TECHNICAL REPORT

ISO/TR 22370

Security and resilience — Urban resilience — Framework and principles

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Foreword

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This document was prepared by Technical Committee ISO/TC 292, *Security and resilience*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The justification for a global set of standards for achieving urban resilience is clear: urban areas, the engines of economic growth, are projected to provide the living and work environment for two-thirds of the global population of close to 10 billion by 2050. Urban disasters have an increasingly costly local, regional, national and global socio-economic impact. For example, disaster events in the past decade alone have claimed over a million lives, affected more than 2,5 billion people and caused over $1 trillion in economic loss.

By engaging all stakeholders in resilience efforts, urban areas have the ability to harness transformational change and improve the lives of their inhabitants. This has been acknowledged by the global community as an essential aspect of the United Nations (UN) 2030 Agenda for Sustainable Development[1] through agreements such as the Sustainable Development Goals (SDGs), New Urban Agenda[2], Paris Agreement[3] and Sendai[4] Framework. However, urban areas tend to lack the capacity to operationalize these alone and fully harness change. One approach to addressing this and ensuring implementation of the 2030 Agenda is through holistic and multi-stakeholder resilience-building.

Resilience offers a crucial meeting point among different yet essentially similar paradigms in urban development. Enhancing resilience can reduce risks by increasing capacities, and addressing vulnerabilities, thereby supporting effective and forward-thinking responses. Building urban resilience seeks the betterment of people, specifically those in vulnerable situations in urban areas.

The proposed framework for urban resilience presented in this document was developed in response to demand arising from urban areas in all parts of the world for support to make them safer and more resilient to all manner of hazards, risks, weaknesses and vulnerabilities. It was developed to provide local governments and relevant stakeholders with analytical tools to measure urban resilience and develop relevant actions.

The framework aims to transform urban areas into better places to live by improving capacities to prepare, respond and recover from all potential shocks, stresses and challenges, leading the area towards resilience. The framework views urban resilience as a hub for transversal aspects including risk reduction, sustainability, development and governance. It achieves this by understanding and measuring resilience, in any human settlement in any circumstance or context. Furthermore, the framework provides an approach for building resilience baselines (or "profiles"), prepares guidelines in the use of the diagnostic and action-planning tools, and advises on constant real-time monitoring.

The early stages of development of this framework involved extensive testing and modelling in urban areas all over the world, and the refinement and improvement of data acquisition, use and application. The approach is to establish a building resilience baseline (or profile), based on metrics that can evaluate the various dimensions of urban resilience and capture the system's weaknesses, vulnerabilities and strengths. Then to develop concrete and prioritized actions to address risk and build-in resilience. The framework follows a multi-sectorial, multi-shocks and stresses, and multi-scales approach, built on the understanding that urban areas function as urban systems, integrated and interdependent, regardless of their size, culture, location, economy and/or political environment.

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1) In 2015, countries adopted the 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDGs).

2) The New Urban Agenda was adopted at the United Nations Conference on Housing and Sustainable Urban Development (Habitat III) in Quito, Ecuador, on 20 October 2016. It was endorsed by the United Nations General Assembly at its sixty-eighth plenary meeting of the seventy-first session on 23 December 2016. The New Urban Agenda represents a shared vision for a better and more sustainable future. If well-planned and well-managed, urbanization can be a powerful tool for sustainable development for both developing and developed countries.

3) The Paris Agreement is a global landmark agreement, signed in December 2015, for combating climate change effects. Its central aim is to strengthen the global response to the threat of climate change.

4) The Sendai Framework was adopted by UN Member States on 18 March 2015 at the Third UN World Conference on Disaster Risk Reduction in Sendai City, Miyagi Prefecture, Japan. The framework for 2015–2030 was developed to better assist governments, at the national and local levels, in addressing disaster risk reduction and resilience-building.

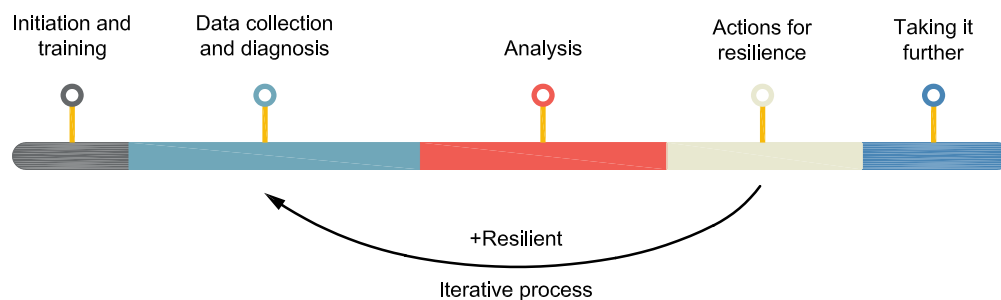The implementation process for the framework is shown in Figure 1.

Figure 1 — Implementation process

Security and resilience — Urban resilience — Framework and principles

1   Scope

This document describes a framework and principles that are coherent with the 2030 Agenda for Sustainable Development, including the New Urban Agenda, Paris Agreement and Sendai Framework, that can be applied to enhance urban resilience. This document proposes the use of metrics and models as the framework upon which to structure urban resilience to assist local authorities and other urban stakeholder's efforts to build more resilient human settlements.

This document is primarily intended for use by organizations with responsibility for urban governance. However, it is equally applicable to all types and sizes of organizations that represent the community of stakeholders noted above, and in particular those organizations that have a role in urban planning, development and management processes in urban areas around the world.

2   Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 22300, *Security and resilience — Vocabulary*

3   Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 22300 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

—   ISO Online browsing platform: available at https://www.iso.org/obp

—   IEC Electropedia: available at http://www.electropedia.org/

3.1
access
ability of the rights-holders to use or benefit of a certain service or product

Note 1 to entry: Restrictions can be caused by distance to the source (e.g. water supply network does not reach a certain neighbourhood) or unaffordability (e.g. service is too costly for a certain household or group of people), among other reasons.

3.2
basic social services
set of services delivered in education, health and social areas, as a means to fulfil basic needs

3.3
biodiversity
variability among living organisms from all sources including, land, marine and other aquatic *ecosystems* (3.13) and the ecological complexes of which the organisms are part

Note 1 to entry: This includes diversity within species, between species and of ecosystems. Biodiversity is thus not only the sum of all ecosystems, species and genetic material, but rather represents the variability within and among them.

Note 2 to entry: Biodiversity can also be referred to as "biological diversity".

[SOURCE: Chan L. et al., 2014, adapted]

3.4
challenge
contextual or environmental change that has the potential to impact upon the ability and capacity of an *urban system* (3.27) to address emerging risks and opportunities

3.5
civil society
wide range of individuals, groups of people, networks, movements, associations and organizations that manifest and advocate for the interests of their members and others

Note 1 to entry: It can be based on philanthropic, cultural, religious, environmental or political values and convictions.

Note 2 to entry: This definition excludes for-profit companies and businesses, academia and all government-dependent entities.

3.6
civil society organization
CSO
formal association in which society voluntarily organizes around shared interests

Note 1 to entry: It includes political, cultural, environmental and faith-based organizations, as well as non-profit and nongovernmental organizations.

Note 2 to entry: CSOs are institutionalized organizations, bearing some form of legal status, that represent particular groups of society and are involved in service delivery.

3.7
coverage
capacity of the *duty-bearer* (3.11) to provide a service or product

Note 1 to entry: It can be influenced by financial capacity, geospatial setting, and the normative and institutional frameworks.

