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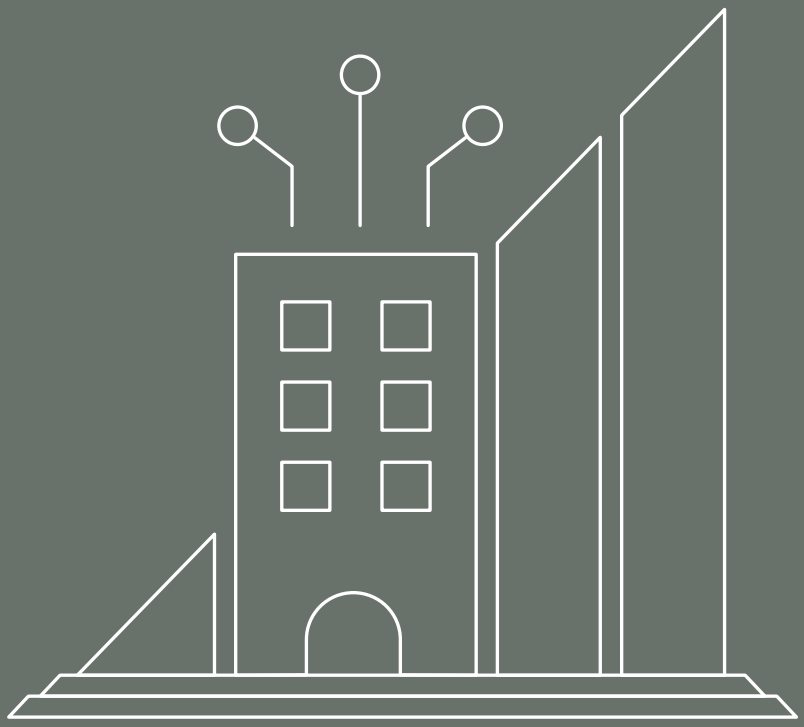
Handbook Series on Innovative Local Governance for the Implementation of the Sustainable Development Goals

Strengthening Resilience in Cities and Local Communities Through Innovation and Digital Government



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Acronyms and Abbreviations

AI	Artificial Intelligence
AIT	Asian Institute of Technology
CEPA	United Nations Committee of Experts on Public Administration
DGCA	Digital Government Capability Assessment
DLT	Distributed Ledger Technology
DPIDG	Division for Public Institutions and Digital Government
DRR	Disaster Risk Reduction
EYWA	Early Warning Systems for Mosquito-borne Diseases
GSCA	G20 Global Smart Cities Alliance
GEO	Group on Earth Observations
GIS	Geographic Information Systems
GP	Global Platform
ICLEI	Local Governments for Sustainability
ICT	Information and Communications Technology
IFRC	International Federation of the Red Cross and Red Crescent Societies
ISO	International Standards Organization
IoT	Internet of Things
JICA	Japan International Cooperation Agency
KPI	Key Performance Indicators
KRILA	Korea Research Institute for Local Administration
MCR	Making Cities Resilient
NbS	Nature-based Solutions
NDCs	Nationally Determined Contributions
NGO	Non-Governmental Organization
OECD	Organization for Economic Cooperation and Development
PDC	Pacific Disaster Center
PPE	Personal Protective Equipment
QRE	Quick Risk Estimation
SDG	Sustainable Development Goals
SME	Small and Medium-sized Enterprises
STAG	Science and Technology Advisory Group
UAV	Unmanned Autonomous Vehicles
UCLG	United Cities and Local Government
UN DESA	United Nations Department of Economic and Social Affairs
UNDRR	United Nations Office for Disaster Risk Reduction
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UN-HABITAT	United Nations Human Settlements Programme
UNOPS	United Nations Office for Project Services
UNPAN	United Nations Public Administrations Network
UNPOG	United Nations Project Office on Governance
UNPSA	United Nations Public Service Awards
WCCD	World Council on City Data
VR	Virtual Reality

Acknowledgement

This Handbook on Strengthening Resilience in Cities and Local Communities through Innovation and Digital Government was developed by the United Nations Department of Economic and Social Affairs (UN DESA), through its Project Office on Governance (UNPOG) of the Division for Public Institutions and Digital Government (DPIDG). The handbook was prepared under the overall guidance of Bokyun Shim, Head of the United Nations Project Office on Governance (UNPOG) with Samuel Danaa, Associate Capacity Development Expert, serving as the lead coordinator.

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An electronic version of this publication and other documents from UNPOG and KRILA are available for download from the United Nations Public Administration Network (UNPAN) website at www.unpan.un.org and KRILA website at www.krila.re.kr.

Executive Summary

Executive Summary

This handbook introduces the reader to concepts, approaches, tools, exercises and innovative cases to Strengthen Resilience in Cities and Local Communities through Innovation and Digital Government. The handbook guides the reader towards roadmaps, policy toolkits, manuals and peer support to help cities and local communities better invest in practical action to strengthen resilience. This handbook builds on global good practices on effective governance. It also build on the Training Toolkit on "Risk-informed Governance and Innovative Technology for Disaster Risk Reduction and Resilience" as part of the Curriculum on Governance for the SDGs, which was developed by the United Nations Department of Economic and Social Affairs (UN DESA), Division for Public Institutions and Digital Government (DPIDG), through the UN Project Office on Governance (UNPOG). This handbook is part of a series of six succinct publications within UN DESA's Curriculum on Governance for the SDGs designed to promote effective, accountable and inclusive public institutions.

COVID-19, climate change and our increasingly interconnected world are changing the existing, emerging and future risk landscapes for cities and local communities. Global innovations, technologies and digitalization are driving social and economic growth and becoming a foundation for prosperity. Technology-driven systems and infrastructures are increasingly interdependent. Failures in one system, such as electricity supply, cascade to others, such as communication and business, with amplified social and economic costs. To protect progress, cities and local communities must address physical, digital, geographic, logistical and resource-dependent risks to systems and infrastructures, including information, communications, transport, food, water and other fundamental systems. While much of the power to regulate this systemic risk is outside a local community's authority and administrative control, local action on global standards and innovations is needed to strengthen resilience.

Technology, digitalization and innovation transform the social and economic foundations of cities and local communities. Technology can drive progress and reduce certain risks. However, new technology, digitalization and innovation also can create new risks. A greater understanding of these emerging risks can mitigate potential social and economic damage. Investing in strengthening the resilience of critical infrastructure reduces these risks. **It also can help address the digital divide.** The digital divide is the result of systemic inequalities in access to technology and limited resources available to invest in digital infrastructure that would increase access and support meaningful, inclusive and equitable transformation.

Global frameworks guide local action. Global frameworks guide cities and local authorities to strengthen resilience coherently into development strategies, plans and investments to protect investments and accelerate progress. The Sendai Framework for Disaster Risk Reduction 2015-2030 guides stakeholders in understanding, governing and investing in risk reduction and resilience and enhancing preparedness for response and resilient recovery. The 2030 Agenda for Sustainable Development calls on cities and human settlements to adopt and implement integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement holistic disaster risk management at all levels in line with the Sendai Framework for Disaster Risk Reduction 2015-2030. The New Urban Agenda as part of its key commitments, calls for strengthening resilience in cities to reduce the risk and the impact of disasters. The Paris Agreement on Climate Change adopted in 2015 guides countries to mitigate climate change, strengthen resilience and enhance their abilities to adapt to climate impacts. The UN Secretary-General's Roadmap for Digital Cooperation adopted in 2020 provides a direction forward to strengthen resilience, recognizing that all stakeholders play a role in advancing a safer, more equitable digital world.

Global, regional, national, inter-governmental organizations and city-to-city networks support cities in navigating emerging and future landscapes by providing roadmaps, policy toolkits, good practices, exchanges and peer support. Global frameworks and guidance prioritize whole-of-society approaches, strengthening resilience in collaboration with all stakeholders and resources within cities. Investments in resilience provide a good return, protect development gains and assets and ensure future social and economic continuity. Effective people-centered governance, including digital governance, strengthens resilience and sustainability. Cities and local communities support resilience by promoting technologies, innovation and people-centered approaches.

This handbook provides guidance for cities and local communities on how to strengthen resilience through various approaches, summarized in six thematic chapters.

Chapter 1 guides the reader towards supported routes to resilience from a city-wide perspective. It explores how to strengthen resilient, smart and inclusive cities and local communities. It provides information on existing, emerging and future risk profiles within existing development paradigms and connects the reader to roadmaps, standards, governance approaches and smart-policy-toolkits to strengthen resilience. City-to-city networks for resilience are introduced and systemic, interdependent, cascading risk and whole-of-society approaches are considered.

Chapter 2 discusses how to maximize the benefits of technologies and innovations while minimizing new risks and strengthening resilience. It introduces the reader to the benefits and risks posed by new emerging technology, namely, the ability to strengthen resilience and the risk of amplifying inequalities or creating new risks if the technology is poorly governed or not people-centred.

Chapter 3 introduces how new technology can revolutionize cities and local communities in new and exciting ways. It provides examples of innovative cases changing the way we live, connect and function and focuses on innovation for strengthening resilience and managing disasters.

Chapter 4 explores the importance of infrastructure asset management for building resilient and sustainable cities. It emphasizes the importance of understating and governing interdependent systemic risk to future-proof the infrastructure of cities and local communities, including the social and economic foundations.

Chapter 5 examines the role of resilient and smart cities in building back better in the post-COVID-19 era. It focuses on preparing and accelerating sustainability and resilience-building initiatives to ensure that cities and local authorities build back better and become more socially and economically resilient to all risks. It explores the importance of keeping people central to digital transformation and of connecting global health agendas to local actions.

Chapter 6 provides policy recommendations and consolidates conclusions from each chapter into common building blocks: *Processes* (finance, planning and products); *Mechanisms* (exploring institutional arrangement, digital technologies, legal and policy frameworks and partnerships); and *People* (including leadership, human capacity and knowledge). The importance of people-centred approaches is emphasized throughout the handbook.

Purpose of this Handbook

Purpose of this Handbook

Handbook Series

The Handbook is one **of a series of six succinct publications** promoting effective, accountable and inclusive public institutions to advance the 2030 Agenda for Sustainable Development at sub-national and local levels. The handbook series is part of UN DESA's *Curriculum on Governance for the SDGs.* It complements the UN Project Office on Governance's (UNPOG) *Training Toolkit on "Risk-informed Governance and Innovative Technology for Disaster Risk Reduction and Resilience"* and the *Training Toolkit on "Effective National to Local Governance for SDG Implementation".*

This handbook on **Strengthening Resilience in Cities and Local Communities through Innovation and Digital Government** contributes to developing the capacities and skills of local government officials, policymakers and other relevant stakeholders in strengthening resilience in cities and local communities to achieve the 2030 Agenda for Sustainable Development and Sendai Framework for Disaster Risk Reduction.

Aim of this handbook

This handbook introduces **concepts, approaches, tools and innovative cases** supported by existing initiatives to strengthen resilience through innovation and digital government. It guides the reader to roadmaps, policy toolkits and approaches to help cities and local communities strengthen resilience and invest in practical action and introduces institutions and initiatives contextualizing good policy and practical guidance. The handbook **incorporates lessons identified for learning and good practices** from the Global and Regional Platforms for Disaster Risk Reduction, the Organization for Economic Cooperation and Development, the United Nations and policy think tanks.

Structure of this handbook

This handbook begins by introducing relevant global frameworks and commitments to strengthening resilience. The chapters follow that explore concepts and approaches, with exercises and innovative cases relating to each theme. The Annex includes a list of reference materials and links to further tools and guidance.

Role of Cities and Local Communities in Strengthening Resilience through Innovation and Digital Government within Global Frameworks

Role of Cities and Local Communities in Strengthening Resilience Through Innovation and Digital Government Within Global Frameworks

According to a 2019 UN DESA report on "Exposure and vulnerability to natural disasters for world's cities," the world is urbanizing. In 2018, approximately 55 per cent of the world's population lived in urban areas, up from 43 per cent in 1990. It is projected that by 2050, more than two-thirds of the world's population will live in urban areas. In 2018, nearly 58 per cent of cities worldwide with a population of more than 300,000 had a high level of exposure to at least one type of natural disaster. The 2019 UN DESA report estimates that the direct losses from all disasters in the period 1998-2017 totalled US$2.9 trillion, which is 2.3 times greater than the overall losses of US$1.3 trillion in the period 1978-1997. Climate-related disasters accounted for approximately 90 per cent of the 7,255 major disasters between 1998 and 2017, most of which were floods and storms. The devastating impact of these disasters underscores the importance of taking measures to reduce loss of life, the number of people affected, damage to critical infrastructure and economic losses.

Urbanization is one of the most significant trends transforming life in the twenty-first century. This transformative force can and should be resilient to ensure and protect sustainable development for all. Cities and local communities are addressing many of today's global challenges, from pandemics, extreme poverty and unemployment to environmental degradation and climate change. Their interventions have wide-ranging and cumulative impacts. Urbanization, innovation and digital government accelerate progress to guide the sustainable development agenda. However, if unplanned and poorly managed, urbanization, innovation and digitalization can exacerbate many of the problems they aim to solve. There can be significant social and economic impacts, including increasing inequalities, poverty and marginalization. Strengthening resilience in cities and local communities reduces those adverse outcomes and protects progress. Global frameworks and commitments that provide global guidance on strengthening resilience for local action include the Sendai Framework for Disaster Risk Reduction, which works hand in hand with the other 2030 Agenda Agreements, including the Paris Agreement on Climate Change, the New Urban Agenda, and the Sustainable Development Goals. Understanding the interdependencies of those global agendas unlocks government's full potential and optimizes and leverages resources and development outcomes at every level of government. Policy coherence and effective multilevel governance arrangements for global agendas is the primary factor for an integrated approach towards strengthening resilience.

Sendai Framework for Disaster Risk Reduction 2015-2030

The **Sendai Framework for Disaster Risk Reduction 2015-2030** aims "to achieve the substantial reduction of disaster risk and losses in lives, livelihoods and health and the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries over the next 15 years". The Framework has four priorities for action to prevent new and reduce existing disaster risks and thus strengthen resilience:

> **Priority 1. Understanding disaster risk -** Disaster risk management should be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment. Such knowledge can be used for risk assessment, prevention, mitigation, preparedness and response.

Priority 2. Strengthening disaster risk governance to manage disaster risk - Disaster risk governance at the national, regional and global levels is very important for prevention, mitigation, preparedness, response, recovery and rehabilitation. It fosters collaboration and partnership.

Priority 3. Investing in disaster risk reduction for resilience - Public and private investment in disaster risk prevention and reduction through structural and non-structural measures are essential to enhance the economic, social, health and cultural resilience of persons, communities, countries, and their assets, as well as the environment.

