

City Resilience Index

December 2015



City Resilience Index

Urban populations are facing increasing challenges from numerous natural and man-made pressures such as rapid urbanisation, climate change, terrorism and increased risks from natural hazards. Cities must learn to adapt and thrive in the face of these diverse challenges - they must learn how to build resilience in an uncertain world. Armed with this knowledge and understanding, governments, donors, investors, policy makers, and the private sector will be able to develop effective strategies to foster more resilient cities.

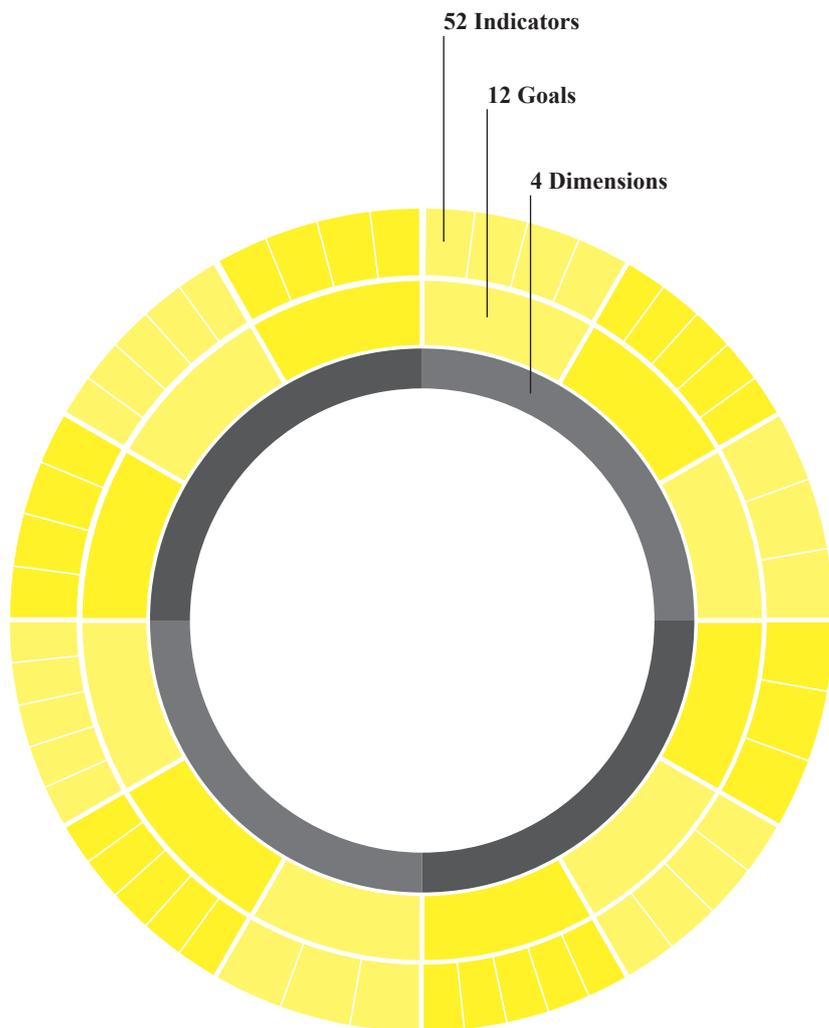
Supported by the Rockefeller Foundation, the City Resilience Index (CRI) is being developed by Arup. It builds on extensive research undertaken by Arup to establish an accessible, evidence-based definition of urban resilience, which culminated in the publication of the City Resilience Framework (CRF) in April 2014 (www.arup.com/cri). This provides a holistic articulation of city resilience, structured around four dimensions and 12 goals that are critical for the resilience of our cities. This structure also forms the foundations of the CRI.

Who is the CRI for?

The CRI will measure relative performance over time rather than comparison between cities. It will not deliver an overall single score for comparing performance between cities, neither will it provide a world ranking of the most resilient cities. However, it will provide a common basis of measurement and assessment to better facilitate dialogue and knowledge-sharing between cities.

It is envisaged that the CRI will primarily be used by city governments who are in the best position to gather administrative data, but it can also be used by other interested organisations and individuals (for example, universities, non-governmental organisations, community groups). It is intended that the CRI process will also provide the means for cities to capture the views of the poor and vulnerable groups as they normally suffer more severely the impacts of disruptions and failures.

Structure of the CRI



4 Dimensions

Our research suggests that resilience of a city relates to four key dimensions:

Health and well-being, ensuring the health and wellbeing of everyone living and working in the city;

Economy and society, the social and financial systems that enable urban populations to live peacefully, and act collectively;

Infrastructure and environment, man-made and natural systems that provide critical services, protect and connect urban citizens; and