3.8
critical facility
physical structure, network or other asset that provide services that are essential to the social and economic functioning of a community or society

[SOURCE: UNISDR, 2017, modified — The term "critical facility" has replaced "critical infrastructure".]

3.9
decentralized authority
local authorities, distinct from the state's administrative authorities, that have a degree of self-government elaborated in the framework of the law, with their own powers, resources and capacities to meet responsibilities, and with legitimacy underpinned by representative, elected local democratic structures that determine how power is exercised and that make local authorities accountable to citizens in their jurisdiction

[SOURCE: UCLG, GOLD I, 2008, adapted]

3.10
disaster risk reduction
policy aimed at preventing new and reducing existing disaster risk and managing residual risk, all of which contribute to strengthening *resilience* (3.19) and therefore to the achievement of sustainable development

[SOURCE: UNISDR, 2017, modified — "policy" has replaced "Disaster risk reduction is".]

3.11
duty-bearer
individual who has a particular obligation or responsibility to respect, promote and realize *human rights* (3.15), and to abstain from human rights violations

Note 1 to entry: The term is most commonly used to refer to State actors, but non-State actors can also be considered as duty-bearers.

Note 2 to entry: Depending on the context, individuals (e.g. parents), local organizations, private companies, aid donors and international institutions can also be duty-bearers.

[SOURCE: UNICEF]

3.12
economic diversity
extent to which economic activity of a given defined geography is distributed among a number of categories such as industries, sectors, skill levels and employment levels

3.13
ecosystem
dynamic complex of plant, animal, and micro-organism communities and their non-living environment (e.g. soil, air, sunlight) interacting as a functioning unit of nature

Note 1 to entry: Everything that lives in an ecosystem is dependent on the other species and elements that are also part of that ecological community.

[SOURCE: ISO 14055-1:2017, 3.1.1, modified — "(e.g. soil, air, sunlight) interacting as a functioning unit of nature" has replaced "interacting as a functional unit" and Note 1 to entry has been added.]

3.14
ecosystem services
benefit people obtain from *ecosystems* (3.13)

Note 1 to entry: These include: provisioning services such as food, water, timber and fibre; regulating services that affect the climate, floods, disease, waste generation and water quality; cultural services that provide recreational, aesthetic and spiritual benefits; and supporting services such as soil formation, photosynthesis and nutrient cycling.

[SOURCE: ISO 14055-1:2017, 3.1.2, modified — Note 1 to entry has been revised and expanded.]

3.15
human rights
rights inherent to all human beings, whatever their nationality, place of residence, sex, national or ethnic origin, colour, religion, language or any other status

Note 1 to entry: People are all equally entitled to their human rights without discrimination.

Note 2 to entry: Human rights are: interrelated, universal and inalienable; interdependent and indivisible; equal and non-discriminatory; and both rights and obligations.

3.16
investment
allocation of resources to achieve defined objectives and other benefits

Note 1 to entry: Investment takes two main forms: direct spending on buildings, machinery and similar assets; and indirect spending on financial securities such as bonds and shares.

[SOURCE: ISO/IEC 38500:2015, 2.13, modified — Note 1 to entry has been added.]

3.17
land tenure
relationship, whether legally or customarily defined, among people, as individuals or groups, with respect to land, determining how land is used, possessed, sold or in other ways disposed

3.18
participation
informed process of engagement with stakeholders, where key groups actively participate in defining the process and content of policy making

3.19
resilience
ability to absorb and adapt in a changing environment

Note 1 to entry: In the context of *urban resilience* (3.26) the ability to absorb and adapt to a changing environment is determined by the collective capacity to anticipate, prepare and respond to threats and opportunities by each individual component of an *urban system* (3.27).

[SOURCE: ISO 22300:2018, 3.192, modified — Note 1 to entry has been added.]

3.20
risk mitigation
lessening or minimizing of the adverse impacts of a hazardous event

[SOURCE: UNISDR, 2017, modified — The term "risk mitigation" has replaced "mitigation".]

3.21
shock
uncertain, abrupt or long-onset event, that has potential to impact upon the purpose or objectives of an *urban system* (3.27)

3.22
social protection
preventing, managing and overcoming situations that adversely affect people's well-being

Note 1 to entry: It consists of policies and programmes designed to reduce poverty and vulnerability by promoting efficient labour markets, diminishing people's exposure to risks, and enhancing their capacity to manage economic and social risks, such as unemployment, exclusion, sickness, disability and old age.

[SOURCE: UNRISD, 2010, modified — Note 1 to entry has been added.]

3.23
stress
chronic and ongoing dynamic pressure originated within an *urban system* (3.27), with the potential for cumulative impacts on the ability and capacity of the system to achieve its objectives

3.24
urban agglomeration
physical structure and composition of an urban area or continuity of large urban clusters where the built-up zone or population density of an extended city or town area or central place and any suburbs are linked by continuous, connected urban development

3.25
urban open area
vacant areas, public or private, within urban boundaries

Note 1 to entry: Urban open areas are all fringe open spaces and captured open spaces associated within the scope and parameters of the *urban system* (3.27).

Note 2 to entry: State parks, national parks or open areas in the countryside outside the parameters of the urban area are not considered as urban open areas in this document.

3.26
urban resilience

ability of any *urban system* (3.27), with its inhabitants, in a changing environment, to anticipate, prepare, respond to and absorb *shocks* (3.21), positively adapt and transform in the face of *stresses* (3.23) and *challenges* (3.4), while facilitating inclusive and sustainable development

Note 1 to entry: A more resilient urban system is characterized by its ability to continue through disruption in the short-to-medium term, combined with a capacity to reduce pressures and adapt to changes, risks and opportunities. Urban resilience, therefore, is dependent upon the ability of an urban systems not just to deal with shocks, but also with chronic stresses and challenges.

Note 2 to entry: Urban resilience is dependent upon the individual and collective *resilience* (3.19) of the separate components of a complex urban system. Although a city, town or community within an urban area can individually demonstrate enhanced resilience within its respective boundaries, urban resilience encompasses the broader geographic scope of *urban agglomeration* (3.24). Resilience of an urban system is measured by the capacity for resilience of each individual system component and dependent upon the resilience of the weakest performer among the urban agglomeration within the system scope.

Note 3 to entry: In order to assess, plan and act accordingly in the face of shocks, stresses and challenges, an urban system's capability for resilience should be measured and analysed through qualitative and quantitative data.

3.27
urban system

human settlement, integrated and complex set of system components, characterised by universal and interdependent dimensions: physical, functional, organizational and spatial; comprised of people, processes and assets managed through effective governance mechanisms

Note 1 to entry: Being dynamic, the composition and elements of an urban system changes with time.

Note 2 to entry: Every urban area has characteristics of an urban system, regardless of its size, culture, location, economy and/or political environment.

Note 3 to entry: Characterized as urban systems, urban areas have the objectives of managing the complex interactions and interdependencies among its multiple components, with the purpose of fulfilling a variety of functionalities including social, economic, cultural and environmental.

3.28
vulnerable group

individuals who share one or several characteristics that make them more susceptible to social exclusion and marginalization, have limited opportunities or income, and/or are exposed to a higher risk of suffering abuse (physical, sexual, psychological or financial)

Note 1 to entry: This can include children without parental care, poor people, alone and dependent elderly people, ethnic minorities, people with disabilities, people living in marginalized communities, and other categories (HIV/AIDS, addictions, deprivation of liberty, homeless, LGBTI, victims of domestic violence, trafficking, refugees and immigrants).