Priority 4. Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation, and reconstruction - The growth of disaster risk means there is a need to strengthen disaster preparedness for response, act in anticipation of events and ensure capacities are in place for effective response and recovery at all levels. The recovery, rehabilitation and reconstruction phases are critical opportunities to build back better, including integrating disaster risk reduction into development.

The Sendai Framework for Disaster Risk Reduction outlines seven global targets to guide efforts and against which to assess progress. ***Target D is: to increase the number of countries with national and local disaster risk reduction strategies.*** Global, regional and national platforms and intergovernmental organizations increasingly contextualize disaster and climate risk reduction strategies built on the Sendai Framework for Disaster Risk Reduction. The Sendai Framework for Disaster Risk Reduction also outlines 13 guiding principles and priorities for action at national and local levels.

New Urban Agenda

The **New Urban Agenda** adopted at the United Nations Conference on Housing and Sustainable Urban Development (Habitat III) in Quito, Ecuador, on 20 October 2016, presents a paradigm shift based on the science of cities and lays out standards and principles for the planning, construction, development, management and improvement of urban areas along its five main pillars of implementation: national urban policies, urban legislation and regulations, urban planning and design, local economy and municipal finance and local implementation. The core dimensions of the New Urban Agenda and transformative commitments are social, economic, environmental and spatial sustainability that are deeply embedded in resilience. The New Urban Agenda in paragraph 13(g) and 77 commits to a shared vision for disaster risk reduction and adaptation to climate change and to strengthening the resilience of cities and human settlements in line with the Sendai Framework for Disaster Risk Reduction 2015-2030.

The New Urban Agenda is a resource for different actors in multiple levels of government and civil society organizations, the private sector and all who reside in the world's urban spaces. For more information, see the Urban Agenda Platform with its online portal for sharing knowledge, monitoring and reporting. Thematic Chapter 1 of this handbook further explores commitments and strategies deriving from the New Urban Agenda.

Sustainable Development Goals (SDGs)

The **Sustainable Development Goals (SDGs)** are a universal call to achieve a sustainable future and promote equality, human rights and justice for all by 2030. The SDGs are a collection of 17 interlinked goals designed to guide reflection and action on the most pressing challenges and opportunities humanity faces. The SDGs acknowledge the importance of innovations and digital governance in strengthening resilience, including action at the city and local community levels. Local and regional governments are increasingly acknowledged as peers in a process in which global goals, national resources and local implementation are expected to work seamlessly together. Without proper engagement and coordination with local and regional governments, 65 per cent of SDG targets will not be reached. In addition to achieving the SDGs, effective recovery from public health emergencies such as the COVID-19 pandemic also requires increased localized action.

- **Chapter 1** explores strengthening resilience within SDG 11 - Making cities and human settlements inclusive, safe, resilient, and sustainable.
- **Chapter 4** explores strengthening resilience within SDG 9 - Building resilient infrastructure, promoting inclusive and sustainable industrialization, and fostering innovation.

All SDGs affect cities and local communities. In addition to SDGs 11 and 9 as noted above, the following SDGs are particularly relevant to this handbook:

- SDG 16 - Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable, and inclusive institutions at all levels.
- SDG 17 - Strengthen the means of implementation and revitalize the global partnership for sustainable development.
- SDG 13 - Take urgent action to combat climate change and its impacts.

The Paris Agreement on Climate Change

Climate change is a global emergency that goes beyond national borders and demands action at all levels. To tackle climate change and its negative impacts, world leaders in 2015 committed to the Paris Agreement, which sets long-term goals to guide all nations to:

- Substantially reduce global greenhouse gas emissions to limit the global temperature increase in this century to 2 degrees Celsius while pursuing efforts to limit the increase even further to 1.5 degrees Celsius.
- Review countries' Nationally Determined Contributions (NDCs) every five years.
- Provide financing to developing countries to **mitigate climate change, strengthen resilience and enhance abilities to adapt to climate impacts.**

The Paris Agreement was historic and marked the beginning of a shift towards a net-zero emissions world.

All parties to the Paris Agreement committed to strengthening the global response to climate change by increasing the ability of all to adapt and build resilience and reduce vulnerability. Thus, the Paris Agreement aims to strengthen the global climate change response by increasing the ability of all to adapt to adverse impacts of climate change and foster climate resilience. The Agreement defines a **global goal on adaptation** to enhance adaptive capacity and resilience and reduce vulnerability to contribute to sustainable development. For more information, see new elements and dimensions of adaptation under the Paris Agreement.

For additional learnings and good practices on climate change, a 2020 UNEP Adaptation Gap Report chronicles slow progress in climate adaptation, including a lack of financing, and showcases nature-based solutions. Seven lessons on adapting to climate change by UNDP Climate draws on experiences to date to step up adaptation efforts. From the Global Commission on Adaptation, Adapt Now details the benefits from adaptation to urge action by governments, businesses, investors and community leaders. An article from the UNDP climate change adaptation website on closing the digital divide addresses how to generate more and better data and predict climate risks.

Report of the UN Secretary-General Roadmap for Digital Cooperation

The Report of the UN Secretary-General Roadmap for Digital Cooperation adopted in the year 2020 provides a direction forward to strengthen resilience. The Roadmap recognizes that the world is shifting from analogue to digital faster than ever before, further exposing people to both the vast promise and perils of new technologies. While the digital era has brought society many incredible benefits, it also brings challenges such as growing digital divides, cyber threats and human rights violations online. The roadmap acknowledges that all stakeholders play a role in advancing a safer, more equitable digital world and calls for action in eight areas:

1. Achieving universal connectivity by 2030
2. Promoting digital public goods to create a more equitable world
3. Ensuring digital inclusion for all, including the most vulnerable
4. Strengthening digital capacity-building
5. Ensuring the protection of human rights in the digital era
6. Supporting global cooperation on artificial intelligence
7. Promoting trust and security in the digital environment
8. Building a more effective architecture for digital cooperation.

The 11 **Principles of Effective Governance for Sustainable Development** help build effective, accountable and inclusive institutions at all levels. Good Governance and e-Governance are building blocks for resilience. Chapter 1 of this handbook explores this concept further.

"One crucial condition must be met before we address any of the other drivers of risk, and that is effective governance. Sound and inclusive strategies for disaster risk reduction coherent with climate action can be the foundation for good governance in every country and every city." [1]

Source: [1] Changing the Trajectory: Integrated Resilience Thinking and COVID-19 Recovery Towards 1.5°C, for full message see https://www.undrr.org/news/governance-failure-heart-global-crises

Chapter 1: Strengthening Resilient, Smart and Inclusive Cities and Local Communities

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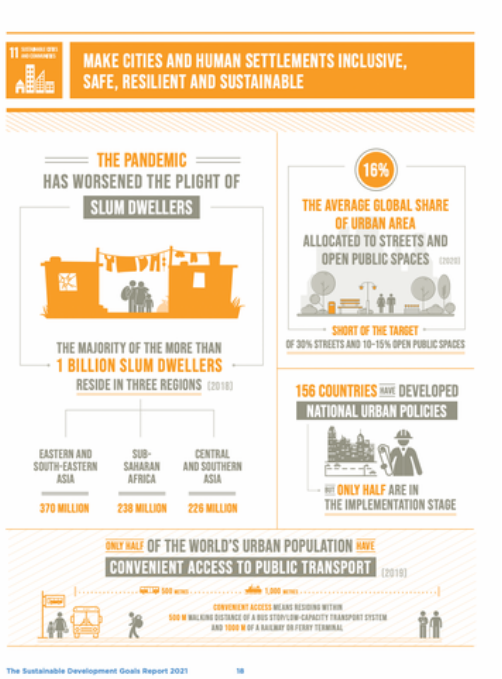
Rationale and benefits

By 2030, it is projected that 6 in 10 people will be urban dwellers.[2] Prosperity is increasingly concentrated in cities that benefit from and also are becoming more reliant on smart technologies. Urban areas attract people by providing economic, social and creative opportunities. But urban challenges also are mounting, including environmental degradation, pollution, poverty, economic shocks and climate-related hazards. Despite these challenges, cities still offer more efficient economies of scale on many levels, including providing goods, services and transportation. Stakeholders, including citizens, policymakers, the private sector and others, are working towards a vision of resilient, smart and inclusive cities. Creating resilient cities requires imagination, innovation and recognition that even global problems need local action and solutions. Resilient cities protect development investments and are prepared to absorb and recover from shocks and stresses while maintaining their essential structures, functions and identity. With sound, risk-informed planning and management, resilient cities can become incubators for innovation and growth and drivers of sustainable development.

Figure 1 - SDG 11
Sustainable Cities and Communities



Source: The SDG Report (2021).
https://unstats.un.org/sdgs/report/2021/The-Sustainable-Development-Goals-Report-2021.pdf

Expected Learning Outcomes

This chapter of the handbook complements SDG 11 and Module 1 of the UN DESA 2021 Handbook on Risk-informed Governance and Innovative Technology for Disaster Risk Reduction and Resilience Learning outcomes for this chapter include:

1. Readers are introduced to central concepts, frameworks, approaches, policy tools and commitments guiding strengthening resilient, smart and inclusive cities and local communities.
2. Readers are introduced to strategies to understand existing, emerging, and future risks to protecting development gains.
3. Readers are introduced to strategies, institutional guidelines, and good policies to strengthen resilience using risk-informed development paradigms and good governance.
4. Readers are introduced to roadmaps, benchmarks and city-to-city support to strengthen resilience.

Source: [2] UN DESA. Make cities and human settlements inclusive, safe, resilient and sustainable. https://sdgs.un.org/goals/goal11

Concepts

SDGs and Resilient City

The concept of a resilient city is encapsulated within Sustainable Development Goal (SDG) 11 to "make cities and human settlements inclusive, safe, resilient and sustainable." SDG 11 guides cities with seven goals and targets and 14 indicators. SDG goal 11.5 best reflects resilience, with the aim that "By 2030, (to) significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to the global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations". Resilience also is encapsulated in SDG 9, (explored further in Thematic Chapter 4), and in the SDGs related to governance, inequality, innovation and the environment.

The New Urban Agenda 2030 articulates further commitments to the concept of a resilient city with a shared vision to "adopt and implement disaster risk reduction and management, reduce vulnerability, build resilience and responsiveness to natural and human-made hazards and foster mitigation of and adaptation to climate change". The New Urban Agenda commits to fostering resilience, including strengthening the resilience of cities and human settlements. The New Urban Agenda aims to strengthen resilience through the development of quality infrastructure and spatial planning by adopting and implementing integrated, age- and gender-responsive policies and plans. It encourages ecosystem-based approaches in line with the Sendai Framework for Disaster Risk Reduction 2015-2030 and mainstreaming holistic and data-informed disaster risk reduction and management at all levels to reduce vulnerabilities and risk. The New Urban Agenda spotlights the importance of investing in risk-prone areas of formal and informal settlements, including slums, and enabling households, communities, institutions and services to prepare for, respond to, adapt to and rapidly recover from the effects of hazards, including shocks or latent stresses. The New Urban Agenda also calls for the integration into future planning of resilience-building, environmental and spatial measures, lessons from past disasters and awareness of new risks.

The People-Centered Smart Cities Framework, articulated in *Centering People in Smart Cities: A Playbook for Local and Regional Governments*, aligns with the New Urban Agenda Shared Vision 11 "cities for all". The framework details principles for the equal use and employment of cities and human settlements, promoting inclusivity and representation of all without discrimination. Through actionable digital governance, the framework enhances public e-participation and co-creation in the delivery of public goods, ensuring the respect of digital human rights and ultimately strengthening resilience in cities.

Approaches to Strengthen Resilience in Cities

Several approaches and roadmaps can be combined to strengthen resilient, smart and inclusive cities and local communities. These include:

Sendai Framework and Making Cities Resilient 2030 (MCR2030) Approach

The **Sendai Framework for Disaster Risk Reduction 2015-2030** provides cities and local communities with four priorities for action to prevent new and reduce existing disaster risks:

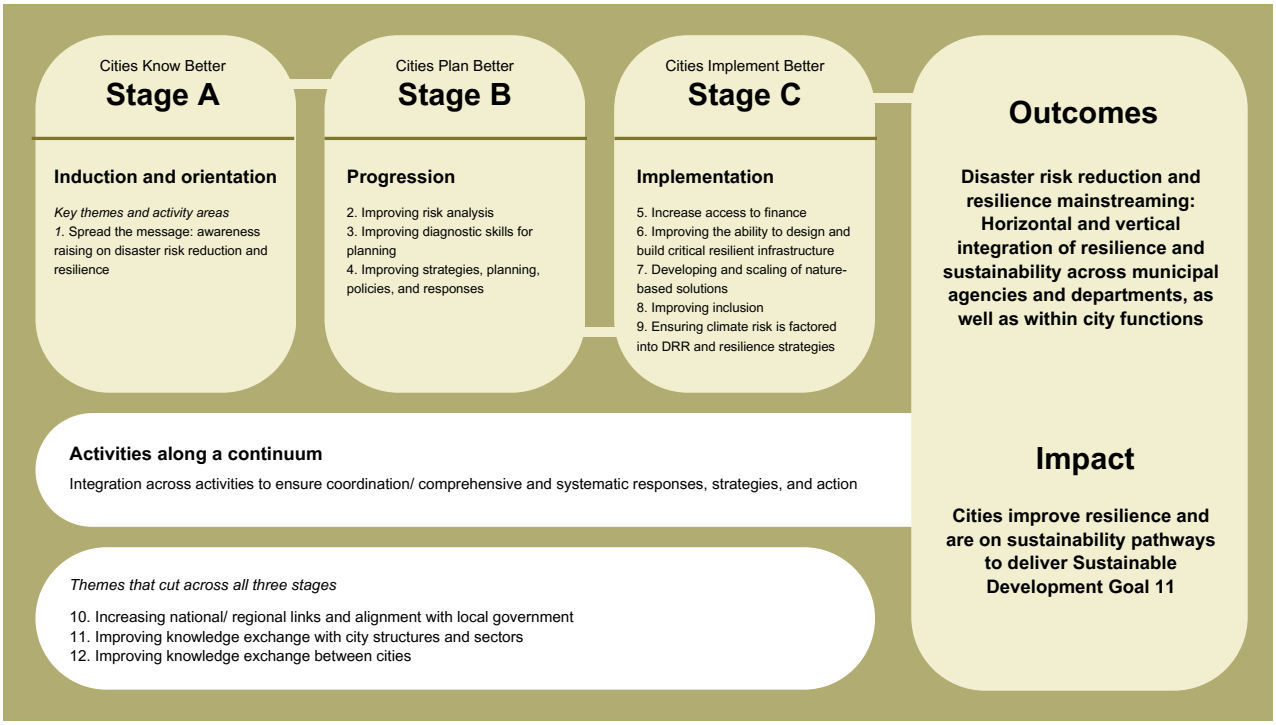
1. **Understanding disaster risk.**
2. **Strengthening disaster risk governance to manage disaster risk.**
3. **Investing in disaster reduction for resilience.**
4. **Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation, and reconstruction (this is explored further in Chapter 5).**

The framework also includes 13 guiding principles to enable those actions. To strengthen resilience, cities need to invest in each priority for action.

