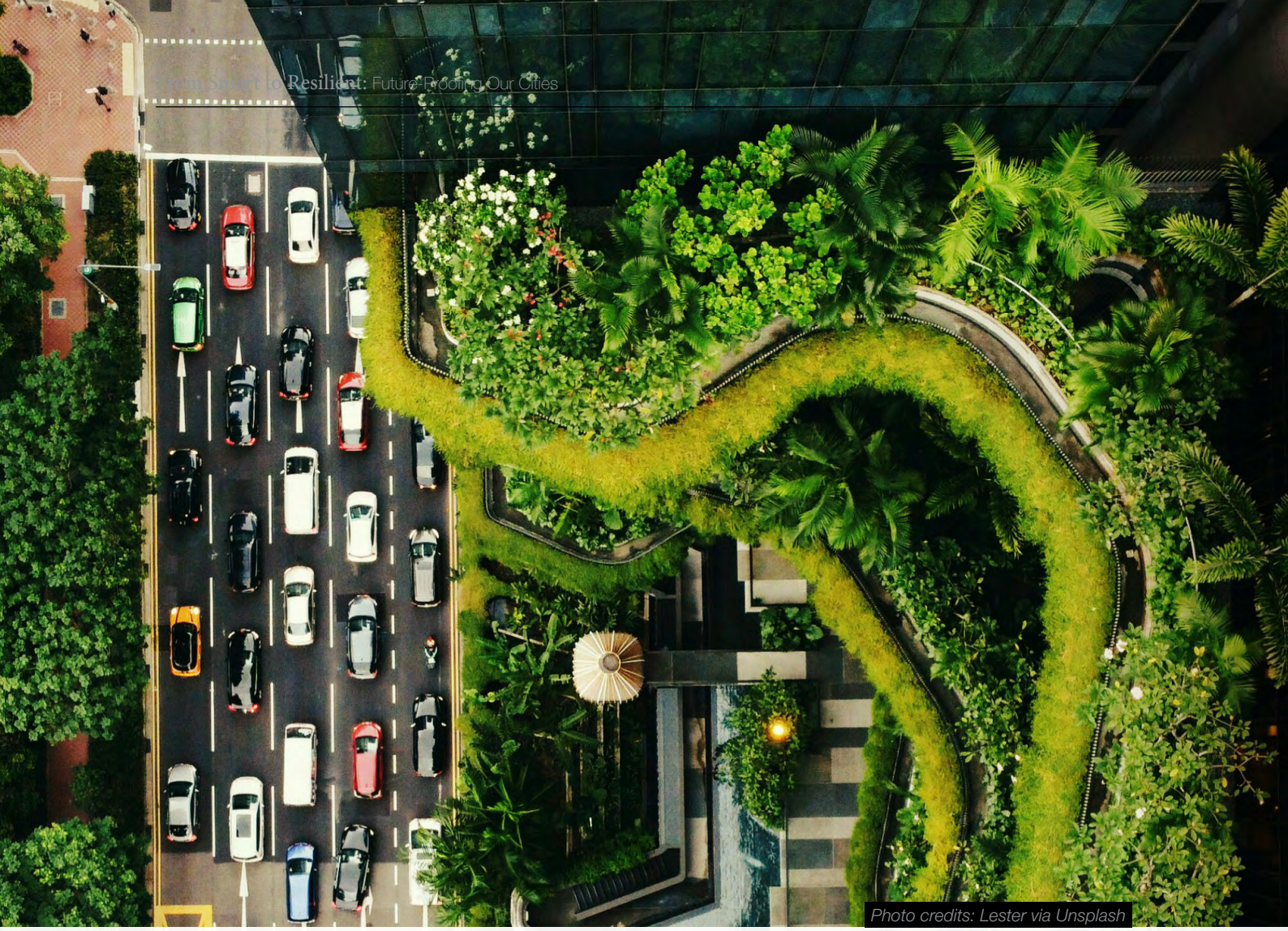


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4. Approach

The research began with a scoping study to explore the existing understanding of the Smart Cities and disaster resilience nexus, based on a systematic review, to identify gaps and areas requiring further investigation. The study then brought together existing knowledge, expert perspectives and empirical evidence to explore how Smart City development and disaster resilience can be better understood and integrated.