4   Principles for building urban resilience

4.1   Principle 1: Dynamic nature of urban resilience

Resilience is not a condition but a state that cannot be sustained unless the system evolves, transforms and adapts to current and future circumstances and changes. Therefore, building resilience requires the implementation of context-specific and flexible plans and actions that can be adjusted to the dynamic nature of risk and resilience.

4.2   Principle 2: Systemic approach

Recognizing that urban areas are comprised of systems interconnected through complex networks and that changes in one part have the potential to propagate through the whole network, building resilience

requires a broad and holistic approach that takes into account these interdependencies when the urban system is exposed to disturbances.

4.3 Principle 3: Promote participation in planning and governance

A resilient system ensures the preservation of life, limitation of injury and enhancement of the prosperity of its inhabitants by promoting inclusiveness and fostering the comprehensive and meaningful participation of all, particularly those in vulnerable situations, in planning and various governance processes. Such an approach can ensure a sense of ownership, thus achieving the successful implementation of plans and actions.

4.4 Principle 4: Multi-stakeholder engagement

A resilient system should ensure the continuity of governance, economy, commerce and other functions, and flows upon which its inhabitants rely. This necessitates promoting open communication and facilitating integrative collaborations between a broad array of stakeholders ranging from public entities, the private sector, civil society organizations and academia to all inhabitants.

4.5 Principle 5: Strive towards development goals

Resilience building should drive towards, safeguard and sustain development goals. Approaches to resilience should ensure that efforts to reduce risk and alleviate certain vulnerabilities do not generate or increase others. It must guarantee that human rights are fulfilled, respected and protected under any circumstances.

5 Characteristics of urban resilience

5.1 The following characteristics articulate urban resilience through describing WHAT comprises being resilient (by being persistent, adaptable and inclusive) and the process of HOW these can be achieved through being integrated, reflexive and transformative. See Figure 2 for the characteristics of urban resilience.
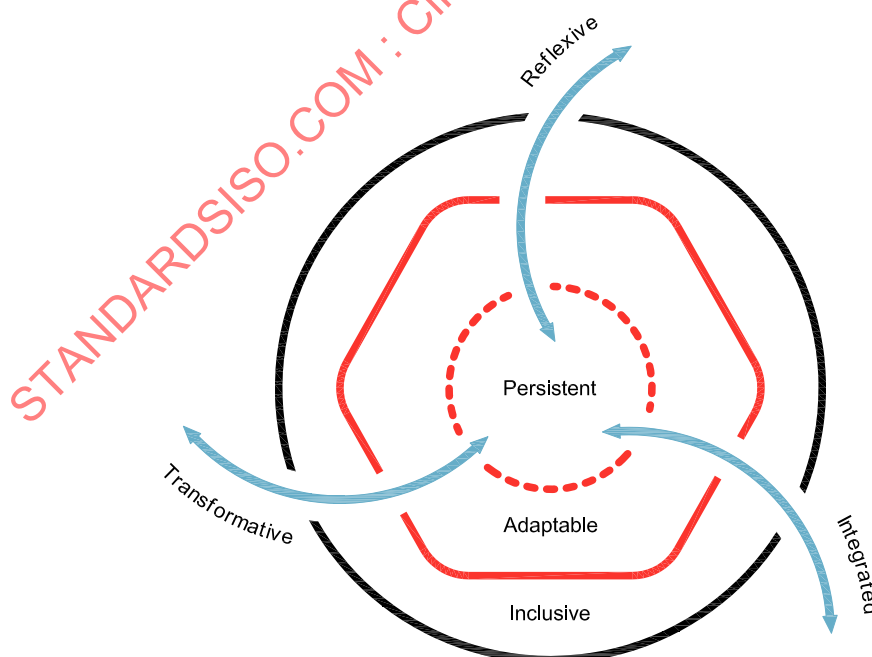

Figure 2 — Characteristics of urban resilience

5.2   Persistent: Capable of withstanding disturbances while protecting people, assets and processes by building robustness and encouraging redundancy.

NOTE 1   Involves anticipating impacts in order to prepare for current and future shocks and stresses.

NOTE 2   It incorporates coping mechanisms, spare capacity and backups to maintain and restore systems, ensuring reliability during and after a disruption.

5.3   Adaptable: Pursuing flexibility to absorb, adjust and evolve in the face of changing circumstances, while dynamically responding by turning change into opportunity.

NOTE 1   Adaptability considers not only foreseeable risks, but also accepts current and future uncertainty.

NOTE 2   Adaptability goes beyond redundancy by diversifying its systems and establishing alternatives.

NOTE 3   Adaptability involves the capacity to re-purpose human, financial and physical capital.

5.4   Inclusive: Centred on people and striving towards social inclusion, cohesion and participation, while protecting each person, particularly those in vulnerable situations, from any negative impact.

NOTE 1   Inclusivity recognizes that people in vulnerable situations are among the most affected by hazards.

NOTE 2   Inclusivity promotes equality, equity and fulfilment of human rights, and fosters comprehensive and meaningful participation in all governance processes.

5.5   Integrated: Enabling transdisciplinary collaborations by recognizing that urban resilience is composed of and influenced by indivisible, interdependent and interacting systems.

NOTE 1   Integration combines and aligns many perspectives to ensure input is holistic, coherent and mutually supportive towards a common cause.

NOTE 2   Integration encourages open communication and facilitates strategic coordination.

NOTE 3   Integration supports the collective functioning of the urban area and guarantees far reaching, positive and durable change.

5.6   Reflexive: Learning from its continuously changing systems and contexts to systematically update and improve its structures.

NOTE 1   Involves awareness that past trends have shaped current urban processes yet appreciates its potential to transform through shocks and stresses over time.

NOTE 2   Reflexive involves conveying the capacity to learn from knowledge, past experiences and new information by installing mechanisms to iteratively examine progress.

5.7   Transformative: Actively striving to generate positive change by fostering ingenuity and pursuing forward-looking and innovative solutions.

NOTE 1   Transformation involves seeking alleviation from untenable circumstances that over time create a system no longer prone to negative impacts.

NOTE 2   A transformative urban area is focused and goal-oriented towards a shared vision of its resilience.

6   Framework for urban resilience

6.1   General

The proposed framework for urban resilience provides a transversal diagnosis and pathway towards resilience-based sustainable urban development. To this end, it adopts multiple analytical lenses through which information covering the entire urban system is mapped, analysed and inter-related,

leading to an in-depth picture and thereby providing a baseline for the development of concrete and prioritized actions to address risk and build-in resilience.

The framework is built around four overlapping phases: Data, Analysis, Diagnosis and Actions. While the first, Data, is concerned with gathering all information relevant to the Urban Context and Urban Performance, the second phase, Analysis, is where information is grouped and interrelated as per each of the three main lenses:

— the Who lens: local government and stakeholders (LGS);

— the Why lens: shocks, stresses and challenges (SSC);

— the How lens: policies, plans and initiatives (PPI).

The three analytical lenses, together with information on the urban system's performance, lead to the formulation of the third phase, Diagnosis.