Making Cities Resilient 2030 (MCR2030) is a cross-stakeholder initiative for improving local resilience through advocacy, sharing knowledge and experiences, establishing mutually reinforcing city-to-city learning networks, injecting technical expertise, connecting multiple layers of government and building partnerships. The MCR2030 aims to ensure cities become inclusive, safe, resilient and sustainable by 2030, contributing directly to the achievement of SDG 11.

MCR2030 builds on the Making Cities Resilient Campaign of 2010 to 2020, promoting urban disaster resilience through local government authorities and promoting the **Ten Essentials for Making Cities Resilient**. MCR2030 partners with networks and learning initiatives to support different cities, including United Cities and Local Government (UCLG), ICLEI – Local Governments for Sustainability, C40 Cities, Resilient City Network, International Federation of the Red Cross and Red Crescent Societies (IFRC), Japan International Cooperation Agency (JICA), United Nations Development Programme (UNDP), United Nations Human Settlements Programme (UN-HABITAT), United Nations Office for Disaster Risk Reduction (UNDRR), The United Nations Office for Project Services (UNOPS), World Council on City Data (WCCD), and the World Bank Group. To guide city governments of all sizes in resilience planning and decision-making, the MCR2030 provides a clear three-stage roadmap to urban resilience. It provides access to knowledge and monitoring and reporting tools. For more information, see Figure 2 on the resilience roadmap, and disaster resilience scorecards.

Figure 2 - MCR2030 Stages and Outcomes



Source: *https://mcr2030.undrr.org/resilience-roadmap*

Guiding Cities with Normative Standards

The ISO 37120 series provides globally standardized and independently verified data enabling cities of all sizes to attract investment and drive economic development. Global comparative data allows cities to effectively localize the UN Sustainable Development Goals. Standards and the related indicators provide a baseline to challenges such as climate change, rapid population growth and political and economic instability. The standards and indicators help cities improve how they engage society to build a dynamic and innovative economy ready for the challenges of tomorrow.

Indicators detailed in ISO 37120 for city services and quality of life provide an international reference point for cities by providing quantitative, globally comparable and independently verified local-level data. The associated ISO 37122 provides indicators for **Smart Cities** and ISO 37123 provides indicators for **Resilient Cities**. ISO 37120 has 104 key performance indicators (KPIs) across 19 themes, all prioritized by cities to measure city services and quality of life. These metrics are modest and achievable and are already being collected by cities worldwide.

Figure 3 - ISO structure for Sustainable Cities and Communities

Source: *https://kebs.isolutions.iso.org/obp/graphics/std/iso_std_iso_37120_ed-2_v1_en/fig_1.png*

Standardized data provides a normative reference point to measure and compare progress both internally and to other peer cities locally and globally. The World Council of City Data (WCCD) supports cities across the globe in reporting data conforming with the definitions and methodologies contained in ISO 37120 - indicators for sustainable cities. The WCCD is a partner of MCR2030.

Risk-informed Governance

Strengthening Resilience through Risk-informed Governance Resilience

To strengthen resilience, cities' development, spatial, long, short-term, and fiscal strategies, plans, budgets, and governance arrangements need to consider all risks. Guidance for cities and local communities to strengthen resilience includes:

Guidance 1 - Risk-informed governance for policy and decision-making requires that existing, emerging and future risks be understood

- Existing risks are known, historic and well defined, such as earthquakes.
- Emerging risks are new risks or risks that become apparent in new contexts, including from new technologies, including cyber, nuclear and industrial.
- Future risks include future climate change, urbanization and technological advancement scenarios.

Guidance 2 - Risk-informed governance for policy and decision-making in cities: objectives, strategies, developments and fiscal plans

- Structure risk-informed data to be compatible with social, economic, environmental and spatial plans. Digital and geo-spatial data allow users and decision-makers to integrate risk information into development strategies, plans and governance structures. Involving city planners, the strategy department and ICT staff in structuring compatible data from the start of the process is a good approach.

- Cities' resilience depends on support systems that have physical, cyber, geographic, logistical and resource dependencies and vulnerabilities. Those systems often are regulated and controlled outside of the city's administrative boundaries. For example, critical systems such as ICT, national and international networks and water and food security systems rely on external efforts and eco-systems, and transport and logistics rely on connections outside cities. To strengthen resilience, stakeholders, regulators and users must be involved.
- To understand risk, future climate, environment and biodiversity scenarios and plans need to be considered.
- Recognize that risks are interconnected and cascading. Failure in critical infrastructures such as water, transport or electricity will have social and economic costs far greater than the infrastructure itself.
- All-of-society approaches such as public-private partnerships and the science-policy interface strengthen resilience. Innovation, particularly technological innovation such as remote management, data sharing and analysis, can further support institutional arrangements and provide the necessary insight for stakeholders to make informed decisions.

Guidance 3 - Integrate risk information into principles of effective governance and digital governance

The United Nations Committee of Experts on Public Administration (CEPA) developed the **Principles of Effective Governance for Sustainable Development** to help build effective, accountable and inclusive institutions at all levels to achieve the shared vision for the people and the planet embodied in the 2030 Agenda for Sustainable Development. These 11 principles are grouped into three categories: **effectiveness** (competence, sound policymaking, collaboration); **accountability** (integrity, transparency, independent oversight); and **inclusiveness** (leaving no one behind, non-discrimination, participation, subsidiarity, intergenerational equity). Risk information should be integrated when considering those principles.

Guidance 4 - Operationalizing principles and strategies

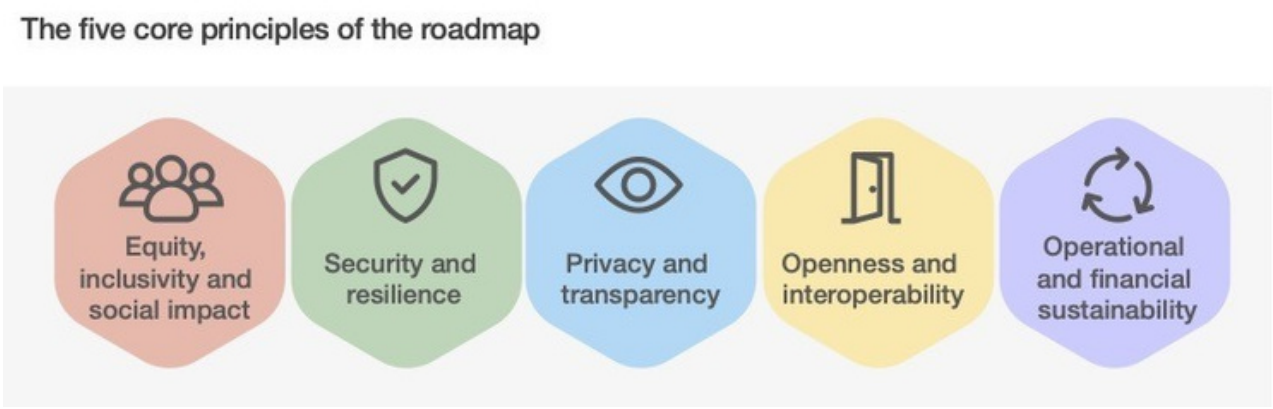
CEPA issued a Guidance Note on Risk Management Frameworks associated with the principle of sound policymaking and the importance of evidence-based analysis, data analytics, auditing and other quality processes. This principled approach to planning and mainstreaming focuses on strategic principles and targets for integrating disaster risk reduction (DRR) into development. CEPA also identified 62 commonly used strategies to assist with operationalizing the principles included in the approach.

In 2019, as part of its Words into Action series, the UNDRR published a guidebook to advise local governments on developing and implementing a holistic and integrated local DRR strategy that contributes to building resilience at the local level while accommodating a national strategy when one is in place. The guidebook outlines what a local DRR and resilience strategy should look like and what is needed to create and implement one. While aligned with national strategies, local strategies are generally more specific. They reflect the local context and hazard profile and concentrate on the planning and implementation phases, clearly assigning roles and responsibilities at the subnational level. For more information, see Words into Action guidelines: Implementation guide for local disaster risk reduction and resilience strategies.

Making Smart Policies Resilient

The G20 Global Smart Cities Alliance (GSCA) helps cities identify and adopt foundational policies for smart city technologies as a baseline for sound technology governance.

Figure 4 - The Five Core Principles of the Roadmap



Source: World Economic Forum (2021). *https://www.weforum.org/agenda/2021/07/being-smart-about-smart-cities-a-governance-roadmap-for-digital-technologies/*

The GSCA 5 key policy areas focus on being smart about smart cities, emphasizing a broad, flexible and agile approach applicable to a range of large and small cities at different levels of development. The G20 Global Smart Cities Alliance provides a policy roadmap structured on five core principles: equity, inclusivity, and social impact; privacy and transparency; security and resilience; and operational and financial sustainability. It also provides guidance on "Governing Smart Cities: Policy Benchmarks for Ethical and Responsible Smart City Development".

Through the GSCA, global experts from government, private-sector partners and civil society compile and analyze policies worldwide to identify model policies for prosperous, ethical, smart cities. Policies are prioritized based on two primary conditions:

1. They are **established** as good practice based on considerable experience leading cities from multiple geographies.
2. They are **foundational** to building smart cities and are not prescriptive technologies, applications or outcomes.

The GSCA policy roadmap is an evolving process and includes a pioneer programme. As of February 2022, a Cyber Accountability Model is available, including model policies and critical responsibilities. Works in progress include a resilience strategy and Internet of Things minimum standards.

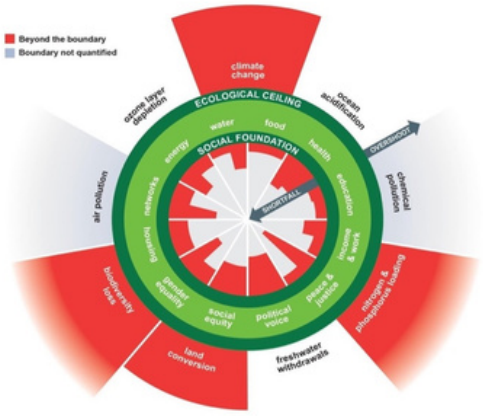
Integrating risk into effective Governance also can be guided by the Digital Government Capability Assessment (DGCA), a ready-to-use tool for digital government investment guided by capability assessment tools and six dimensions of digital government (leadership, strategy, governance, legal, technology and professional and workforce development).

Innovative Cases

Amsterdam's Circular Policies and the City Doughnut

The Amsterdam City Doughnut is an economic model and tool for transformative action. The City Doughnut of social and planetary boundaries envisions a world in which people and the planet can thrive in balance. It offers a compass for guiding 21st-century prosperity. The City Doughnut connects global limitations and concerns with local sustainability and resilience. Its social foundation is derived from the social priorities in the UN Sustainable Development Goals. The City Doughnut's ecological ceiling includes nine planetary boundaries, drawn up by Earth-system scientists to identify Earth's critical life-supporting systems and the global limits of pressure they can endure. Between the social foundation and the ecological ceiling lies a doughnut-shaped space in which it is possible to meet the needs of all people within the means of the living planet – an ecologically safe and socially just space in which humanity can be resilient and thrive. The Amsterdam City Doughnut is intended as a stimulus for cross-departmental collaboration within the city and for connecting a network of city actors in an iterative change process. This doughnut approach is consistent with policies on the circular economy which together address many of the ecological, logistical, environmental and systemic risks that cities face. It provides a clear planning framework to strengthen resilience and ensure long-term sustainability, taking into consideration global challenges with local actions. For more information see City of Amsterdam's policies, strategies and frameworks on the circular economy.

Figure 5 - Transgressing the Doughnut 's social and planetary boundaries



Source: The Amsterdam City Doughnut. https://assets.amsterdam.nl/publish/pages/867635/amsterdam-city-doughnut.pdf

Geospatial Technology as a Shared Platform for Action in Thailand

In Thailand, wildfires and haze increasingly impact people's lives, with more people suffering from respiratory tract disease, more flights being delayed or cancelled, and tourists cancelling their trips. National, provincial and local governments and stakeholders in local communities needed an accessible, understandable platform to develop a shared strategy to address those issues and find longer-term solutions to wildfires and haze. The Geo-Informatics and Space Technology Development Agency created a platform that identifies hotspots from satellite data, coupled with observed wildfire and haze occurrence, to provide situation reports that are accessible to users via a website and mobile applications. The system integrates local knowledge and provides intelligence on a shared platform with two-way communication. For more information, see UNPSA initiative Battling against Wildfire with Geospatial Technology.

Understanding and Addressing Risk in an Urban Context: Water Dialogues in Panama

Figure 6 - Water Dialogue in Panama City

Source: Wetlands International. *https://www.wetlands.org/casestudy/living-water-wetlands-flood-risk-reduction-panama-city/panama-dutch-water-dialogues-plenary-jan-20/*

The Juan Diaz subdistrict of Panama City is Panama's most vulnerable area. This densely populated subdistrict is a low-lying area separated from the sea by a large strip of mangroves, officially protected by law as a Ramsar Site of International Importance. A large river runs through the subdistrict alongside small streams and creeks, most of which have been encroached upon and channelled into gutters and drainage systems that are poorly maintained and have become urban garbage dumps. Much of the floodplains, wetlands and surrounding mangroves have become landfills rising up to a height of six meters. When heavy rains fall, these landfills divert the water to Juan Diaz. From 1990-2013, 155 flooding events were recorded there, intensifying from 2008 onward. The situation is worsened by upstream urbanization, which has caused sedimentation of the river and streams and reduced rainwater infiltration. The result is increased surface water runoff and a reduced drainage capacity. A Dutch risk reduction team supported by Wetlands International organized a scoping mission in 2015 to assess the situation further and evaluate ways to address the flooding problems. One of their key recommendations was for the municipality to start multi-stakeholder water management dialogues.

The water dialogues provide a platform to facilitate inter-sectoral learning and opportunities for cooperation between stakeholders to initiate a new water management process and help optimize water governance. Community groups and representatives of the Juan Diaz neighbourhood, private developers, national and local authorities, universities and NGOs participated in the dialogues. The dialogue process resulted in an action plan including grey and blue-green infrastructural works such as dikes, walls and wetland reservoirs to reduce the flood risk. The action plan also details various regulatory adjustments, including municipal agreements, legal tools and a risk zone map to prevent inadequate and unplanned construction in flood risk zones. *Source*: Extracted from Words into action: Nature-based solutions for DRR. For more information, see https://www.wetlands.org/casestudy/living-water-wetlands-flood-risk-reductionpanama-city/ and https://www.ramsar.org/

Operation Cooling Centers to Address Future Climate Risk Needs of the Vulnerable in the Republic of Korea

Due to climate change, the number of heatwave days in the Republic of Korea is expected to increase from 10.1 to 35.5 per year by the late 21st century. The Korean population is rapidly aging and in 2026 is expected to become an ultra-aged society. As the population ages, the number of older people vulnerable to heatwaves is increasing.