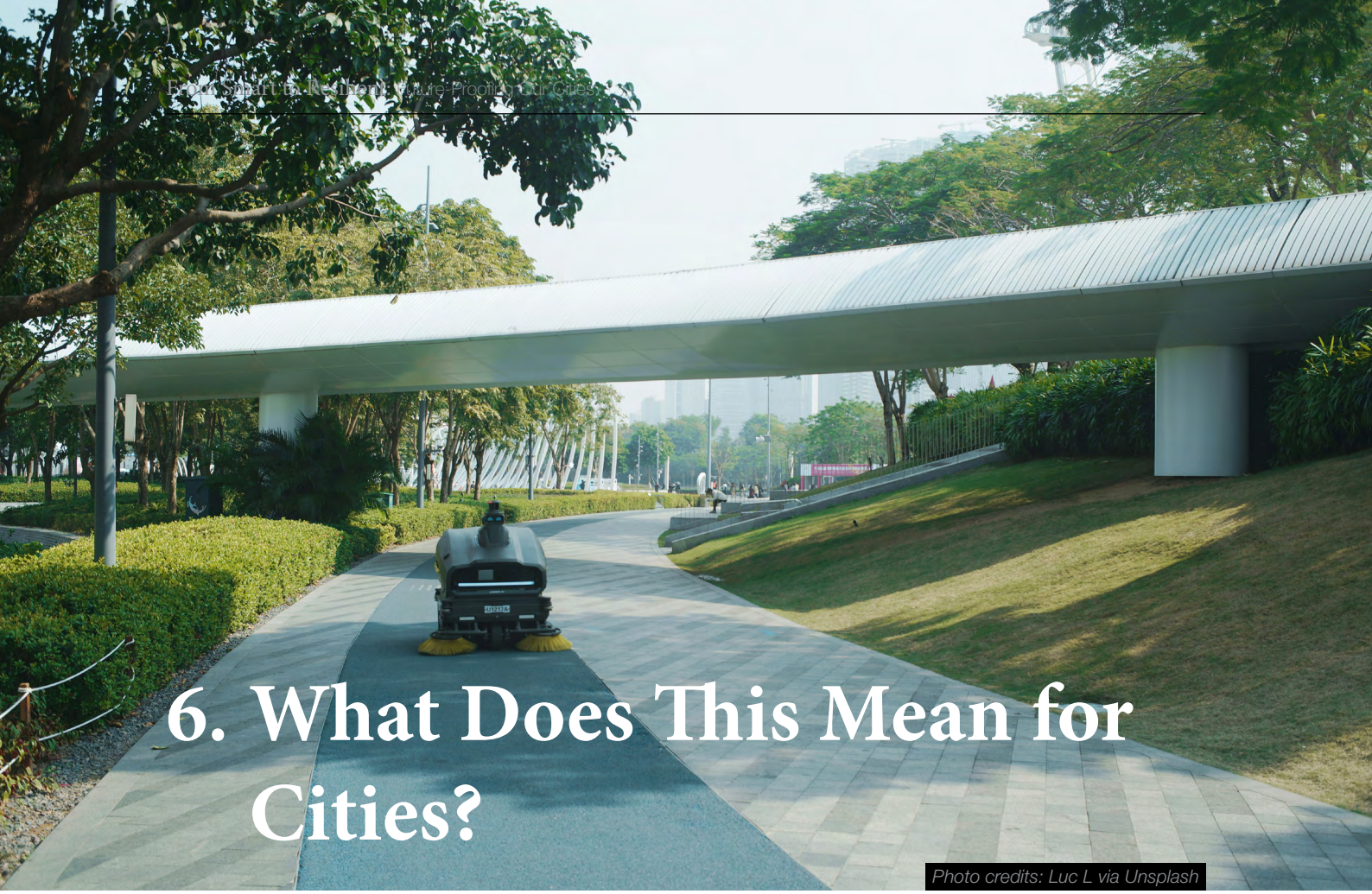
Given the complexity and evolving nature of the topic, the research adopted a problem-centred approach, allowing insights from the literature and empirical findings to inform and refine the understanding of the problem throughout the research process. The data collection involved 28 interviews with experts from the Smart City and disaster resilience fields, and a questionnaire survey, which received 57 valid responses from experts.

To strengthen the developed frameworks and practical outputs and to ensure their credibility and ensure their relevance to practice, these outputs were further explored and validated through a focus group involving experts from the MCR initiative. This iterative approach enabled the research to connect theoretical understanding with practical perspectives and develop an integrated approach to Smart City development and disaster resilie.