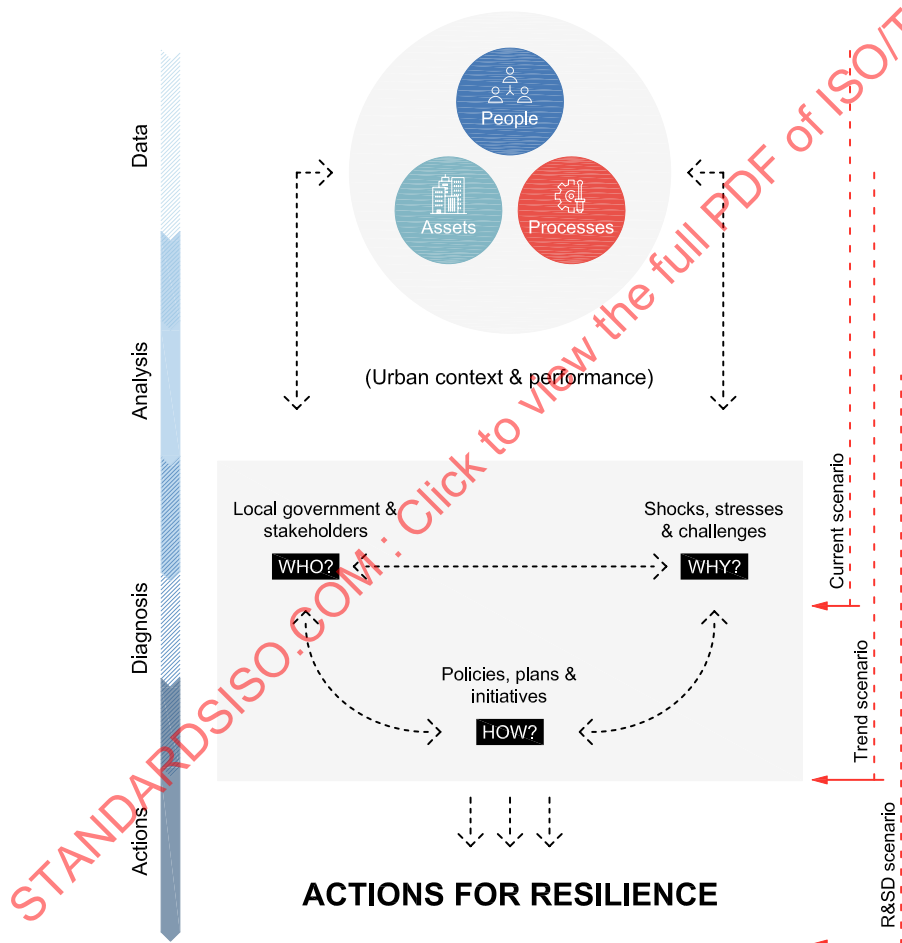The framework of urban resilience is shown in Figure 3.

Figure 3 — Framework of urban resilience

The Actions phase, through the Actions for Resilience (A4R) tool, is where a roadmap is co-created with the local government and other relevant stakeholders, based on the Diagnosis phase and potential scenarios of development, to initiate positive change through verifiable evidence about shocks, stresses and challenges.

Through this framework for urban resilience, three scenarios of the urban system can be built and used to improve its resilience:

a) The Current Scenario is generated from the analysis of the Urban Context and Urban Performance, through which the shocks, stresses and challenges faced are illustrated, the role of the local government and stakeholders are mapped, and the interconnections and impacts of these are evaluated.

b) The Trend Scenario is built upon the current scenario as it follows the trajectory of existing policies, plans and initiatives. It aims to assess if there are ongoing actions that tackle the issues identified in the current scenario and reveal existing gaps. From this assessment, the A4R recommendations can be formulated.

c) The Resilient and Sustainable Development (R&SD) Scenario is the last scenario built based on the trend scenario and modified by the A4R recommendations. It gives a realistic idea of a possible transformation taking into consideration prioritization, management and capacities of the implementing actors: the local government and other relevant stakeholders.

Central to this framework is the Urban System Model. The rationale behind the Urban System Model and how this is employed within the proposed framework for urban resilience in explained in detail in 6.2.

6.2 Urban System Model

Urban areas function as complex, interdependent and integrated social-ecological systems, comprised of people, assets and processes, and managed through effective urban governance mechanisms. An urban system refers to the process of connectivity, interaction, operation and organization of components within an urban area regardless of its size, culture, location, economy and/or political environment.

Urban areas can successfully respond to the impacts of economic, social, political or natural events when viewed as systems in their entirety, connected both within and beyond their boundaries[7]. Recognizing this complexity and interconnectedness, the urban system model aims at systematically gathering data, analysing information and formulating a diagnosis through which strengths as well as weaknesses are captured when exposed to shocks, stresses or challenges.

The methodology for operationalizing the urban system model is to assess the resiliency of human settlements through the analysis of five dynamic and interdependent dimensions, listed and explained as follows.

— Spatial: All human settlements are geographically distributed somewhere on the planet. This dimension is critical for addressing risk/hazard/vulnerability/(dis)continuity as a result of the deficient spatial distribution of people, assets and functions within the local, functional/ metropolitan area.

— Physical: All constructed features comprise the physical dimension regardless of typology, quantity or qualitative state.

— Functional: All human settlements exist for a reason, and functions include the processes, flows, and governance present in all human settlements.

— Organizational: This dimension refers to the associations of people where the smallest "unit" is the individual, and the typology of "organization" includes everything from community to corporate or government institutions.

— Time: Urban areas are not static; they undergo constant evolution.

Furthermore, to systematically collect data on the urban context and assess performance in terms of resilience, the framework uses these dimensions as a means for determining which indicators and metrics should be adopted. The framework also deploys these dimensions as filters by which a number of shocks, stresses and challenges are prioritized, based on how significant they are in relation to some or all of the system's dimensions combined.

The Urban System Model is shown in Figure 4. Each phase of this framework is further explained in 6.3.

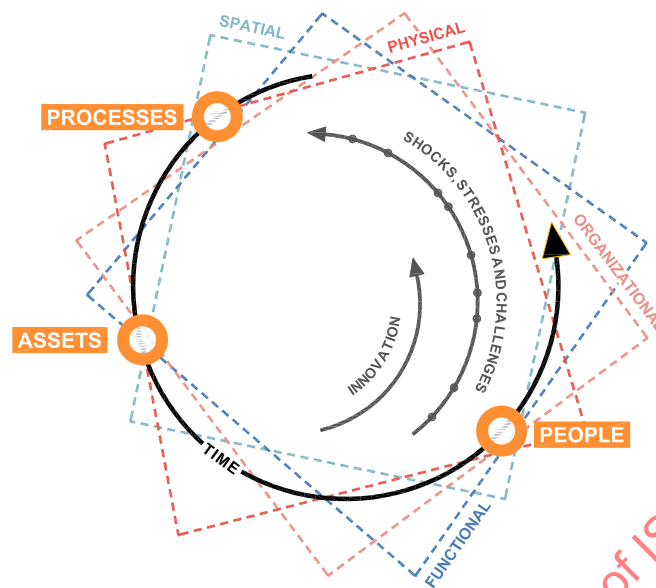**Figure 4 — Urban System Model**

6.3 Data — Urban Context and Urban Performance

6.3.1 General

Centred around people, assets and processes (the key constituents of the Urban System Model), this phase of the framework gathers two complementary types of data: Urban Context (see 6.3.2) and Urban Performance (see 6.3.3).

6.3.2 Urban Context

Urban Context is where the overall picture is provided by gathering contextual information on various topics that give a unique identity. It explores the development narrative through its historical background and its spatial, social, economic and cultural context. It introduces the administrative structure, characteristics and strategies, highlighting those related to resilience, and describes the inhabitants through their composition, characteristics and dynamics.

Urban context allows the subsequent part, Urban Performance, to be attuned to current realities, tailoring questions and prompting deeper inquiries. This contextual information is also used for diagnosis and actions as it provides an idea of the shocks, stresses and challenges faced, including those attributed to climate change, and explores the risk reduction measures in place, such as the ones related to mitigation, preparedness and emergency response.