Figure 7 - Customized Cooling Center in Bucheon

Source: Hwang Hae-kyung (2020). *http://www.ecolaw.co.kr/news/articleView.html?idxno=87239*

The Republic of Korea undertook various efforts to reduce human damage caused by climate change. One of them is the Customized Cooling Center project, which provides vulnerable citizens, including the elderly living alone or in poor housing conditions, with a cool place to rest. The project aims to reduce death and illnesses due to heatwaves. For more information see UNPSA initiative Operation of Cooling Centers to reduce the damage caused by heatwaves.

Using Cybersecurity to Protect Digital Inclusion Assets in Mauritius

As connectivity increases and more people have access to the Internet, there is a growing demand for more security and privacy protections to ensure online spaces also are safe spaces. While technology can enhance benefits to society, it also can increase risks to users. Governance frameworks that manage digital spaces based on multi-stakeholder initiatives and transparency are needed.

In 2017, Mauritius ranked first in Africa in terms of country commitment to cybersecurity. The country took a collaborative approach to cybersecurity measures that included the most vulnerable stakeholders. That inclusion was a key component of the country's digital transformation. Mauritius also has established a regional capacity-building centre for Africa, which supports the formulation of cybersecurity legislation and encourages collaboration among countries to prevent cyber-attacks and build capacity around cybersecurity. For more information, see UN-HABITAT's Centering people in smart Cities: A playbook for Local and Regional Governments (page 48).

Case Study: E-Estonia

Figure 8 - E-Estonia

Source: Antoine Beausoleil (2019). *https://legrandcontinent.eu/fr/2019/08/13/redefinir-ce-que-cest-detre-un-pays-a-tallinn-lhyperconnectee/*

e-Estonia is a successful example of a multi-stakeholder approach to digital transformation led collaboratively by the government, the private sector and the Estonian population. Estonia faced challenges associated with the digital divide and the country did not have a data collection and governance strategy. The government recognized that technology can help optimize resources and maximize efficiency, and credits much of its successful digital transformation to the Estonian people, who were open to adopting new digital solutions.

The principles of the Estonian e-governance strategy include:

- Integrity - data information and communication are fully accountable.
- Interconnectivity - all services and data are interoperable and available for access.
- Transparency - citizens can verify their personal information and how it is used.

Local government measures the success of digital transformation using several indicators, including:

- Electronic identification for all users (almost 98 per cent of the population).
- Years of working time saved thanks to data exchange (844 years every year).
- Health care outcomes (99 per cent of patients in the country have digital health records).

In the future, Estonia plans to digitize all basic services and provide citizens with a good user experience to access e-services automatically, without disruption. The e-Estonia digital solutions also aim to build a competitive advantage for the country by developing capacities to run a business online, providing real-time economic transactions and investing in digital resources for education. For more information, see UNHABITAT's Centering people in smart Cities: A playbook for Local and Regional Governments (page 48) and E-Estonia facts and figures.

Exercises

Exercise	Answer
Prioritize the top five risks your city faces by likelihood and impact (low to severe)	
Prioritize the potential impact of emerging and future risks your city will face by 2030 -- Note where your city gets information on those risks	
List the top three risks your city is likely to face in 2050	
List the ecological, logistical, environmental or other systemic risks to which your city is exposed	
List city plans that are risk-informed, including the existing, emerging and future risks, and list those plans that should be risk informed	
Prioritize stakeholders who should be involved in making risk-informed plans, such as science and technology advisory groups or the private sector, and suggest how to engage them and other stakeholders	
List resilience networks or support organizations your city participates in, identify and prioritize gaps in support and potential collaborations to fill those gaps	

For a better understanding of where your city is on its resilience journey, complete the following

- Quick Risk Estimation (QRE)
- MCR2030 Resilience Roadmap Stage assessment
- Disaster Resilience Scorecards for Cities – The approach is designed and suggested for a one or two-day multi-stakeholder workshop. It provides a good indication of where the resilience journey can take your city.

For further support and next steps, explore MCR2030 and resilient networks. Also see Annex 1 of this handbook.

Takeaway Building Blocks for Local Action

Processes

To strengthen resilience, cities and local communities should risk-inform all strategies, planning, financing and budgeting coherent with national and regional agendas. Building blocks include:

- Risk-informed existing and future public and private strategies and investments to **finance resilient cities** and protect existing investments: local, national, regional and global finance can be explored with national and city-to-city networks.
- **Planning** to strengthen resilience considering all existing, emerging and future risks within city strategies, planning, data and fiscal processes, consistent with investments in climate and new technology: strategies and plans need to consider the risk inherent in support systems such as physical, cyber, geographic, logistical or resource-dependent systems, including systems outside a city's authority.
- City-to-city platforms, including MCR2030, offer **products**, peer-to-peer support and established roadmaps on the journey towards resilience.

Mechanisms

To strengthen resilience, cities and local communities should institutionalize disaster and climate resilience cooperation, leveraging innovative technologies where appropriate, to achieve and protect sustainable development and engage all stakeholders. Building blocks include:

- **Formalize institutional arrangements** such as local forums to engage all stakeholders for a shared understanding of risk and to remove administrative and sector silos, including neighbouring authorities with shared eco-systems consistent with national and regional authorities' agendas.
- **Use digital technologies and science** to create a shared understanding of how to manage and integrate risk, especially using compatible geo-data and earth-monitoring data and the Internet of Things to monitor risk. Partnerships with science and technology actors pay dividends, including accessing and using global and regional open-source data systems.
- Integrate risk-informed principles of resilience and sustainability into **legal and policy frameworks** guided by effective governance principles such as inclusiveness, accountability, efficiency, people-centric digital governance, risk management frameworks or national and international standards.
- Invest in whole-of-society **partnerships**, including public-private partnerships for shared resilient business and services, the science-policy interface to engage transformative technologies and civil society for inclusion and long-term change.

People

To strengthen resilience, cities and local communities' benefit when they invest in people to make long-term changes. Building blocks include:

- **Invest in leadership** to create a shared vision to break down silos, bring in local knowledge and local solutions with a shared understanding and strategy to strengthen resilience against existing, emerging and future risks.
- Invest in people-centred innovative technologies, ICT and partnerships to allow local governments and citizens to control technologies' development, evaluation, purchasing and use in public services, ultimately building **human capacity** at all levels to co-create practical solutions for cities to strengthen resilience.
- Maximize people-centric digital governance practices, transparency and inclusivity in public e-participation with respect to digital human rights, unlocking residents' potential to play a key role in the development, evaluation and decision-making around smart cities.
- Improve access to **knowledge** and products through local partnerships, national authorities, science hubs, standards agencies, peer-to-peer networks and guided pathways.

Chapter 2: Leveraging Risk-Informed Governance, ICTS, Digital Governance and Frontier Technologies for Resilient, Smart and Inclusive Cities

Chapter 2: Leveraging Risk-informed Governance, ICTs, Digital Governance and Frontier Technologies for Resilient, Smart and Inclusive Cities

Rationale and benefits

New technologies such as information communication technologies (ICT), frontier technologies and e-governments strengthen resilience by leveraging risk-informed governance to improve public service delivery, increase citizens' engagement, enhance transparency and foster accountability and inclusion. Technology, especially ICT, is now a critical infrastructure supporting the social and economic fabric of cities. Leveraging innovative technologies increases access to reliable, accurate and timely information at all levels of society and can ensure people remain central to building resilience. Innovative technologies also can amplify existing vulnerabilities, biases and risks and increase the digital divide, which largely impacts historically disadvantaged communities.

Expected Learning Outcomes

This handbook complements Module 1 of the UN DESA 2021 Handbook on Risk-informed Governance and Innovative Technology for Disaster Risk Reduction and Resilience. Learning outcomes for this chapter include:

1. Readers are introduced to the benefits and risks of leveraging risk-informed governance, ICTs, digital government and frontier technologies for resilient, smart, inclusive cities.
2. Readers are introduced to the concepts of cascading and emerging risks associated with technologies.
3. Readers are introduced to approaches and good practices to guide progress and strengthen resilience.

Concepts

A **Smart City** is an urban area that invests in digital infrastructures, information and communication technologies, connected communication systems and web-based devices, (often referred to as the “Internet of Things”, or IoT), to collect data, manage assets and improve the social and economic foundations of the city. Smart cities strengthen resilience by leveraging risk-informed governance and technologies such as geographic information systems (GIS), remote sensing, big data, open government data, drones and artificial intelligence (AI). Innovative technologies support more robust, timely, accurate, disaggregated, people-centred and accessible information as a tool for decision-making for disaster risk reduction (DRR) and building inclusive and resilient societies.

Digital transformation is critical to meeting the demands of sustainable urban development. In the past decade, Internet connectivity has become a requirement for full participation in society, including accessing education and critical government services.

According to UN-HABITAT’s Assessing the Digital Divide: Understanding internet connectivity and digital literacy in cities and communities, 3.7 billion people globally were offline in 2019. The COVID-19 pandemic introduced even greater urgency for local and national governments to bridge the digital divide, especially for marginalized groups and informal settlement communities, and to build more efficient and secure data management systems and protect citizens’ privacy when using digital services. The digital divide’s impact is felt across many sectors, including education, workforce development, and financial inclusion.

During the COVID-19 pandemic, as schools closed and turned to the Internet to provide remote instruction, in developing countries an estimated four out of five children were without Internet access and were left behind.

Leveraging innovative technologies can boost the local economy and make cities more sustainable, efficient and a better place to live. Innovative technologies and digital governance make public service delivery more efficient and people-centric, improve access to reliable sources of information, increase citizens' participation and enhance transparency, accountability and inclusion. Digital technologies allow risk managers to make evidence-based decisions and to communicate faster and more effectively with more people. However, technologies also can be a threat if their risks are not understood and adequately mitigated. Technologies such as AI can amplify bias and inequalities. Access to digital infrastructures and services can create newly marginalized groups. It is critical to keep that risk in mind when designing digital solutions and using innovative technologies.

Approaches

Leveraging Technology in Planning Processes and Investments

New technologies provide local governments with tools to create smart, resilient and inclusive cities. They also allow local governments to understand and better govern existing, emerging and systemic risks, facilitate whole-of-society approaches and apply evidence-based decision-making. Tools to support leveraging technology in planning processes and investments include:

- Leverage geospatial data to better inform existing spatial planning by integrating existing, emerging and future risks: for more information, see the video Geospatial Technology and the Sustainable Development Goals at http://bit.ly/2E0NDy3.
- Leverage existing earth monitoring systems, especially early warning systems, by using the connected Internet of Things: for more information, see Chapter 3, page 18 of How Malawi Modernized Its Community-Based Flood Early Warning Systems.
- To increase the efficiency and effectiveness of existing disaster risk management capacities, leverage frontier technologies such as drones and smart materials: for more information, see the video: Frontier Technologies for a Sustainable Future https://youtu.be/NzFTbhmiMyk.
- Use mobile phones to communicate better and faster with more people. This is especially important for disaster management early warning systems and to provide real-time data, which can save lives and mitigate impacts. Real-time mobile phone data also helps conduct rapid assessments, which provide valuable insights into disaster response systems. For more information, see Chapter 3 of this handbook,Connecting people, things, and information for building resilience.

To leverage innovative technologies, cities and local communities should:

- Invest in open data, placing data at the centre of discussions on urban resilience and disaster risk reduction: for more information, see the open data infrastructure resilience roadmap showcasing how open data-based approaches, combined with the use of geo-spatial data and geographic information systems (GIS), can generate substantial resilience dividends for city authorities.
- Invest in sharing and accessing global (open) information and technologies, including the Group on Earth Observations (GEO): GEO is a partnership of more than 100 national governments and more than 100 participating organizations that envisions a future where decisions and actions for the benefit of humankind are informed by coordinated, comprehensive and sustained earth observations. GEO's global priorities include the Sustainable Development Goals, climate action, and disaster risk reduction. For more information, see the Group on Earth Observations website.
- Invest in the science-policy interfaces to engage science and technology innovators with practitioners through partnerships with universities or by establishing urban labs: for more information on how to recognize Science, Technology and Innovation as a driver for Sustainable Development, see the UN DESA video http://bit.ly/2YAUXIN.

Technologies, Resilience, Emerging Risks and Critical Infrastructure

Technology and innovations enable more efficient services but there also are risks for cities using them. To reduce risks and strengthen resilience, cities should:

- Frame technologies within a legal framework that considers all potential issues and risks, for example, cybersecurity, licensing, cost of infrastructures, governance mechanisms and coordination among the authorities and data privacy: Many legal and regulatory systems are national or regional in nature. Cities need to work with national and regional authorities and establish dialogues and forums with the private sector, academia and civil society to ensure risks are integrated into the design and governance of new digital technologies.
- **Put people at the centre of effective digital governance and equally ensure online and offline participation**. Cities should provide a solid foundation to use technologies to strengthen resilience to existing, emerging, and future risks, including risks arising from new technology. The UN Department of Economic and Social Affairs (UN DESA) publishes the E-Government development index (EDGI), a UN composite indicator that assesses governments' performance in their digital transformation path, benchmarking countries against six key factors of readiness: organizational, governance and leadership, customer, competency, technology and legal. For more information, see the E-Government Development index website.

Addressing the Digital Divide

UN-HABITAT's Assessing the Digital Divide: Understanding internet connectivity and digital literacy in cities and communities is a playbook for local, regional and national governments, policymakers, civil society and non-governmental organizations. The playbook builds on the People-Centred Smart Cities framework, which presents a holistic approach to developing smart cities that leverage data, technology and services to empower people. The framework rests on five pillars: community, digital equity, infrastructure, security and capacity.

As noted previously in this handbook, the digital divide is the gap between those who have access to and use ICTs and those who do not. This includes Internet connectivity, Internet-enabled devices and digital literacy skills. To address the divide, communities need to establish a robust and sustainable digital connection, particularly as services such as education and workforce development move online. Internet connectivity is widely regarded as the foundation for participation in a digital society and a pillar of digital human rights. Without robust, affordable, sustainable and inclusive Internet connectivity, participation in a digital society and access to digital service offerings remain systemically exclusive.

Access to broadband connectivity is necessary to attract businesses, industries and jobs to underserved communities. The digital divide is a known barrier to financial inclusion, as it limits opportunities for empowering the public as savers, lenders, borrowers, investors and taxpayers.