5. Key Findings

• Smart City development needs to be context-specific, and so are resilience measures in the Smart City	There is no single Smart City solution that will work for every city. The effectiveness of a Smart City intervention depends on local characteristics, including the city's hazards, infrastructure, governance arrangements, resources, population, economy and technological capacity. Similarly, disaster resilience cannot be approached through a one-size-fits-all model. Resilience measures need to recognise the specific vulnerabilities, capacities and resources of each Smart City and consider how these interact with its particular technological, social and institutional context.
• Impact from interconnected and cascading risks	Smart Cities rely on increasingly interconnected digital, physical and organisational systems, making them potentially more vulnerable to cascading risks and system-wide disruptions. Resilience planning should therefore consider these interdependencies, rather than assessing risks in isolation, and incorporate appropriate fallback and alternative arrangements to prevent interconnectivity from amplifying vulnerabilities.
• Technology alone does not create resilience	One key finding is the risk of adopting a techno-centric approach. Technology can provide valuable tools for resilience, but it cannot compensate for weak infrastructure, governance, insufficient skills, poor coordination or social exclusion. A resilient Smart City therefore requires a balanced approach.
• Governance is fundamental	The research identified Smart Governance as particularly important in supporting Smart City disaster resilience. Effective governance is essential to breaking down departmental silos and enabling coordinated approaches to Smart City development and disaster resilience. Greater coordination can encourage cohesive planning and policy coherence.

• Inclusivity needs to remain at the centre	Smart City initiatives can unintentionally create new inequalities if access to technology and digital services is uneven. Digital exclusion, differences in technological literacy, accessibility and public trust should all be considered when developing technology-enabled services, as failing to do so may not only exclude certain groups but also exacerbate existing vulnerabilities and create new ones. Therefore, Smart City solutions designed to strengthen disaster resilience should consider not only what the technology can achieve, but also who it serves and who may be left behind. This requires asking: Who can access it? Who may be excluded? And what happens to those who cannot use it?
• Resilience requires continuous investment and capacity	Smart City development is not a one-off investment. The introduction of new technologies creates an ongoing need for new skills, maintenance, system upgrades and further investment, while technological advancement can itself increase costs over time. Without sustained funding and capacity, Smart City initiatives risk remaining ambitious projects with high initial capital costs but limited long-term value. Resilience should therefore be viewed as an ongoing process requiring continuous investment, skills development and adaptation.
• Multi-stakeholder engagement	A single organisation or department cannot achieve Smart City disaster resilience. It requires collaboration across entities including Local government, Public agencies (including the Smart City administration team and city resilience planning team), Academia and research, National government, NGO, Community groups, Private sector (including technology firms, utility providers, constructors, insurance companies, etc.), Investors/funders and First responders, that work in collaboration can enhance the coherent application of the Smart City policy and disaster resilience policy. Different stakeholders bring different knowledge, resources and perspectives, helping cities better understand vulnerabilities and develop solutions that are practical, inclusive and context-specific. A dedicated coordinating unit or champion formed with the engagement of all such entities can help bring these stakeholders together, break down departmental silos and ensure policy coherence between Smart City development and disaster resilience. This can support shared priorities, better coordination and more integrated decision-making.



6. What Does This Mean for Cities?

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The findings suggest that cities should move from asking:

"How can technology make our city smarter?"

towards asking:

"How can Smart City approaches help our city become more resilient?"

This shift changes the way Smart City projects are planned and evaluated to be disaster-resilient.

This change should happen at three levels as follows:

1. Conceptualising what a Smart and resilient city means in its own context

Cities should first define what they want their Smart City to achieve and what resilience means within that specific context. This requires understanding local hazards, vulnerabilities, capacities and resources, and recognising how Smart City development may create both opportunities and reduce new vulnerabilities.

2. Aligning Smart City and disaster resilience policies

Smart City and disaster resilience should be considered as two interconnected policy agendas. Cities need to examine how these policies can be implemented coherently, avoiding fragmented approaches and ensuring that Smart City investments contribute to wider resilience objectives.

3. Designing and implementing resilient Smart City initiatives

At the initiative level, cities need to consider what characteristics Smart City solutions should have to effectively support disaster resilience. This includes ensuring that technology is appropriate, inclusive, adaptable and supported by the necessary people, institutions, resources and governance arrangements.

To support this, city professionals should focus on:

1. Adopting a balanced resilience approach that combines the strengths of technology with human-centred principles.
2. Prioritising community engagement, cultural sensitivity, transparency and citizen-centred service delivery.
3. Fostering capacity-building initiatives and data literacy programmes to ensure that people have the skills needed to engage with and make effective use of Smart City technologies.
4. Addressing digital and data gaps and ensuring accessibility of information to the public.
5. Depoliticising decision-making processes to support evidence-based and resilience-focused Smart City decisions.
6. Investing in institutional capacity to ensure that organisations have the resources, skills and structures required to implement and sustain resilient Smart City initiatives.
7. Developing adaptive governance frameworks that foster flexibility, responsiveness and innovation as technologies, risks and urban needs evolve.
8. Overcoming short-term bias in funding decisions and creating enabling environments that incentivise long-term investment in resilience.
9. Establishing conflict-resolution mechanisms and procedures to address disagreements arising from competing priorities, interests or technology choices.
10. Developing comprehensive technology assessment frameworks that consider not only immediate benefits, but also longer-term resilience implications, vulnerabilities, dependencies and potential unintended consequences.