The key analytical functions of Urban Context are shown in Annex A.

6.3.3 Urban Performance

Urban Performance includes all the elements and their associated components that frame the urban area, from a close-up in the built environment to the broader scale of the ecology, supply chain and logistics, basic infrastructure and mobility. It further identifies the public services provided by the municipality and other levels of government, and the mechanism and institutions promoting social inclusion and protection, as well as analysing the aspects of economy relevant to the local context.

Urban Performance is an in-depth, indicators-based approach of assessing the urban system. It is focused on collecting objective data, information and knowledge, localized through the Urban Context. It considers all aspects and attributes that shape the urban area (people, processes and assets) and further assesses the interconnections between them.

Every component, water supply, land tenure, etc., has a set of specific indicators linked to the dimensions of the Urban System Model. These indicators are dedicated to the assessment and definition of the system's performance (e.g. coverage as physical and spatial dimensions, continuity of operations as functional dimension), and the identification of key stakeholders and policies, plans and initiatives.

Urban Performance allows identification of the key functions of local governments and stakeholders in developing and consolidating the resilience that will be detailed and structured through the Who lens (local governments and stakeholders). Furthermore, it provides a comprehensive understanding of strengths and weaknesses in the urban system and evidence for future decision-making regarding resilience-building.

Urban Performance looks into eight main elements deemed as constituents of the urban system. These elements are shown in Annex B and explained in detail in 6.3.4.

6.3.4 Elements of an urban system

6.3.4.1 Built environment: Assesses the evolution, composition and robustness of the urban built-up area by analysing the urban area in four layers. Urban form, the first layer, provides an overall view on the growth patterns and how this is translated in the urban built-up and urban open areas. Land tenure, together with housing, addresses the right to shelter that is secure, accessible, affordable, and adequately built and located. The fourth layer assesses the physical built quality of assets and critical facilities that provide essential services to the urban area and its inhabitants. This comprehensive analysis of the built environment can reveal important issues such as informality, insecurity of tenure and inefficiencies in land use, themselves stresses in the urban system that can further exacerbate the impacts of other threats.

6.3.4.2 Supply chain and logistics: Deals with how essential non-human resources are accessed, distributed and managed. It focuses on the diversity, availability and consumption of food, water and energy resources, and assesses the critical entry and distribution points for general materials and goods. Lack of these resources, due to reasons ranging from changes in natural processes to overconsumption and inadequacies in means of delivery, can severely cripple the urban system and increase vulnerabilities. Furthermore, this element is a crucial connection to humanitarian affairs as it assesses the availability of resources in crisis situations and the existing capacities and strategies to utilize these.

6.3.4.3 Basic infrastructure: This addresses existing and future issues in delivering a resilient urban environment, presented by increasing urbanization, population growth and climate change, and supports equitable, inclusive and sustainable development. Resilient urban areas should work towards the promotion of equitable and affordable access to a sustainable basic physical infrastructure for all, without discrimination, including affordable safe drinking water and sanitation, modern and renewable energy, waste disposal, and information and communications technologies. These services are crucial resources to empower people and communities to provide for their economic, social, environmental and cultural well-being. Following the commitments of the New Urban Agenda, this framework assesses these urban systems' performances, considering innovative, resource-efficient, accessible, context-specific and culturally sensitive sustainable solutions, as well as the reliance on alternative sources in lack of access and coverage of services.

6.3.4.4 Mobility: Assesses the ability to meet the current, projected and future surges of demand of moving people within, from and to the urban area including the local and functional/metropolitan boundaries. It aims at evaluating the transport capacity for resilience by capturing the potentials of diversity, redundancy and robustness of the various modes of transport existing in the urban area. Furthermore, this element assesses the coverage of transport infrastructures provided by the duty-bearers, as well as people's access (including spatial, physical and socio-economical) to the various

modes available. The data analysis in this element allows for detecting current stresses originated within the mobility system as well as anticipating future ones and the subsequent interdependencies with potential shocks.

6.3.4.5 Municipal public services: Essential components of the urban system provided by governments to people living within their jurisdictions, either directly (through the public sector) or by financing the provision of services. It allows for an in-depth analysis of those services delivered by the municipalities and which require specific attention from a resilience perspective. They include services relevant from a humanitarian perspective and from cultural and religious perspectives such as services of cultural heritage, cultural activities, cemeteries and crematoriums. In addition, they include services relevant from an emergency response and safety perspective, such as firefighting services, and other services usually provided in exchange for the taxes paid by citizens.

6.3.4.6 Social inclusion and protection: Provides an overview on how accountable the local government is in relation to the inhabitants, and how much it is striving for social inclusion and promotion of full participation of each man and woman, boy and girl. Based on the principles of equity, equality and fulfilment of human rights, the data analysis in this element allows for assessing the population's access to their basic developmental rights translated into access to basic social protection and basic social services such as education, health, food and social care, and anticipating potential shocks and stresses in order to build their social resilience. The whole element has a particular focus on analysing the status of a large array of categories of people in vulnerable situations, all by being in line with the provisions of international human rights standards and instruments.

6.3.4.7 Economy: Urban areas should adopt policies enabling them to improve their ability to cope with shocks, stresses and challenges. In economic terms, a resilient system is one that has the ability to absorb, recover quickly and/or avoid economic shocks. A shock could be absorbed if economic mechanisms are in place to react and reduce adverse effects. For example, economic diversity will support the absorption of potential shocks as an economic system is more able to shift resources to sectors with a stronger demand when needed. Furthermore, for an economic system to recover quickly, having the flexibility to "bounce back" after a crisis is essential. Some economic conditions can support or prevent an economy to recover quickly. For example, a tendency for large fiscal deficits or high rates of unemployment will prevent quick recovery. However, a solid fiscal position that permits the use of additional expenditures or fiscal restraint to reduce economic shocks can support rapid economic recovery. Lastly, a resilient economic system is one that enables the sustainable pursuit of prosperity for all inhabitants as a prosperous urban system is often better equipped to respond to crisis.

6.3.4.8 Ecology: Human settlements depend on and interact with their surrounding ecosystems for the provision of food, fresh water, clean air, spaces for worship, etc. Overconsumption, contamination from human activity and a changing climate, however, affect a region's bio-capacity, biodiversity and environmental quality. These impacts, in turn, change ecosystems, potentially exposing natural and environmental threats, and exacerbating their inherent social vulnerabilities. To safeguard the livelihoods of current and future generations as well as the physical and mental well-being of all citizens, the framework adopts the ecosystem services approach as a reference framework to analyse urban ecology and assess environmental resilience in relation to human health. Following this approach, the ecology element studies the management of its ecosystem services, its consumption and production pattern, the preservation of natural areas and biodiversity in the region, and current pollution levels.

6.4 Analytical lenses

6.4.1 General

The proposed framework employs three analytical lenses by which all data gathered throughout Urban Context and Urban Performance are analysed, inter-relations between urban elements and components are mapped when exposed to shocks, stresses and challenges, and stakeholders' responsibilities and interconnections are portrayed.

The Who lens (LGS) and the Why lens (SSC) articulate the current scenario of the urban area in the light of its present context and performance. The How lens (PPI) further filters the outcome of the two previous lenses, leading to the formulation of the trend scenario based on the trajectory of statutory planning and development. The three lenses together constitute the basis for the Diagnosis.

The analytical lenses are explained in further detail in 6.4.2 to 6.4.4.