The digital divide largely impacts historically disadvantaged communities. While every community is different, the digital divide consistently reflects and amplifies existing social, economic and cultural inequalities such as gender, age, race, income and ability. Section 05 of the UN-HABITAT's Assessing the Digital Divide: Understanding internet connectivity and digital literacy in cities and communities highlights the communities that are known to be disproportionately affected by the digital divide: women and girls, children and youth, older people, urban and rural poor, marginalized or minority communities, persons with disabilities, refugees, persons on the move and indigenous communities. For more information, see UN-HABITAT's Assessing the Digital Divide: Understanding internet connectivity and digital literacy in cities and communities.

Innovative Cases

Using Science for Early Warning of Epidemics

The Early Warning Systems for Mosquito-borne Diseases (EYWA) project is a game-changer in the field of epidemics. Based in Greece, the European platform won the European Innovation Council- Horizon Prize for "Early Warning for Epidemics". EYWA reduces the risk and results of mosquito-borne disease by reliably depicting the dynamics of mosquito habitats and breeding sites. EYWA translates scientific knowledge to support decision-making and makes an essential contribution to combating and controlling the threat of mosquito-borne diseases. EYWA enhances mosquito surveillance and control at various spatio-temporal scales and in different climatic zones and guides day-to-day prevention and mitigation actions. The technological novelty of EYWA lies in the efficient processing of multiple earth observation data sources, such as entomological, epidemiological and crowd-sourced data, together with dynamic and data-driven models to generate knowledge about mosquito abundance and pathogen transmission. The system capitalizes on European investments in earth observation and cloud-based data repositories and capacities.

Fostering Co-creating Solutions with Innovative Technologies

The Moscow Innovation Pilot Program - fostering innovation to deliver inclusive and equitable services for all, including digital transformation, is part of the "Moscow – Smart City 2030" strategy. The programme recognizes the dynamic and innovative value of start-ups and small and medium-sized enterprises (SMEs). To support innovation, the programme facilitates the market for small and medium-sized technology companies to test their innovative solutions with a wide range of potential users at more than 90 urban and commercial facilities in Moscow. The programme provides an easy entry point for innovations in the smart city market and helps overcome procurement challenges with public and prominent private actors. Start-ups drastically reduce the time to development, avoiding lobbying or spending time communicating with the city and corporations – who, in return, receive the cutting-edge products. The programme goals are to improve the quality of life with innovative solutions and to foster citizen engagement in innovative development. It is the first programme in the world of such scale and ease of access. For more information see the UNPSA database Moscow Innovation Pilot Program.

Digital and Open Government as a Foundation for a Smart Resilient City

A comprehensive citizen platform lays the foundations for the transformation towards a smart and sustainable city, strengthening resilience and keeping people central to governance. The Municipality of Coatzacoalcos, Mexico invested in the *Cotzabierto* project, using technology to enhance citizen services, apply effective governance practices and transform into e-government. The municipality invested in modernizing the city's ICT infrastructure to generate citizen-oriented digital services that improve citizen communication, participation, collaboration and empowerment by creating a modern, intelligent city. The open, reliable and accessible data provide information for better decision-making and fast and efficient communication with citizens, building trust, transparency and accountability. The project also invests in strengthening information and cybersecurity. For more information, see the UNPSA Initiative Coatzabierto project – strategy of open government and intelligent city.

Connecting Young People Around the World to the Internet

Launched in 2019, Giga is a joint UNICEF-ITU initiative with the objective of connecting every school in the world to the Internet. To date, Giga has connected more than 1 million students and more than 3,200 schools to the Internet in Africa, Central Asia, Latin America and the Eastern Caribbean.

The location of more than 1 million schools has been mapped on Giga's open-source platform, Project Connect. Connectivity infrastructure in 18 countries also has been mapped, enabling Giga to propose technical solutions to help governments get more schools online. Support has been secured from 14 partners, including Ericsson, Dubai Cares and the Musk Foundation, to develop solutions for affordable, sustainable connectivity. The project sets the scene for the further work needed if all schools are to be online by 2030. For more information, see the Giga Annual Report 2021.

Connectivity for Refugees

The UNHCR believes that displaced populations and communities that host them have the right to be part of a connected society and to have access to technology that enables them to build better futures for themselves, their families and the world. UNHCR works towards inclusion of displaced populations and host communities, availability of services and affordable access to meaningful Internet connectivity. UNHCR believes digital connectivity can be a tool for self-reliance and positive change only when Internet access is available to all, inclusive of displaced and host communities alike. For more information, see the Connectivity for Refugees Emergency Handbook.

Exercises

Exercise	Answer
List the ICTs, digital governance and frontier technologies your city currently uses for planning, such as geospatial, earth-observation, or satellite data. Prioritize technologies needed for resilience building.	
Prioritize the science and technology stakeholders that can support incorporating medium- and long-term climate scenarios into strategic and investment planning.	
List science and technology actors involved in your city's disaster risk reduction planning. Prioritize those who should be engaged.	
List the available digitization or open government assessments and plans already conducted and prioritize those that should be accessed.	

To better understand where your city is on its resilience and technology journey, complete the following:

- Open Government Data (OGD) Readiness Assessment
- E-Government assessment tools

For more information and support, see Annex 1 of this handbook. Also see: Group on Earth Observations website.

Takeaway Building Blocks for Local Action

Processes

Processes should facilitate a multi-stakeholder shared vision coherent with national objectives, climate change and global technology-driven opportunities.

- Appropriate regulations and forums facilitate the public, private, technology and civil society partnerships to **finance** resilience in innovation and align with national and regional plans on digitization and new generation technologies such as 5G.
- **Planning** needs clear objectives, budget lines and a shared vision with stakeholders to co-create solutions to risks when leveraging technology.
- **Products** and innovative technologies are nationally regulated and globally developed, ready for cities to leverage. Investments must have system-level planning, such as for 5G.

Mechanisms

Mechanisms should allow global developments to inform local action and ensure actions do not increase inequalities or reduce resilience.

- **Institutional arrangements** connect city stakeholders with national, regional and global technological opportunities and open-source data such as Global Earth Observation.
- Investments in the science-policy interface, urban labs or multi-stakeholder forums facilitate the local leveraging of **digital technologies**.
- Ensure **legal and policy frameworks** are coherent with national, regional and global innovations and regulations, depending on the scope of the system.

Partnerships

Partnerships recognize global opportunities for creating local action.

- Ensure **people** are central to the design of innovations and use of technology. Involve people in designing resilience initiatives.
- A shared long-term vision should be created with collaborative mechanisms for action and investment with all stakeholders, including the private sector, academia and civil society.
- Invest in the **human capacity** to take global opportunities for local action. This can be guided by the Competency Readiness and e-Government Customer Readiness assessment.

Chapter 3: Innovative Technologies and Innovative Cases

Chapter 3: Innovative Technologies and Innovative Cases

Rationale and benefits

Innovative technologies are driving progress, laying the foundation for a fourth Industrial Revolution. This chapter builds on module 2 of the UN DESA 2021 Handbook on Risk-informed Governance and Innovative Technology for Disaster Risk Reduction and Resilience, and introduces five main areas on how innovative technologies change the way cities build resilience.

Expected Learning Outcomes

This handbook directly complements and is structured on module 2 of the UN DESA 2021 Handbook on Risk-informed Governance and Innovative Technology for Disaster Risk Reduction and Resilience. Expected learning outcomes for this chapter include:

1. Readers are introduced to innovative technologies and innovations to better understand how technologies might contribute to a city's resilience.
2. Readers are introduced to institutions and building blocks to support access to new and emerging technologies from regional, national and global organizations and initiatives.
3. Readers are introduced to UN DESA's city e-government assessment framework and how to apply its methodology in countries.

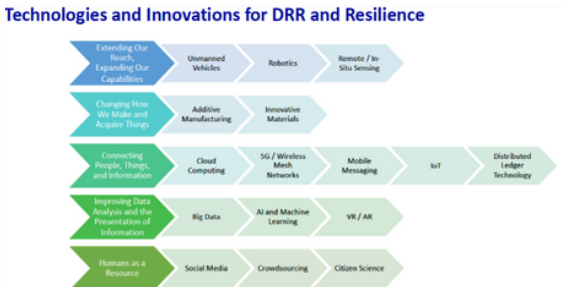
Concepts

The Fourth Industrial Revolution is changing the way people live, work and relate to each other. Cities are at the centre of this technology-driven revolution. The speed of current technological breakthroughs has no historical precedent and is disrupting almost every industry in every country. The breadth and depth of these changes herald the transformation of production, management and governance systems. The first Industrial Revolution used water and steam power to mechanize production. The second used electric power to create mass production. The third used electronics and information technology to automate production. The fourth builds on that and is characterized by a fusion of technologies blurring the physical, digital and biological spheres. For more information, see the World Economic Forum's Fourth Industrial Revolution.

Approaches Supporting Science, Technology and Innovations

Innovative technologies affect the lives of billions of people connected by mobile devices that have unprecedented processing power and storage capacity, providing users with access to vast amounts of information. Emerging technology breakthroughs in artificial intelligence, robotics, the Internet of Things, autonomous vehicles, 3-D printing, nanotechnology, biotechnology, materials science, energy storage and quantum computing expand the possible ways technology can impact lives. Cities are developing infrastructure, regulations, incentives and collaborations to foster technology and its innovative use for resilience. For more information, see the World Economic Forum's Fourth Industrial Revolution.

Figure 9 - Module 2 from UN DESA 2021 Handbook on Risk-informed Governance and Innovative Technology for Disaster Risk Reduction and Resilience



Source: *https://unpan.un.org/sites/unpan.un.org/files/DRR%20Handbook.pdf*

Innovative technologies are changing the way we do things in five fundamental ways related to building resilience.

1. Extending Our Reach, Expanding Our Capabilities to Build Resilience

Unmanned Autonomous Vehicles (UAV) – Emergency response and recovery teams increasingly use unmanned vehicles and satellite data to assess post-disaster damage and rapidly inform a plan of action. Those unmanned vehicles, fixed-wing and rotary-wing UAVs also are being used to reduce the risk to responders. For example, in 2011, the Great East Japan Earthquake and Tsunami damaged the Fukushima nuclear power plant and resulted in radiation contamination. In the aftermath of the disaster, responders used UAVs to complete 3-D mapping of the impacted zone, rapidly providing much-needed information and protecting lives. For more information, see pages 171-177 of UN DESA's 2021 Toolkit on Risk-informed Governance and Innovative Technology for Disaster Risk Reduction and Resilience.

Robotics – Robots are increasingly being used worldwide in building things and to deliver goods. They also are being used to assist (not replace) people during disaster recovery work. During the COVID-19 pandemic, robots were used to support medical staff, including by disinfecting patient rooms and operating theatres in hospitals. An array of powerful short-wavelength ultraviolet-C (UVC) lights were used that emit enough energy to shred the DNA or RNA of microorganisms. For more information on how robots played a role during the pandemic, see this World Economic Forum article and an IEEE article on Autonomous robots in hospitals. For more on how robots play an important role in risk management by reaching out to rescue missions, see the videos Search and Rescue in Extreme Environments and After Disaster Strikes.

Remote/in situ sensing – Climate information supports policy and practice to address weather-related risks. Data availability, access and reliability remain significant challenges in gathering that information. One effort that does so is the Copernicus Climate Change Service, which generates information for assessing risks associated with extreme rainfall events in Europe. It is designed to inform the implementation of the Sendai Framework for DRR 2015-2030. Another example is the EU Civil Protection Mechanism, which compels the multi-hazard risk assessments and climate change adaptation strategies and plans. For more information, see the pluvial flood risk assessment project in urban areas. For more information on the benefits of earth monitoring, including disaster risks, see the Video on Copernicus is the European Union's Earth Observation and Monitoring programme. For more information on how remote sensing technology can be used to monitor flooding in real time, see the video with Bessie Schwarz, Co-founder and CEO of Cloud to Street.

2. Changing How We Make and Acquire Things to Build Resilience

Additive manufacturing – During COVID-19, to help with ongoing personal protective equipment (PPE) shortages and challenges in global supply chains, an Ontario-based nanofiber manufacturer collaborated to create a local supply chain for protective masks using additive manufacturing. For more information and details on how 3-D printing works, see this article on personal protective equipment (PPE). To learn how 3-D printing addresses operations challenges in disaster management, see this article by Oscar Rodriguez-Espindola and Ahmad Beltagui on how 3-D printing technologies help address potential disaster management challenges.

Innovative materials – Climate change increases the heat island effect for cities and stresses building materials, including paint. To address that challenge, the Dubai central laboratory developed a paint using nanotechnology. The paint has reduced maintenance costs by 22 per cent, increased the building's lifespan and reduced carbon emissions by 10 per cent using biomass, binder and recyclable packaging. The cool pigments technology in the nanopaint reflects solar energy, reduces the temperature inside buildings and makes more for comfortable living conditions. The effort was a UNFSA nominee. For more information, see the Effect of NANO technology in the paint under Dubai climatic conditions.

3. Connecting People, Things and Information to Build Resilience

Cloud computing – Slow access to information increases the negative impacts of disasters. In Turkey, after the Gölcük/Yalova earthquake in 1999 and the Erciş/Van earthquakes in 2011, poor communication slowed relief efforts. The Government of Turkey invested in a "Disaster Management Decision Support System" (AYDES) to provide current, accurate data and analyses at every stage of a disaster. The reliable, easily accessible information and communication tool improved decision-making and coordination and allowed public institutions and NGOs to meet humanitarian needs in a timely, coordinated and efficient manner. The system provides all community members equal access to disaster-related information and effectively reduces the impacts of disasters. Estonia also has successfully used cloud computing. For more information, see the video http://bit.ly/30goY20.

5G and wireless mesh networks – 5G and wireless mesh networks are enabling "smart city" infrastructures, such as autonomous bus lines, improved traffic monitoring and management, electricity and water system management and all sorts of new consumer technologies that simply are not possible with a 4G network infrastructure. For more information on how 5G technology works, see the video http://bit.ly/2tmO4R6. For information on how mesh networks work see http://bit.ly/37i4Y2e. For an example of how 5G improves emergency response, see this interview with Mariana Beckham, an emergency medical technician.

Mobile messaging - Mobile technology allows people to report hazards when they occur and allows authorities to act quickly on those reports. Safety e-Report was launched in the Republic of Korea in September 2014 as what was then the world's only safety hazard report system run by a government. E-report allows Koreans to report and track the status of any safety hazards around them, such as damaged facilities, fire hazards and standing or parking violations. They can do so by taking a photo or video and uploading it to the Safety e-Report web portal or via a mobile application. Accessibility is an important element of the site, which includes a means to enlarge text, an English-language service, and a speech-to-text and text-to-speech converter. For more information, see UNPSA awards nominee from the Republic of Korea, A Safety-Keeper in My Hand, Safety e-Report.