The research identified a noticeable gap between the perceived importance of these priorities and their actual application in practice within Smart Cities. This highlights the need for greater attention within the MCR2030 community, particularly in supporting cities to translate resilience principles into practical Smart City policies, planning and implementation.

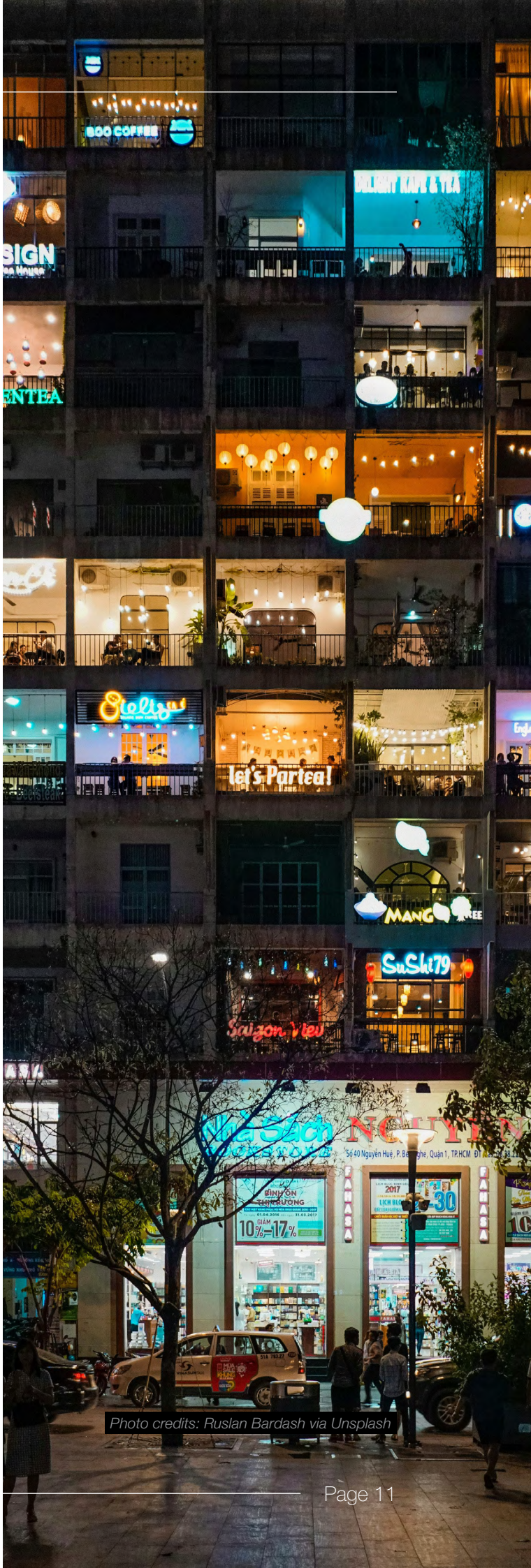


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7. A Self-Assessment Approach

A structured self-assessment approach that can support cities in examining how effectively disaster resilience has also been integrated within Smart City development.

The approach considers the six Smart City dimensions and provides a mechanism for identifying strengths, weaknesses and areas requiring further attention.

The purpose is not simply to produce a score. Instead, self-assessment can support reflection, prioritisation and continuous improvement.

Smart cities can use an assessment approach to:

- establish a baseline;
- identify resilience gaps;
- prioritise interventions;
- support discussions between departments and stakeholders;
- inform investment decisions; and
- monitor progress over time.

This is particularly important because Smart City development and urban risks are continuously evolving.



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8. Closing

Smart City initiatives offer tremendous scope for increasing resilience against disasters in cities. However, technology alone cannot achieve this goal.

The key findings from this research clearly show how essential it is to incorporate disaster resilience in the governance, planning and implementation of Smart Cities. It calls on cities to factor technological, social, environmental, economic and institutional dimensions into their work as well as understand the interconnections between urban systems.

This implies that the future of resilient Smart Cities does not simply lie in advancing technology but also lies in ensuring that this technology is appropriate, inclusive, well-governed and supported by all the systems that keep cities going.



Photo credits: Trac Vu via Unsplash

9. Further reading

Samarakkody, A., Amaratunga, D., & Haigh, R. (2023). Technological Innovations for Enhancing Disaster Resilience in Smart Cities: A Comprehensive Urban Scholar's Analysis. *Sustainability*, 15(15), 12036. MDPI AG. Retrieved from http://dx.doi.org/10.3390/su151512036

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