6.4.2 Key analytical functions of the Who lens — Local government and stakeholders (LGS)

Using the data gathered throughout Urban Context and Urban Performance, particularly those related to stakeholders, the Who lens (LGS) tackles the stakeholders and the processes at three levels in order to provide tailored support to the formulation of meaningful and relevant actions for resilience that are implementable and adapted to specific local needs in any urban setting. In other words, the design of this lens aims at providing a clear picture of the stakeholders and their roles, by assessing the interactions in designing and implementing the public policies relevant from a resilience perspective, with a thorough understanding of how each one's power is influencing these processes. The three levels are as follows.

a) The role and place of the local government, the governance structures and processes, made up of two elements as follows.

   1) Making an inventory of responsibilities of the local governments, the functions of the public administration and decentralized authorities. This is essential in understanding the local government as the central stakeholder in charge of the design and implementation of various policies relevant from urban resilience perspective.

   2) Analysis of decentralization that captures administrative and fiscal decentralization characteristics to understand the extent to which the policy making and the policy implementation could be effective from the perspective of responsibilities and capacities of the local government.

b) Stakeholders' mapping, made up of two elements as follows.

   1) Exhaustive mapping of the stakeholders, covering all the areas and themes of interest from a resilience perspective. It enables knowing who's who on a broad map of stakeholders that often can have complementary but also conflicting positioning regarding the themes relevant from a resilience perspective. The thematic grouping of the stakeholders should consider the shocks, stresses and challenges as the main analytical vector.

   2) Analysis of public, private, civil society, academia and other important stakeholders, including their responsibilities. In line with the exhaustive mapping, this section captures the essential roles and responsibilities the stakeholders have regarding the selected urban resilience themes.

c) Stakeholders' relationships, made up of two elements as follows.

   1) Analysis of interactions between the stakeholders, in terms of power, interest and resources that need to be deployed in order to develop sustainable resilience strategies. This section, carried-out at a later stage than the effective database filling-in process, involves significant qualitative analysis that will allow for a better understanding of the effective interactions between the stakeholders, beyond the legal frameworks, into the practicality of the day-by-day business. This requires significant additional training.

   2) Preparing the ground for informed and evidence-based recommendations for actions for resilience.

The key analytical functions of the Who lens (LGS) are shown in Annex C.

6.4.3 Key analytical functions of the Why lens — Shocks, stresses and challenges (SSC)

6.4.3.1 General

Urban areas are constantly evolving, changing and transforming. By exploring the shocks, stresses and challenges present in the urban system, this lens contributes to the formulation of a Diagnosis attuned to the realities, capturing weaknesses, pressures and contextual changes, and preparing the ground for the design of implementable and adapted actions aimed at decreasing the possible impacts of those threats at the urban scale.

The Why lens (SSC) focuses on providing a thorough understanding of how these adverse events and pressures are influencing the resilience of the urban setting, by drawing an overall mapping proneness to shocks, stresses and challenges, and their interrelations, while performing an analysis of those requiring priority actions, to be tackled in the Actions phase. Criteria for filtering the priorities are deployed, following the urban system dimensions and based on how significant they are in relation to some or all of the system's dimensions combined.

The key analytical functions of the Why lens (SSC) are shown in Annex D.

6.4.3.2 Shocks

Shocks, as potential uncertain abrupt or long-onset events, have the main consequence of shifting from a current state to a disturbed one. Through the Urban Context data, a full range of shocks is exposed and identified, see Annex E. In alignment with the Sendai Framework[11], the appraisal of "risk reduction measures" adopted to anticipate, mitigate and prepare for such events is conducted. They provide a baseline for the mapping and analysis of those requiring priority actions, using criteria to detect those of significance that require specific measures. These actions are referred to as "risk reduction actions" and are tackled through A4R.

6.4.3.3 Stresses

Stresses, as chronic and ongoing dynamic pressures originated within the urban system, have cumulative impacts undermining the capacity for sustainability and resilience, which renders it fragile and vulnerable. In the Data phase, stresses are identified both by the local government and detected through several indicators of the Urban Context and Urban Performance, known as "stressors" or "risk drivers". An approach has been predefined to determine the existence of certain stresses that were selected based on a thorough analysis of the UN Agenda 2030, including the SDGs and the New Urban Agenda, as well as an extensive review of existing research and practitioners' work on urban hazards. The Why lens (SSC) articulates an additional review conducted by experts and specialists in relation to stresses, to add further insights into the mapping. The criteria for prioritization of those requiring actions are then deployed and a performance analysis carried out, towards the reduction or annihilation of consequent vulnerabilities and weaknesses. These actions are referred to as "vulnerability reduction actions".

6.4.3.4 Challenges

Challenges, as long-term contextual changes and pressures originated outside of the urban system, also undermine the capacity for sustainability and resilience. Special attention is given to these, due to their long-term effects and potentiality for exacerbating the impacts of both shocks and stresses on the urban system. Analogous to the stresses, their identification and detection through the Urban Context and Urban Performance is followed by a mapping and analysis, with additional insights by experts and specialists. The prioritization of those requiring actions is articulated using criteria, in order to reduce the consequent vulnerabilities and enhance adaptation capacities detected through a performance analysis. These actions are referred to as "adaptation actions".

6.4.4   Key analytical functions of the How lens — Policies, plans and initiatives (PPI)

The How lens (PPI) analyses the existing policy context and statutory planning, recognizing the presence of complementary efforts and repositories of knowledge, and provides the backbone on how resilience strategies are developed and implemented. Hence, this lens acts as a critical piece in formulating evidence-based actions.

Information on the existing policies, plans and initiatives stems, as an essential outcome, from the data phase of the proposed framework. General strategies are derived from the Urban Context, while specific policies, plans and initiatives are captured per associated component of each urban element, including their implementation status and characteristics.

This information is organized in an inventory that coherently maps these among the entire governance structure and the issues currently or potentially faced, and is assessed through specific criteria based on these relations, to determine areas of focus, gaps and overlaps. Thus, the PPI should be analysed in conjunction with LGS and SSC, in order to understand the trajectory of development. Through this, the How lens (PPI) reveals the trend scenario, which portrays if there are ongoing actions that tackle the issues identified in the current scenario and reveals existing gaps, upon which the A4R recommendations are built.

The key analytical functions of the How lens (PPI) are shown in Annex F.

7   Actions for Resilience (A4R)

Actions for Resilience (A4R) is the key output of this proposed framework. It is a public, policy-centred strategic planning tool that combines risk reduction, vulnerability reduction, adaptation and capacity-building actions with sustainable development in order to ameliorate the resilience of the urban area. It presents to the local government the conclusions of the process in the form of evidence-based actions (programmes, projects and other initiatives) in a well-managed framework of governance, that is geared towards enhancing political awareness, providing a reason to act and offering knowledge on what to do.

A4R aims to develop a shared vision among stakeholders for transformative change towards a more resilient and sustainable urban area aligned within international frameworks. It guides this vision through the following outputs.

— A roadmap towards a R&SD Scenario comprised of short-, medium-, and long-term actions, with a description sheet per action that links with the New Urban Agenda and includes indicators for impact monitoring.

— A map of stakeholders and planning tools, including key local stakeholders, processes and actions to be engaged, as well as advice for other types of stakeholders, technical support or fundraising needed, in order to ease or stimulate the implementation of the roadmap.

— A data assessment report and map of current databases, providing a thorough review of data availability and existing gaps, and providing inputs on data collection and information management.