Internet of Things – In one example of how the Internet of Things can help build resilience, Malawi improved flood warning information by integrating GEOGloWS-ECMWF Streamflow Forecasting into a Community-Based Flood Early Warning System. With support from international partners, Malawi established an operational hybrid flood forecasting system using telemetry data from 21 river stations and the GEOGloWS-ECMWF streamflow forecast (bias-corrected) for the eight flood-prone districts. Investments were made in modernized climate information and early warning systems to increase warning lead time to produce a 15-day forecast on every river. This increased lead time allows community preparedness to take early action and significantly reduce flood risks. In January 2022, Cyclone Ana hit Malawi, causing severe flooding. Thanks to the GEOGloWS-ECMWF streamflow forecast and other resources, service losses and damages were limited. For more information, see UNPSA initiative Improving Flood Warning Information in Malawi. For more on how the Internet of Things keeps governments and citizens informed about natural disasters, see the video featuring Ramneek Kalra, member of Institute of Electrical and Electronic Engineers.

Distributed ledger technology (DLT) is a digital application that enables and rides on top of distributed ledgers without requiring an administration centre or centralized database. DLT is applied to e-commerce and banking, information management, document, storage, legal practices and Blockchain components. DLT has no direct transaction cost but, in some forms, uses large amounts of energy, creating risks to the electric system. However, as the technology evolves, so too do the risks and indirect transaction costs. Newer state-of-stake processes such as Ethereum use 1 per cent of the energy of state-of-proof technologies such as blockchain. For more information, see page 309 of UN DESA's 2021 Handbook on Risk-informed Governance and Innovative Technology for Disaster Risk Reduction and Resilience.

4. Improving Data Analysis and the Presentation of Information to Build Resilience

Big Data and analytics enable both users and key decision-makers to generate predictions of current and future impacts of risks. One example of a platform using big data for such purposes is The Pacific Disaster Center (PDC), which provides actionable information to save lives and reduce disaster risk. Many of its solutions are technology-based, including its flagship Big Data Analytics platform, DisasterAWARE™, tailored to the needs of the disaster risk management community. The platform incorporates thousands of different data sets, including static information such as population data or the location of hospitals and fire stations. It also includes other dynamic databases that are constantly updating, such as those tracking wind, precipitation, temperature, satellite imagery and radar imagery. The system also incorporates data from social media, news feeds and web cameras such as traffic cameras. Big Data and data analytics bring the power of this real-time information together to empower decision-makers with real-time information to make real-time decisions. For more information, see DisasterAWARE® Reduces Disaster Risk, Saves Lives.

AI and machine learning – Electricity underpins social and economic progress. Improving distribution analysis and maintenance strengthens the resilience of the electric power generation system. Continuity of electricity supports security and reliability by strengthening resilient infrastructure. In Thailand, real-time data analytics and artificial intelligence reinforced the maintenance process of electrical power system infrastructure to ensure continuity of power delivery. For more information, see UNPSA awards nominee Integrated predictive maintenance using Integration of Maintenance Innovation for human well-being for more information.

Virtual Reality (VR) and AR – The Asian Institute of Technology (AIT), Thailand, and U-Inspire Thailand developed a Virtual Reality (VR) application for flash floods education in Thailand. The VR allows users (in this case, school children) to experience a simulation of flash floods, providing them with a virtual experience and deeper insights into what would happen and how to respond if flooding occurred. The technology can be replicated to other hazard types and other user groups to support awareness-raising, simulations and education. For more information, see page 73 of the UNDRR ASIA STAG report.

5. Humans as Actors to Build Resilience

Social Media – As weather patterns intensify and become increasingly unpredictable, cities in Indonesia are regularly faced with the challenge of anticipating and responding to extreme weather events. A lack of access to verified real-time data compromises people's ability to make informed, evidence-based decisions concerning planning and response, resulting in ineffective resource management, confusion and conflict. PetaBencana.id is a free web-based platform reducing risk from disasters and increasing emergency response times by providing free real-time disaster information and transparent communication between residents and government agencies. By enabling reliable, non-trivial communication between users and government agencies, the platform promotes civic co-management as a form of megacity climate change adaptation. For details, see UNPSA nominee PetaBencana.id.

Crowdsourcing – As part of the G20 Global smart city alliance pioneer programme, the city of Bogota issued a Statement of Intent for Open Data with crowdsourcing capabilities. The statement recognized the city administration's goal of providing citizens with a tool to transform governance, improve the link between citizens and public management through technology and allow each citizen to access information and spaces for participation from any computer or mobile device. Under this vision, the Mayor's Office of Bogota designed the Bogota Open Government strategy to transform Bogota into a city where data, technology and innovation serve all citizens to improve their quality of life. The guarantee of access to public information and specifically open data is a cornerstone of this process. Data is a fundamental input for public policy, for decision-making, to generate economic value and to support academia. The Open Government strategy aims for open data to anticipate and capture the benefits of new digital technologies, such as the Internet of Things and Artificial Intelligence. For more information, see Statement of Intent for City of Bogota.

Citizen Science – In the Philippines' local governance system, there is one youth council in each village. Pagadian, officially known as the City of Pagadian, is a second class component city and the capital of the province of Zamboanga del Sur, Philippines. In Pagadian, 12 coastal village youth councils are working to save and propagate mangroves. The youth assist in the initial assessment of the current condition of mangroves, then help select appropriate mangrove species and reforestation sites based on advice from experts and available resources. The youth councils also share information on the importance of mangroves with residents of their villages to convince them to join mangrove conservation and rehabilitation efforts. For more information, see page 67 of UNDRR ASIA STAG report case transdisciplinary Citizen Science Project on Mangrove monitoring and rehabilitation (Philippines).

UN DESA's city e-government assessment framework and how to apply its methodology in countries

ICTs can play an essential role in achieving an improved form of governance, especially when employed locally. The Local Online Services Index (LOSI) of the United Nations E-Government Survey 2022 demonstrates e-government development at the local level through the assessment of city portals. LOSI includes 86 indicators relating to five criteria: institutional framework, content provision, services provision, participation and engagement and technology.

UN DESA applied the LOSI methodology to the most populous cities in 193 UN Member States. The most populous cities were selected to reach as many residents as possible. There was strong interest expressed in applying the LOSI methodology to more cities in a single country. To achieve this, UN DESA finalized a Memorandum of Understanding (MOU) legal document and partnered with other institutions to run LOSI pilots. UN DESA welcomes collaboration in applying LOSI methodology in additional countries. Interested parties are encouraged to send an email to dpidg@un.org.

Exercises

Exercise	Answer
Review the list of features used to assess city e-government portals found in the Annex of the United Nations E-Government Survey 2022	
Share your observations about this list in a short, one-page essay	
Assess your city's e-government portal	
Write a short essay on the performance of your city's e-government portal based on the assessment conducted	

To learn more about LOSI methodology and how to apply it in your country, please visit this link: https://bit.ly/UNDESA_LOSI

- **Review the individual country reports**
- **Prepare a few slides on the main findings (one or two slides per country, with a maximum of 12 slides)**

Prepare a project plan to conduct an assessment exercise in your country

- **To support execution of that plan, contact UN DESA by sending an email to dpidg@un.org**

Chapter 4: Infrastructure Asset Management to Build Resilient and Sustainable Cities

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Rationale and benefits

Infrastructure is a foundation for the social and economic wellbeing of cities and local communities[3]. Resilient infrastructure reduces disaster and climate risk and supports the Sustainable Development Goals (SDGs). Resilient infrastructure not only protects the value and longevity of assets but also reduces the risk of social and economic losses and damage caused by the failure of a city's foundation and potential future investments. To build a resilient infrastructure, existing, emerging and future risks need to be integrated within the infrastructure and their supporting systems need to be aligned to its life cycle. Technologies such as ICT, AI, or the Internet of Things strengthen resilience and are pillars for social and economic growth. Good policies, principles, standards and risk-informed approaches can maximize benefits and reduce risks by protecting not only the infrastructure assets but also the social and economic benefits they support. Greater reliance on digitization and greater interconnectedness of infrastructure systems amplifies cascading risks. Infrastructure assets and systems that are not risk-informed disrupt the social and economic wellbeing they support.

Over the next 15 years, nations will need to build US$93 trillion worth of low-emission, climate-resilient infrastructure to meet the goals set out in the Paris Agreement[4]. Such investments in future-proofed resilient infrastructure also support future prosperity.

Expected Learning Outcomes

This handbook directly complements SDG 9 and module 1 of the UN DESA 2021 Handbook on Risk-informed Governance and Innovative Technology for Disaster Risk Reduction and Resilience. Learning outcomes for this chapter include:

1. Readers are introduced to the importance of resilient infrastructure in creating and protecting the development gains of cities.
2. Readers are introduced to good global practices and how they can adopt better policies, principles and implementation processes for managing assets and their systems outside city boundaries.
3. Readers are introduced to the benefits of understanding existing, emerging and future risks aligned to the life cycle of Infrastructure.
4. Readers are introduced to approaches and standards for future-proofing infrastructure assets.

Concepts

The importance of Infrastructure Asset Management to build resilient and sustainable cities is conceptualized in global agreements, but the fact that infrastructure in cities is increasingly interconnected with **Interdependencies**, posing significant **cascading social and economic risks** beyond the scope of the infrastructure itself, also needs to be considered. **Interdependencies** can be broadly divided into four types: physical (such as electricity or water), cyber (information and data), geographic (proximity and nature-based), and logistical or resource-dependent.

UNDRR defines critical infrastructure as "the physical structures, facilities, networks and other assets which provide services that are essential to the social and economic functioning of a community or society."[5] Critical infrastructure assets cannot operate in isolation but as "a system of systems". The failure of one structure could result in severe disruptions in others, causing a **cascading risk**.

Source: [3] G20 Principles for Quality Infrastructure Investment - Principle 1: maximizing the positive impact of infrastructure to achieve sustainable growth and development.
[4] Track #7: Infrastructure, Cities and Local Action. https://www.un.org/sustainabledevelopment/wp-content/uploads/2019/05/WP-Infrastructures-Cities-and-Local-Action.pdf.
[5]UNDRR. Critical infrastructure. *https://www.undrr.org/terminology/critical-infrastructure*

Sustainable Development Goal (SDG) 9 aims to "build resilient infrastructure, promote sustainable industrialization and foster innovation." Its targets focus on resilient infrastructure, including:

- Target 9.1 aims to develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.
- Target 9.4 aims to by 2030 upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries acting in accordance with their respective capabilities.

These targets emphasize the value of innovative technologies, coherence with climate adaptation and the importance of systems supporting infrastructure outside city boundaries.

The **2030 Agenda for Sustainable Development** calls for "sustainable industrial development; universal access to affordable, reliable, sustainable and modern energy services; sustainable transport systems; and quality and resilient infrastructure." The **New Urban Agenda** commits to financing and upgrading resilient and sustainable infrastructure and recognizes green and digital investments opportunities.

The **Sendai Framework for Disaster Risk Reduction 2015-2030** highlights the importance of infrastructure assets, especially critical infrastructure, as one of its seven global targets. Target D is to "substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including developing their resilience by 2030".

Approaches

Approaches to strengthen Infrastructure Asset Management for Building Resilient and Sustainable Cities include:

Taking a Systems Approach

Building resilience to existing, emerging and future risks requires planning within the entire infrastructure system, including physical, cyber, geographic, logistical or resource-dependent support systems. It is important to consider the following:

- **Consider the entire life cycle**. A life cycle approach requires that different resilience measures be applied at different phases of the infrastructure life cycle. Life cycle management focuses on the specific activities that must be undertaken during all four phases of the asset life cycle, namely, plan, acquire, use and dispose. It is essential to consider all risks, including hazards and threats, in the design phases and to retrofit as necessary. A comprehensive policy that enables resilience throughout the infrastructure life cycle is vital. For more information, see Managing Infrastructure Assets for Sustainable Development: A Handbook for Local and National Governments.
- **Consider eco-systems and nature and solutions and future climate scenarios. Nature-based solutions (NbS)** build resilience and are actions to protect, sustainably manage and restore natural and modified ecosystems in ways that address societal challenges effectively and adaptively to provide both human well-being and biodiversity benefits. The Economic Case for Nature demonstrates how protecting ecosystems can avoid trillions in losses to national economies. For more information on setting up and implementing nature-based solutions (NbS), including for climate change adaptation, see UNDRR 2021 Words into Action: Nature-based solutions for disaster risk reduction.
- **Engage system stakeholders**. Operators, policymakers and users affect the resilience of infrastructure. Securing resources to support resilience requires that interdependencies be addressed. Policymakers and operators need to go beyond a silo-based approach. A large share of critical infrastructure is either privately owned or operated. The resilience of these systems depends on governments partnering with infrastructure operators from the public and private sectors in resilience efforts through the establishment of suitable governance arrangements.

Understanding Interconnected Layers of Risk

For infrastructure assets to be resilient and sustainable, existing, emerging, and future risks must be considered, including risks within technology embedded within the system, such as the Internet of Things. Assessing all risks enables policymakers and operators to better prepare for the unexpected. This includes considering physical, cyber, geographic and logistical interconnectedness.

Cities and local communities need to assess risks, including those originating from outside a city's administrative boundaries, including infrastructures such as transport waste and water management. Risks arising from interdependencies and interconnectedness cannot be fully mitigated without incorporating their transboundary or international dimensions. Fostering international cooperation is key to infrastructure resilience. Understanding and assessing interdependencies and potential cascading risk is a vital component of the understanding risk approach. For more information, see the GAR2019 background paper Critical Infrastructure Interdependency Analysis: Operationalizing Resilience Strategies.

Flexible Approaches to Future Risks

Future risks need to be taken into consideration within infrastructure standards and design parameters. The interconnectedness of infrastructure, including within emerging green and digital economies, and infrastructure's reliance on ecosystems and transboundary collaboration must be considered. Several guides on **climate-resilient infrastructure** stress the importance of flexible, adaptive approaches to infrastructure design and management. Such approaches recognize the need to include flexibility and uncertainty in the design of future climate models and to strengthen the enabling environment to develop climate-resilient infrastructure, using climate model projections and considering other socio-economic and environmental factors. For more information, see the OCED theme on resilience and adaptation, which includes additional guidance on climate-resilient infrastructure. Also see the UN Environment Programme practical guide to climate-resilient buildings.

Taking a Standards Approach

Climate-resilient infrastructure standards can be divided into two categories:

- a direct application of metrics in rating systems to evaluate the sustainability and resilience of infrastructure projects – including CEEQUAL, Envision, IS Rating Tool, and SuRe®
- an indirect application of concepts related to climate-resilient infrastructure in standards, codes and guidance documents (such as discussed in Thematic Chapter 1 of this handbook), indicators for resilience at the city level, in the ISO 37123:2019 and the MCR2030 Disaster Resilience Scorecard for Cities. ISO also has standards to assess adaptation to climate change (ISO 14080:2018) and green investment criteria (ISO/DIS 14097).