These are framed by the themes of the New Urban Agenda, which sets out a holistic vision and calls for coordinated action for sustainable urban development, in order to propose multi-thematic and multi-dimensional actions to be executed in the short, medium and long term:

— national urban policies and local implementation enhance multi-stakeholder decision-making, while identifying implementable actions and existing or potential barriers to sustainable urban development;

— rules and regulations integrate with existing legal frameworks and create a monitoring strategy, and urban planning and design develops thematic strategies and resilience-based solutions;

— financing urbanization addresses the urban economy and seeks to strengthen municipal finances, increase creditworthiness and identify potential public–private partnerships (PPP) investment.

Formulating these outputs entails a thorough evaluation through the Data, Analysis and Diagnosis phases of the proposed framework, from which the current and trend scenarios are based. Following this process, a series of steps are conducted to ensure actionable and implementable results, as follows.

a) Preliminary results of the process stemming from the current and trend scenarios, including initial A4R recommendations based on the reinforcement or modification of ongoing actions, as well as the creation of new actions from best practices.

b) Two-day workshop with local authorities and relevant stakeholders, moderated by the project team, to build a common consensus on the proposed actions and its prioritization towards the R&SD scenario roadmap.

c) Integration of workshop conclusions for final A4R outputs.

d) A4R briefing and delivery of the final results in an official meeting with the local authority, relevant stakeholders and the project team.

Through A4R, the proposed framework provides a pathway towards resilience-based sustainable urban development that features:

— adaptive learning based on the urban area profile;

— consensus-building among different stakeholders;

— evidence-based, targeted, scheduled and coordinated actions;

— implementation within a wider strategy that can be monitored and measured over time.

8   Assessment of relevant International Standards and frameworks

8.1   General

In order to more effectively understand and contextualise this proposal to develop a series of International Standards regarding resilience, and urban resilience more precisely, it is vital to acknowledge the previous work that has been developed on this topic. For this purpose, an assessment of relevant existing and currently under-development International Standards, against this proposed framework, was carried out. As a result, a number of gaps were identified (explained in more detail under 8.2). The assessment covered International Standards developed by the following ISO Technical Committees:

— ISO/TC 224, *Service activities relating to drinking water supply, wastewater and stormwater systems*;

— ISO/TC 262, *Risk management*;

— ISO/TC 268, *Sustainable cities and communities*;

— ISO/TC 292, *Security and resilience*.

8.2   Identified gaps

The preliminary assessment of current International Standards relevant to resilience, including both published standards and those currently under development, reveals an approach to understanding resilience that is reflected within this proposed framework for urban resilience. It is anticipated that this approach will influence the development and revision of ISO/TC 292 documents going forward. Areas in which this influence can be evident are set out briefly below.

— **Resilience in the face of a disaster**. The emphasis in ISO/TC 292 documents on disaster preparedness, including risk mitigation measures, could benefit from employing a broader-reaching, urban systems-based approach to resilience. Recognizing that resilience is extremely important in

the face of a disaster, the concept of resilience should be linked to capacity building and ways to engage with all aspects of the urban system potentially affected by anticipated hazards.

— **Emphasis on the physical elements of resilience**. ISO/TC 292 documents emphasize resilience in relation to physical assets, such as infrastructure and buildings. The emphasis on people in this proposed framework for urban resilience allows for increased ability to assess social, economic and environmental considerations, and to understand resilience as a process that addresses all urban functions, processes, flows and service delivery mechanisms, in addition to physical assets.

— **The importance and benefits of including broad input from a full range of countries**. The advantage of UN engagement in ISO/TC 292 work on urban resilience will encourage and permit contextual knowledge and lessons learned from engagement in both Least Developed Countries (LCDs) and Small Island Developing States (SIDS). This will provide for a more nuanced conception of resilience and how it can be measured in a variety of contexts beyond large, wealthy countries now with the resources to participate in the standards development process.

— **Improved emphasis on resilience in the urban context**. ISO/TC 292 documents have historically focused on resilience in a global context limiting the attention paid to resilience in an urban context.

— **Recognizing the important role of governance**. ISO/TC 292 documents have not considered the governance structures or decision-making mechanisms and their contribution to building resilience. The proposed framework provides valuable information on the importance of engagement, and the development of actions in conjunction with local governments.

— **An action-oriented approach.** ISO/TC 292 documents focus primarily on developing best practices and to a lesser extent on actions to be taken to build resilience. The proposed framework emphasizes the development of recommendations for action to be taken by local governments as they address resilience-building priorities.

— **The importance of stakeholder engagement**. The proposed framework recognizes that urban systems function through organization(s) or urban stakeholders with jurisdictional authority to make decisions and that have a mandate to influence decision-making. TC 292 documents currently place less emphasis on the importance of stakeholder engagement, shown in this framework to be of primary importance when developing urban resilience. The encouragement of stakeholder participation of those who should be involved in decision-making and consultation with those who are yet not involved but could be is evidence of commitment to Principle 3 (see 4.3). In addition to promoting sustained inclusiveness, the framework also recognizes that that resilience is achieved incrementally and is measured at any point in a continuum of positive change.

9 Conclusion and suggestion for future standardization work

Drawing on the above assessment of relevant standards, it is recommended that a new comprehensive International Standard for urban resilience that is coherent with the already existing ones, and the entire international sustainable development agenda, is developed. The proposed framework would complement the already extensive documents produced by ISO/TC 292 and fill the aforementioned identified gaps. Furthermore, in its endeavours to mainstream the UN's SDGs, the programme could provide resilience-relevant standards that contribute to the SDGs.

In addition to its contribution to the SDGs, a key outcome of the framework is the development of actionable recommendations for local governments to address resilience-building priorities in the short-, medium- and long-term based on the multi-thematic and multidimensional recommended actions of the New Urban Agenda. Thus, the framework offers an opportunity for alignment between International Standards on resilience and the New Urban Agenda.

Additional advantages of this approach, particularly of the assessment of Context and Performance, are the identification of gaps in data availability and the generation of an inventory of existing or under-development policies, plans and initiatives pertinent to resilience at the local level. Whereas the latter will be a critical piece in formulating evidence-based actions for resilience, gaps in data availability lead

to actions on possible data mining and management methods, through which future iterative processes of diagnosis and actions can be consolidated.

Finally, while the framework provides a broad-reaching and urban system-based approach for evaluating the capacity for resilience, it also allows for a comprehensive appraisal of specific topics defined as cross-cutting issues and thematic enhancers, through filtering relevant information gathered and analysed throughout data collection and analysis phases. Annex G provides further detail on the different issues considered.

The proposal for standards on urban resilience stems from the belief that there is a significant necessity to move beyond disaster resilience and climate mitigation towards a holistic articulation of resilience as a long-term, pro-active, forward-looking approach that enables urban settlements to withstand adversities, adapt to changes, as well as transform challenges to opportunities.

Annex A
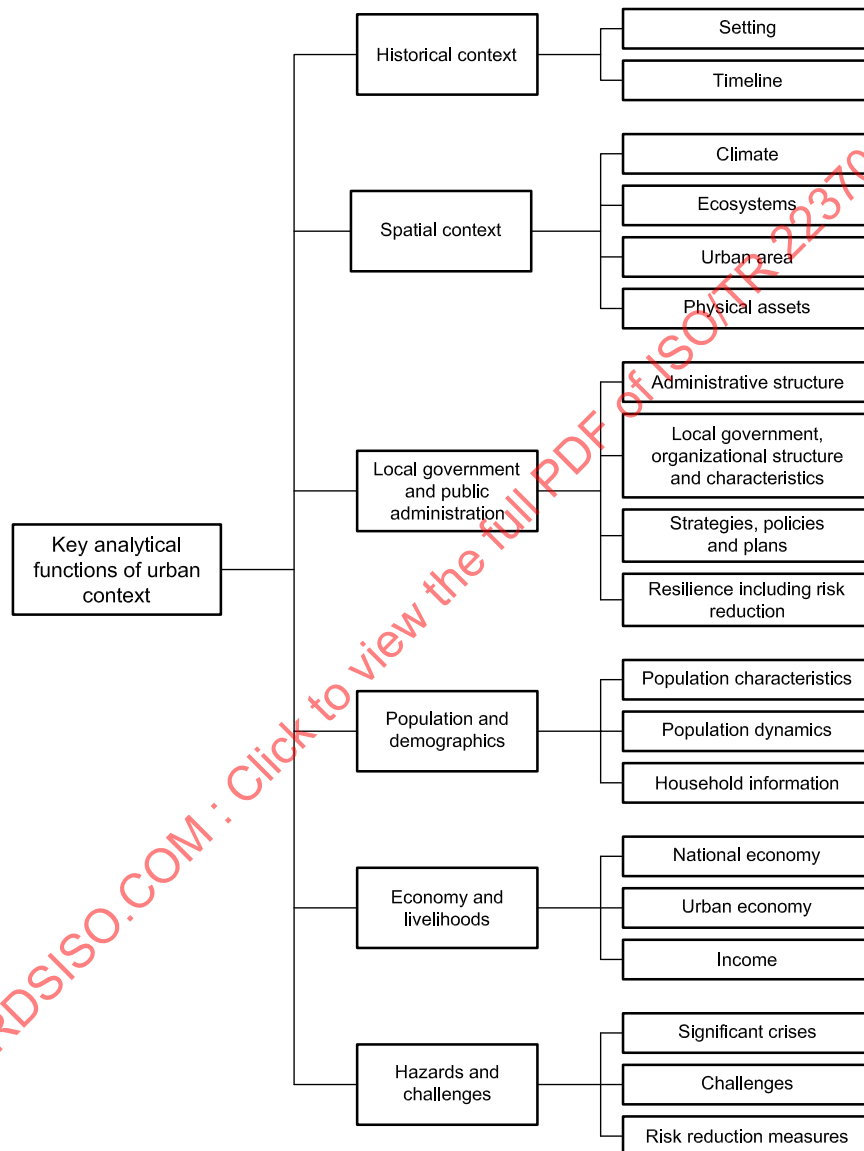## (informative)

Data — Urban Context

Figure A.1 — Key analytical functions of Urban Context

Annex B
(informative)
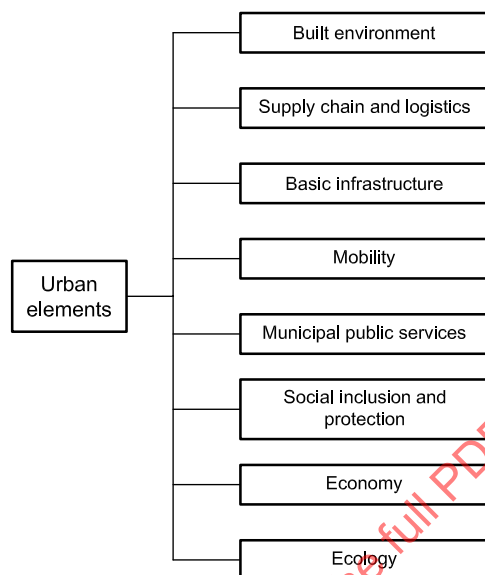
Data — Urban Performance

Figure B.1 — Key analytical functions of Urban Performance

Annex C
(informative)

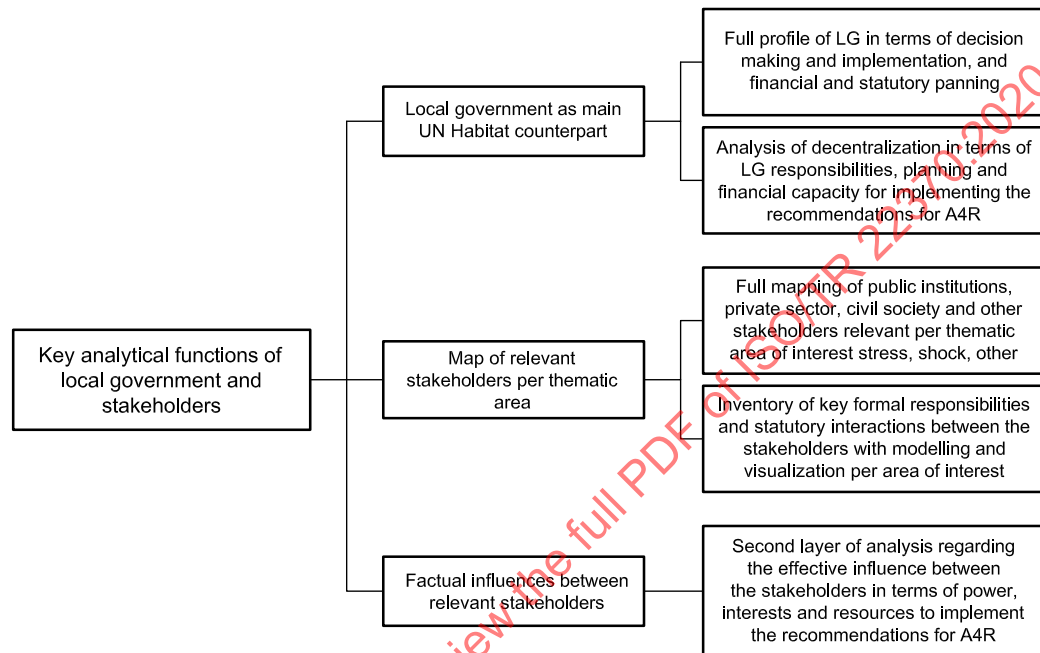# The Who lens — Local government and stakeholders (LGS)

Figure C.1 — Key analytical functions of the Who lens (LGS)

Annex D
(informative)
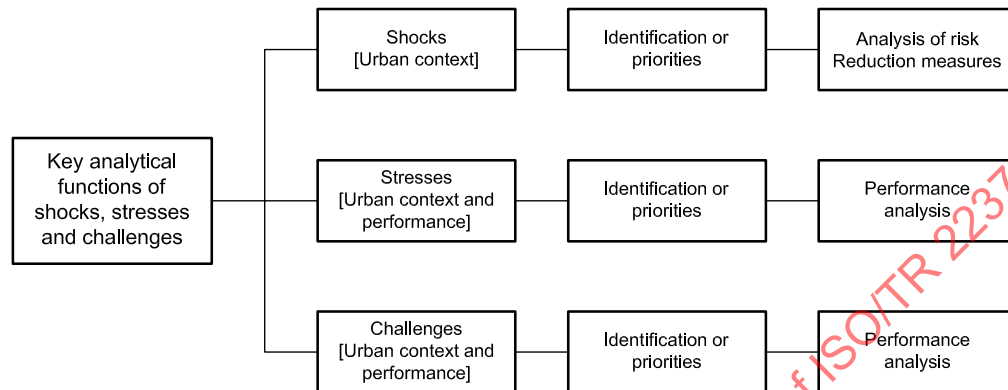
The Why lens — Shocks, stresses and challenges (SSC)

Figure D.1 — Key analytical functions of the Why lens (SSC)