For more information, see ISO, or CEEQUAL, a sustainability assessment, rating, and awards scheme for civil engineering, infrastructure, landscaping, and public realm projects.
Standards for Infrastructure assets are informed by global, regional or national bodies. National or regional codes such as Eurocodes provide contextualized standards for infrastructure, including structural safety codes of buildings and constructions. For more information, see European Standardization Organizations and SURE Infrastructure Resilience Standard.

Governance Approaches

Ensuring effective governance, policies and principles is at the heart of building infrastructure resilience.

Figure 10 - Principles for Quality Infrastructure Investment

Source: OECD (2021). OECD Implementation Handbook for Quality Infrastructure Investment: *https://www.oecd.org/finance/OECD-Implementation-Handbook-for-Quality-Infrastructure-Investment-EN.pdf*

The **G20 Principles for Quality Infrastructure Investment [6]** recognize infrastructure investment as a driver of economic prosperity and as being essential for resilience and sustainability. Principle 4: Building Resilience Against Disasters and Other Risks recommends that:

- Sound disaster risk management should be factored in when designing infrastructure. A comprehensive disaster risk management plan should influence infrastructure design, ongoing maintenance, and re-establishing essential services.
- Well-designed disaster risk finance and insurance mechanisms may also help incentivize resilient infrastructure by financing preventive measures.

The OECD recommendations for Good Governance for Critical Infrastructure Resilience emphasize the importance of making critical infrastructure resilience a policy priority and of using a multi-hazard system approach to building resilience. The document suggests following a structured approach with seven steps for critical infrastructure resilience policies. Policy questions and benchmark indicators are included for each step. The seven steps are:

1. Create a multi-sector governance structure for critical infrastructure resilience;
2. Understand complex interdependencies and vulnerabilities across infrastructure systems to prioritize resilience efforts;
3. Establish trust between government and operators by securing risk-related information sharing;
4. Build partnerships to develop a shared vision and agree on achievable resilience objectives;
5. Define the policy mix to prioritize cost-effective resilience measures across infrastructure lifecycles;
6. Ensure accountability and monitor implementation of critical infrastructure resilience policies;
7. Address the transboundary dimension of infrastructure systems.

OECD also provides policy advice on Climate-resilient infrastructure and a Policy Toolkit on Governance of Critical Infrastructure Resilience. For further information from OECD, see advice and toolkits for Strategic Policies for Sustainable Infrastructure.

Source: [6] A set of voluntary, non-binding principles designed to reflect the G20's common aspiration for quality infrastructure investment (including resilience).

The UN DESA-UNCDF publication on Managing Infrastructure Assets for Sustainable Development: A Handbook for Local and National Governments calls national and local governments to action and provides them with concrete guidance on how to ensure the resilience, sustainability and accessibility of existing and planned infrastructure investments. The handbook contains practical tools to improve infrastructure asset management along with recommendations on how to adapt them to socio-economic and environmental challenges such as climate change and public health emergencies. Finalized during the height of the COVID-19 crisis, the handbook brings global visibility to infrastructure asset management as a critical, high impact area for local capacity investment, including in emergencies.

Innovative Cases

Assessing the Economic Value of Restoration Interventions for the Beira Lake, Colombo

In Colombo, the Beira Lake suffers from hypertrophic conditions, algae growth, poor water clarity, fish mortality and an odour caused by several pollution sources. A sustainable asset valuation was applied to assess the value of restoring and preserving the southwestern part of the lake. The results demonstrated that a long-lasting improvement of water clarity to a depth of 1.4 meters would create economic benefits for the city. The assessment also showed that investment in two interventions would result in a cumulative property value increase of US$43.2 million in the surrounding area by the end of 2025 and additional recreational spending of US$19.6 million by people visiting that part of the lake between 2020 and 2025. The designated interventions were:

- an upgrade of wastewater treatment facilities that currently release ineffectively treated wastewater with high nutrient loadings into the lake; and
- one-time dredging of the lakebed to remove phosphorus deposits.

The cost-benefit analysis of this combined investment scenario yielded a net result of more than US$56.5 million. This demonstrated to property owners, real estate investors and public authorities that investing in restoring this natural asset would pay off and provide long-term opportunities for value capture. For more information, see UNDRR 2021 Words into Action: Nature-based solutions for disaster risk reduction and https://www.iisd.org/savi/project/beira-lake-colombo-sri-lanka/.

Room for the River Program in the Netherlands

Large parts of the Netherlands are only just above sea level, and approximately one-quarter of the country's surface is below it. After numerous flood events in the 1990s, the Government of the Netherlands decided to undertake a large-scale flood protection programme, which was implemented in 2007. Completed in 2018, the Room for the River Programme included more than 30 projects along four major rivers. The individual projects aimed to reduce the risk of flooding and, at the same time, make the landscape sustainable and ecologically valuable. Hybrid solutions combined classical engineering with landscape design and environmental management. Dikes were extended and retention areas and flood plains were created, reducing the risk of flooding, providing valuable habitats and offering high potential for tourism and recreation. The high investment costs of about USD 2.4 billion were offset by extensive benefits that go far beyond flood protection. For more information, see https://www.dutchwatersector.com/.

A Win-Win Partnership in Canada Between the Community, Public and Private Sectors

Canada's Partners for Action (P4A) initiative demonstrates how targeted data and research can drive coalition building and lead to a broad public policy discussion on risk-based solutions involving property developers, insurance companies and property owners. Over several years, P4A has engaged diverse stakeholder groups, including NGOs, municipal, provincial and federal governments and the insurance industry on the risks of overland and urban floods in Canada. Canadian decision-makers were encouraged to make adaptation decisions aimed at protecting homes, businesses, infrastructure and communities. In May 2015, after more than three years of research and consultation, the Co-operators became the first Canadian insurer to bring a homeowner's flood insurance product to the market. Aviva Canada and other insurers have followed since. The P4A partners agreed that increasing access to insurance covering flood damage would be accompanied by communication and awareness-building campaigns to ensure Canadians understood the risk that overland and urban floods present to their homes, businesses and communities. And sound adaptation decisions by policymakers aimed at protecting homes, businesses, infrastructure, and communities is important. For more information, see page 67 of UNDRR 2019 Words into action: Implementation Guide for Land Use and Urban Planning.

Exercises

Exercise	Answer
Prioritize critical infrastructure whose failure could damage the social and economic fabric of your city and local communities	
Prioritize who should be in forums or mechanisms to engage stakeholders to support future-proofing infrastructure assets, including Nature-based Solutions	
List the principal regulations and support needed for infrastructure asset managers to build resilience, then describe how best to access or provide that support	
Prioritize the most effective ways your city could support infrastructure resilience with new technology, physical, cyber, geographic, and logistical risks.	

To better understand where your city's infrastructure is on its resilience and technology journey, complete the following:

- Disaster Resilience Scorecards for Cities – essential 8 – The approach is designed and suggested for a 1- or 2-day multi-stakeholder workshop but provides a good indication of where the resilience journey can take your city.

For further guidance or support, see Annex 1 of this handbook and

- Managing Infrastructure Assets for Sustainable Development: A Handbook for Local and National Governments.

Takeaway building blocks for local action

Processes

To protect the social and economic fabric of their infrastructure, especially critical infrastructure, cities and local communities need to assess all risks, including interdependencies, and integrate that assessment into risk-informed processes.

- When making financing decisions, existing, emerging and future risk must be appropriately costed, including cascading risk in cost-benefit analysis over the entire life cycle of infrastructure assets.
- Infrastructure asset management must risk-inform all planning coherent with green, climate and digital future scenario plans and investments relevant to the entire life cycle of infrastructure.
- **Products** guiding resilience strengthening are available from city-to-city networks under national and international standards.

Mechanisms

To strengthen resilience, new technology and physical, cyber, geographic and logistical risks supporting city infrastructure must be considered. This often involves systems and stakeholders outside a city's administrative boundaries.

- **Institutional arrangements** must include relevant stakeholders, especially from the private sector, operators, regulators, users and policymakers, to ensure interconnected risks within systems supporting infrastructure, often outside authorities' administrative boundaries, are integrated into investment and asset management decisions and are not siloed.
- **Digital technologies** increase interconnectedness and efficiency but also increase cyber and cascading risks, which can threaten the foundation of cities' social and economic progress. Technology's impact must be fully understood and integrated into investment and asset management decisions.
- **Legal and policy frameworks** that emerge from outside a city's administrative boundaries often require local contextualization and action. Those global, regional, national and up-to-date technological regulations, standards, norms and frameworks are tools to ensure both prosperity and resilience.
- **Partnerships** are essential to strengthen resilience. Partners include the private sector (to develop and implement strategies), national policymakers (for policy generation and exchange), local and regional governments and city-to-city networks.

People

Resilience requires that operators, regulators, users and policymakers understand the benefits as well as the risks of technologies.

- **Leadership** needs to foster a shared understanding of risk encapsulated into policies. Local leadership fosters local wisdom, inclusion, and local solutions.
- Increasing the **human capacity** of operators, regulators, users and policymakers in understanding risk will prolong infrastructure assets' life cycle and value.
- **Knowledge** for infrastructure assets management is increasingly articulated in guidance, standards and analytical tools within city-to-city networks, think tanks and other support structures.

Chapter 5: Role of Resilient and Smart Cities in Building Back Better in the Post-Covid-19 Era

Chapter 5: Role of Resilient and Smart Cities in Building Back Better in the Post-COVID-19 Era

Rationale and benefits

The COVID-19 pandemic and resulting health crisis damaged the social and economic foundations of cities, states and nations. The COVID-19 pandemic caused global disruptions in supply chains and business processes. Climate change and global interconnectedness, especially between urban centres, create an environment for more frequent and intense disasters, including pandemics. If left unchecked, future global emergencies will generate social and economic damages far more extensive than those caused by COVID-19. Building resilience to these future risks is critical to safeguarding cities and citizens' futures. There are lessons to be learned from the COVID-19 recovery to date on how "Building Back Better" can work in practice, protecting gains and accelerating resilient and sustainable development. In the post-COVID-19 era, investing in resilient social and economic recovery, including emerging green and digital economies, enabled by innovations and technologies, builds resilience to future climate risks.

"Economic recovery packages in the aftermath of the COVID-19 pandemic represent a once-in-a-generation opportunity to build more resilient and sustainable infrastructure. Cities are at the forefront of rethinking their social and economic fabric with emerging opportunities relating to green deal/recovery, digitization driving innovations in the workplace, and management of critical social and economic infrastructure." [7]

Expected Learning Outcomes

This handbook directly complements module 1, especially module 1.4 of the UN DESA 2021 Handbook on Risk-informed Governance and Innovative Technology for Disaster Risk Reduction and Resilience. Learning outcomes for this chapter include:

1. Readers are introduced to the concept of Building Back Better through social and economic resilience to existing, emergent, and future risks.
2. Readers are introduced to lessons identified for learning from the ongoing COVID-19 recovery to Building Back Better, including accelerating green and digital programmes.

Concepts

Priority 4 of the Sendai Framework for Disaster Risk Reduction for Action 2015-2030 aims to enhance *disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation, and reconstruction.* Changing risk profiles means there is a need to strengthen disaster preparedness for response, act in anticipation of events, and ensure effective response and recovery capacities at all levels. The recovery, rehabilitation and reconstruction phase is a critical opportunity to build back better, including by integrating disaster risk reduction into development measures.

Build Back Better is the "use of the recovery, rehabilitation and reconstruction phases after a disaster to increase the resilience of nations and communities through integrating disaster risk reduction measures into the restoration of physical infrastructure and societal systems, and into the revitalization of livelihoods, economies, and the environment."

In the post-COVID-19 era, cities and states are Building Back Better by accelerating existing climate and resilience plans and capitalizing on digitization opportunities. Thematic Chapters 1 and 4 of this handbook spotlighted approaches to strengthen resilience from a smart city and infrastructure asset management perspective. Building Back Better allows for those approaches to be accelerated.

Source: [7] *The G20 Infrastructure Working Group on 6th of February 2021 under the Italian presidency (OECD iNFRA)*

Approaches

Build Back Better, Accelerating Development and Resilience Plans

Resilient social and economic recovery from COVID-19 depends on sustainable practices. Disaster recovery efforts can bring political momentum, accelerated financing and support to achieve transformational change. Build Back Better is best achieved with shovel-ready resilience and sustainable development packages, such as green and digital recovery packages. To prepare for resilient recovery or Build Back Better, cities should:

- **Frame recovery coherent with existing resilience and sustainable frameworks:** International agreements such as the Paris Agreement on climate change, the Aichi Biodiversity Targets, the Sendai Framework for disaster risk reduction and the UN Sustainable Development Goals provide an overarching compass for social and economic resilience and development.
- **Align recovery with long-term objectives,** including cities' social and economic visions and smart, inclusive and resilient objectives: Screen all elements of recovery packages for longer-term resilience, consider all risks and systemic resilience and prioritize resilient and sustainable projects.
- **Accelerate a pipeline of shovel-ready** initiatives within existing sustainable development and resilience plans, allowing recovery plans to align with digital, climate and green finance flows.
- **Keep people central to recovery by fostering innovation to build enduring behaviour changes:** Governments can ensure people remain central while fostering an innovation ecosystem, well beyond funding basic research and development.
- **Identify and address vulnerabilities highlighted by the disaster event,** such as bottlenecks in global supply chains and the advantages of local manufacturing. Accelerating innovation and technology can help address those vulnerabilities.

For more information on learnings from COVID-19 recovery, see *OCED policy responses on building back better after COVID-19*

For further guidance on recovery, see *UNDRR consultative guideline Build Back Better in recovery, rehabilitation and reconstruction.*

Improving Response and Recovery through People-centred Digitization

Keeping people central to all processes is a key dimension of efforts to Build Back Better. This includes staying focused on people's well-being, improving inclusiveness and reducing inequality. As digitization continues to transform cities, engaging citizens in public health responses and health systems is essential. Improving resilience through digitization by keeping technology focused on people benefits everyone. Major categories of transformation, learning and action enabled by digitization during the COVID-19 pandemic included: information sharing, E-participation, E-health, E-business, contact tracing, social distancing, virus tracking, work and school from home, digital policy and partnerships. For more information on people-centred approaches, see UN-HABITAT's Centering people in smart Cities: A playbook for Local and Regional Governments.

Building Back Better through SDG Localization and Multilevel Governance

The COVID-19 crisis demonstrated the importance of local action in addressing the immediate health emergency as well as in designing an inclusive, sustainable, resilient recovery. Investing in achieving the SDGs also has strong local dimensions. Creating policies and plans responsive to the needs of communities improves recovery and contributes to the SDGs. To implement such policies and strategies, local government needs to invest in partnerships with non-state local actors. Those partnerships enhance policy coherence and effectiveness and keep the SDGs and localization at the centre of recovery policies.

Global Health Agendas for Local Action

Resilience to pandemics requires national and local responses consistent with global health agreements, national and regional regulations. Global health agreements to be considered when taking action at the local level include: IHR2005, Pandemic Influenza Preparedness Framework, Global Health Security Agenda, and Universal Health Coverage 2030.

After SARs and MARs, many cities and states invested in better preparedness for public health risks by incorporating digital government processes. The cascading impacts of the COVID-19 pandemic were reduced thanks to improved regulation, standard operating procedures and institutional arrangements. Investments in early detection, early warning, rapid diagnostics, risk governance and communication, and telehealth improved delivery of services. E-health, e-participation and e-government were significant drivers of change. For more information, see Module 1.4 UN DESA 2021 Handbook on Risk-informed Governance and Innovative Technology for Disaster Risk Reduction and Resilience.

Innovative Cases

Legislation and Institutions for Public Health Emergencies

Thailand is continually learning how to deal with public health emergencies affecting its society and the economy. The country's Communicable Disease Act facilitates this learning by raising public health as a national issue. The Act led to investments in a Field Epidemiology Training Programme (FETP), which aimed to enhance epidemiologists' expertise in dealing with emergency and health threats. The programme supported health staff and volunteers with the establishment of 1,030 surveillance rapid response teams to handle public health emergencies and mitigate risk. In 2015, as SARS and Avian Influenza emerged, Thailand updated the Communicable Disease Act to establish national and provincial Centers for Disease Control and Communicable Disease Control Units to manage local Surveillance Rapid Response Teams. That same year, Thailand invested in central command and control, with an Emergency Operation Center responsible for emergency preparedness and response. Thailand's Emergency Operation Center was the first outside of China to detect cases of novel coronavirus (COVID-19). Thailand's experience implementing legislation and creating institutions dedicated to dealing with public health emergencies provides helpful examples of how to support progress on the Sustainable Development Goals. For more information, see UNPSA Nominee – Intelligent & Sustainable in Public Health Emergency System In Thailand.

The Importance of Collaboration During Recovery in New Zealand

In 2016, the 7.8 magnitude Kaikōura Earthquake disrupted transport networks connecting communities across North Canterbury. Overnight, coastal and rural communities were isolated. The area impacted is culturally significant to the local iwi (tribe) Ngāi Tahu. The earthquake disrupted freight, and primary industries, distanced families, caused job losses and effectively shut down the Kaikōura tourism industry. Reinstating the transport networks initially seemed an impossible task. A challenging target was set of reopening transport in time for the busy summer tourist season, which was vital for the region's recovery. Once reopened, transport routes needed to be made safer and more resilient. Through innovation and a collaborative effort involving the community, stakeholders, Māori and thousands of team members, road and rail transport were re-opened ahead of the target dates. It was an extraordinary response to a complex, multi-faceted infrastructure project with many critical safety risks that required new ways of working at all levels, from governance to frontline teams. This was a profound effort that pulled communities, businesses and the public and private sectors together towards shared outcomes. It resulted in a safer, more resilient network that will serve generations to come. For more information, see UNPSA nominee Moving Mountains.

Exercises

Exercise	Answer
List investments and plans currently used to prepare for: 1. emergency response 2. recovery	
List city development planning investments to be prioritized during recovery after a disaster that will increase the resilience and sustainability of your city. Tip: select a public health emergency or a natural disaster that occurs frequently in your region.	
List the stakeholders currently involved in updating public health emergency plans and those who should be involved. Prioritize the list and discuss how best to include all.	

For further guidance or support see Annex 1 of this handbook and

- Disaster Resilience Scorecards for Cities – essential 10 – The approach is designed and suggested for a 1- or 2-day multi-stakeholder workshop but provides a good indication of where the resilience journey can take your city.

Takeaway Building Blocks for Local Action

Processes

Building Back Better is an opportunity to redesign and invest in more resilient systems, including infrastructure, supply chains, and economic, financial and public health systems.

- Recovery brings opportunities to **finance** existing resilience initiatives aligned with long-term objectives by engaging national actors and investments from banking, insurance, the public and private sectors and citizens.
- Recovery **planning** is an opportunity to accelerate shovel-ready risk-informed initiatives such as green and digital initiatives coherent with future (climate) risks.
- Recovery allows for investment in innovative **products** and technology built on learnings to make greener and sustainable cities.

Mechanisms

Recovery requires agile mechanisms with transparent decision-making. Investments need to be guided by identifying explicit risks and resilience trade-offs with a system's efficiency.

- **Streamlined planning and financing processes institutional arrangements** for recovery decisions must be made by top decision-makers. Institutional arrangements need to include whole-of-society approaches, not just civil protection.

- **Digital Technologies** and open data facilitate real-time decision-making and support streamlined processes to enable better response and recovery and better future services.
- Building Back Better should strengthen existing **legal and policy frameworks** coherent with local and national plans and international agreements and frameworks, not create new paradigms.
- Disasters disrupt the status quo and allow the political space to forge new **partnerships** driven by necessity and opportunity and built on good practice, inclusion and good governance principles.

People

Building Back Better needs to be people centred. It requires a focus on people's well-being improved inclusiveness and reduced inequality. Returning to business as usual will not deliver a sustained long-term economic recovery.

- During recovery, **leadership** sometimes has to make decisions with incomplete information. Digital, ICT and frontier technologies can assist decision-making by providing real-time information and engaging e-participation and whole-of-society approaches.
- Building Back Better requires investment in **human capacity** and provides an opportunity to break down silos between sectors and stakeholders to strengthen resilience.
- Building Back Better is an opportunity to foster **knowledge** and innovation to change long-term behaviour and attitudes.

Chapter 6: Policy Recommendations and Conclusions

Chapter 6: Policy Recommendations and Conclusions

Common Building Blocks for Local Action

Processes

Risk-informed planning and investment processes strengthen resilience and protect the social and economic foundations of cities. Risk-informed processes quantify the cost of all risks, consider interdependencies between systems and recognize systemic risks inherent in transboundary technology, physical, cyber, geographic and logistical vulnerabilities within systems.

- Pricing risks into investments allows cities to quantify social and economic costs of failure of critical systems and facilitate processes and regulations to encourage **financing** of resilient strengthening actions at all levels.
- Risk-informed data and resilience strengthening approaches in existing **planning** and fiscal processes requires integration of multi-stakeholder approaches taking into consideration existing, emerging and future risks, including climate and cyber risks. Building Back Better accelerates green, digital and other resilience strengthening initiatives.
- City-to-City networks, the UN, INGOs, and national and international standards contextualize **products** supporting roadmaps and guidance to strengthen resilience for cities of all sizes and their infrastructure, including emerging digital infrastructure.

Mechanisms

To strengthen resilience, cities and local communities should invest in agile mechanisms for multi-stakeholder, multilevel governance and multi-sector collaboration, facilitating partnerships to co-create solutions with innovative technologies to link global frameworks to local action.

- **Institutional arrangements** must include mechanisms with leadership and whole-of-society arrangements to remove administrative and sector silos. They must involve the private sector, civil society, operators, regulators, users and policymakers, including stakeholders outside city boundaries and include systems to incorporate multilevel governance. The adoption of integrated and holistic approaches is key to success and should be anchored on two axes of work: vertical – strengthening and facilitating multilevel governance systems, and horizontal – prioritizing inclusion and participation of all sectors and territorial stakeholders in decision-making processes.
- **Digital technologies, especially** spatial, earth observation and open data, facilitate a shared understanding of risk, a platform for shared action and real-time decision-making and resilience-building guided by existing e-governance initiatives. Technologies also include new cyber and interdependency risks and can increase bias if AI and algorithms do not consider underlying vulnerabilities and inequalities.
- People-centric e-governance improves inclusiveness, accountability and effectiveness and fosters resilience in risk-informed **legal and policy frameworks for local action** consistent with international frameworks and global technological norms.
- Strengthening resilience is a whole-of-society action requiring multiple cross-disciplinary **partnerships** for policy generation, exchange, cooperation and solidarity. City-to-city networks and support structures provide guidance and roadmaps to foster these partnerships.

People

To strengthen resilience, ensure **people** are central to resilience building technology and innovations, guided by e-government and e-participation strategies.

- **Leadership** fosters a long-term vision of resilience and a shared multi-stakeholder understanding of existing, emerging, and future risks, challenges and opportunities encapsulated into policies and decision-making assisted by e-government technologies. **Local leadership** fosters local wisdom, inclusion and local solutions.
- Investing in people-centred innovative technologies and the **human capacity** of operators, regulators, users and policymakers strengthens resilience and facilitates cities to take global opportunities for local action.
- Global frameworks, INGOs, national bodies, standards, regulations, codes and think tanks share knowledge on strengthening resilience and applying innovations. City-to-city driven networks and peer-support organizations help apply that knowledge for local resilience building.

Annex: Reference Materials

Annex 1 - Reference and Sources

Concepts and Global Frameworks

- G20 Global Smart Cities Alliance
- Make the SDGs a Reality
- Critical Infrastructure Interdependency Analysis
- Making Critical Infrastructure Resilient: Ensuring Continuity of Service - Policy and Regulations in Europe and Central Asia. *UNDRR four critical infrastructure sectors from UNDRR ROE highlighting four areas for special attention*
- The New Urban Agenda

Approaches Improving Policies and Principles

- UN DESA principles of effective governance for sustainable development
- The open data infrastructure resilience roadmap, showcase, and guide
- G20 Principles for Quality Infrastructure Investment
- Strategic Policies for Sustainable Infrastructure
- G20 Principles for Quality Infrastructure Investment
- Building back better: A sustainable, resilient recovery after COVID-19
- CEPA strategy guidance note on risk management frameworks
- OECD policy guidance tool for quality infrastructure investment.
- Policy Toolkit on Governance of Critical Infrastructure Resilience

Guidance and Handbooks

- UN DESA 2021 Handbook on Risk-informed Governance and Innovative Technology for Disaster Risk Reduction and Resilience
- United Nations, Managing Infrastructure Assets for Sustainable Development: A handbook for local and national governments.
- UNDRR words into Actions Guides
- Centering people in smart Cities: A playbook for Local and Regional Governments.
- UNHABITAT People-Centered Smart Cities Playbooks
- Climate-resilient infrastructure
- OECD implementation handbook for quality infrastructure investment.
- Sustainable development in communities — Inventory of existing guidelines and approaches on sustainable development and resilience in cities
- A Guide: Leveraging Multi-Level Governance Approaches to Promote Health Equity
- Multi-Level Governance for Effective Urban Climate Action in the Global South
- Assessing the Digital Divide: Understanding internet connectivity and digital literacy in cities and communities
- Law and Climate Change Toolkit

Alliances and Peer Supported Networks

- MCR2030
- G20 Global Smart City Alliance
- United Cities and Local Government (UCLG)
- ICLEI – Local Governments for Sustainability
- C40 Cities
- Resilient Cities Network

Standards and Benchmarks

- ISO37120 - Sustainable cities and communities — Indicators for city services and quality of life
- ISO37122 - Sustainable cities and communities — Indicators for smart cities
- ISO37123 - Sustainable cities and communities — Indicators for resilient cities
- E-Government development index (EDGI) and a focus on E-health and E-participation
- European Standardization Organizations
- SURE Infrastructure Resilience Standard
- UK's National Resilience standards for Local Resilience Forums
- World Council on City Data (WCCD)

Building Blocks, Reports and Learning Tools

- E-Estonia, including E-state building blocks
- Voluntary Local Review
- Quick Risk Estimation Tool
- Open Government Data (OGD) Readiness Assessment.
- MCR2030 and Scorecards
- Copernicus video
- World Economic Forum Views on How To Rebuild Better After the Pandemid
- OECD "Building Back Better": key dimensions for a resilient economic recovery
- A systemic resilience approach to dealing with Covid-19 and future shocks
- UNDRR priorities to BBB in recovery, rehabilitation, and reconstruction
- National health data infrastructure for less disruption in pandemics
- Adapt Now: A Global Call for Leadership on Climate Resilience
- Exposure and vulnerability to natural disasters for the world's cities

Learning Source Documents

- GP2019 recommendations
- 2019 UN Climate Action Summit

Cases by Country

- Argentina - Santa Fe (Argentina) multi-stakeholder risk management system highlighting and importance of preparedness.
- Argentina - Early flood detection and warning system in Argentina developed with Libelium sensors technology (IoT)
- EU - Pluvial Flood Risk Assessment in Urban Areas
- Estonia - E-Estonia case on page 48 of Centering people in smart Cities: A playbook for Local and Regional Governments.
- Haiti - Red cross Haiti (mobile) network
- Indonesia - Jakarta Mass Rail Transit project
- Indonesia - The City of Semarang has developed a six-point strategy
- Indonesia - UNPSA - PetaBencana.id
- Japan - unmanned vehicles in Fukushima to measure radiation and get 3-D maps
- Japan/EU - Hydrological extremes in megacity Tokyo
- Republic of Korea - UNPSA - Operation of Cooling Centers to reduce the damage caused by heatwaves.
- Republic of Korea – Safety Guidance and Risk Prevention
- Republic of Korea- UNPSA - A Safety-Keeper in My Hand, Safety e-Report

- Mauritius -Using cybersecurity to protect digital inclusion assets in Mauritius case on page 48 of Centering people in smart Cities: A playbook for Local and Regional Governments
- Mexico - UNPSA - COATZABIERTO - INTEGRAL STRATEGY OF OPEN GOVERNMENT AND INTELLIGENT CITY
- Netherlands - Amsterdam City Doughnut
- New Zealand - UNPSA - Moving Mountains
- Russian Federation - UNPSA - The Moscow digital infrastructure - institutional preparedness and response in times of crisis
- Russian Federation - UNPSA - Fostering innovation to deliver inclusive and equitable services for all, including through digital transformation
- Thailand - Virtual Reality application for flash Floods Thailand from page 73 of UNDRR ASIA STAG report
- Thailand - UNPSA - Battling against Wildfire with Geospatial Technology
- Thailand - UNPSA - Integrated predictive maintenance using Integration of Maintenance Innovation for human well-being
- Thailand - UNPSA - Intelligent & Sustainable in Public Health Emergency System In Thailand
- Turkey - City of Istanbul - Statement of Intent for Cyber Accountability
- Turkey - UNPSA - Disaster Management Decision Support System (AYDES)
- United Arab Emirates - UNPSA - Effect of NANO technology in paint under Dubai climatic conditions using innovative
- General - use of robots to support health staff

Handbook Series on Innovative Local Governance for the Implementation of the Sustainable Development Goals

Strengthening Resilience in Cities and Local Communities Through Innovation and Digital Government

United Nations Department of Economic and Social Affairs 2023