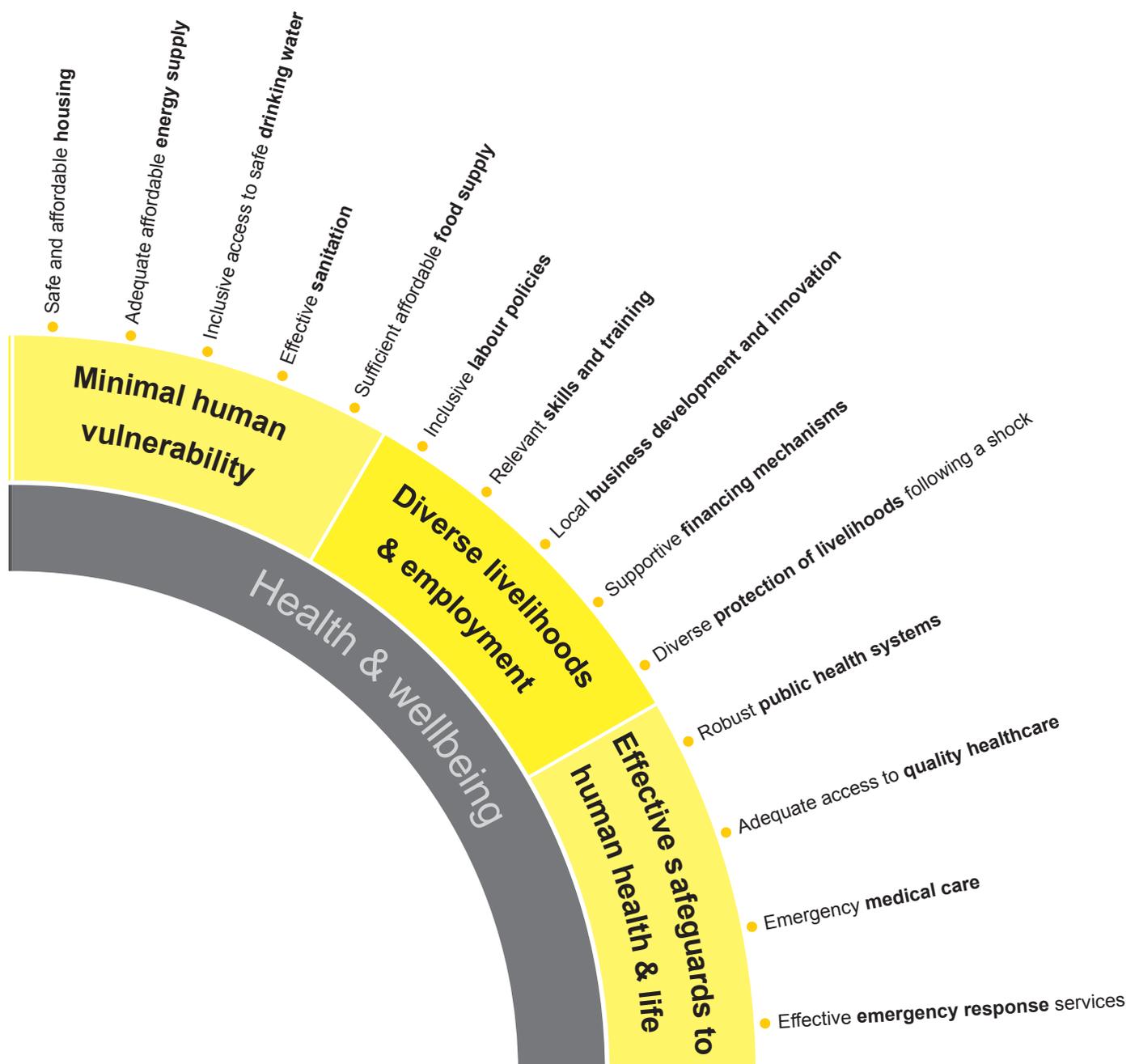
Leadership and strategy, the need for informed, inclusive, integrated and iterative decision making in our cities.

12 Goals

Underpinning these four dimensions, there are 12 goals that each and every city should strive towards in order to achieve resilience. Our research tells us that universally these are what matters most when a city faces a wide range of chronic problems or a sudden catastrophe. However, it is recognised within the framework that the relative importance of each goal and how they are realised will be unique for every city.

52 Indicators

Research to develop the City Resilience Framework and Index has identified 58 indicators. The indicators add further definition to the 12 goals and identify the critical factors that contribute towards the resilience of urban systems. The indicators also integrate the 7 qualities of resilient systems (e.g. robust, inclusive, flexible) that Arup's empirical research has identified as of vital importance.



Health and well-being

This dimension relates to **people** – the health and well-being of everyone living and working in the city. This dimension considers the extent to which the city enables everyone to meet their basic needs (food, water, and shelter), particularly in times of crisis. It considers how well the city supports diverse livelihood opportunities, including access to business investment and social welfare. Finally, it considers if a city is able to safeguard the health of its population through its normal and emergency healthcare provisions.

Minimal human vulnerability

This relates to the extent to which everyone's basic needs are met.

- 1.1 Safe and affordable housing** Safe housing that is affordable for all city residents.
- 1.2 Adequate affordable energy supply** Sufficient and affordable energy supply for all.
- 1.3 Inclusive access to safe drinking water** Access to an adequate supply of safe drinking water.
- 1.4 Effective Sanitation** Safe, reliable and affordable sanitation provided to all areas of the city.
- 1.5 Sufficient affordable food supply** Sufficient and affordable food supplies for all.



Diverse livelihoods and employment

This is facilitated by access to finance, ability to accrue savings, skills training, business support, and social welfare.

- 2.1 Inclusive labour policies** Inclusive labour policies and standards, with an effective welfare system for low income groups.
- 2.2 Relevant skills and training** Effective mechanisms for matching skills to the current and emerging employment marketplace.
- 2.3 Local business development and innovation** Thriving, adaptable and inclusive local business environment.
- 2.4 Supportive financing mechanisms** Inclusive and resourceful finance mechanisms to enable businesses to adapt to changing circumstances and put in place contingencies for shock events.
- 2.5 Diverse protection of livelihoods following a shock** Resourceful and inclusive measures to support businesses and workers following a shock.

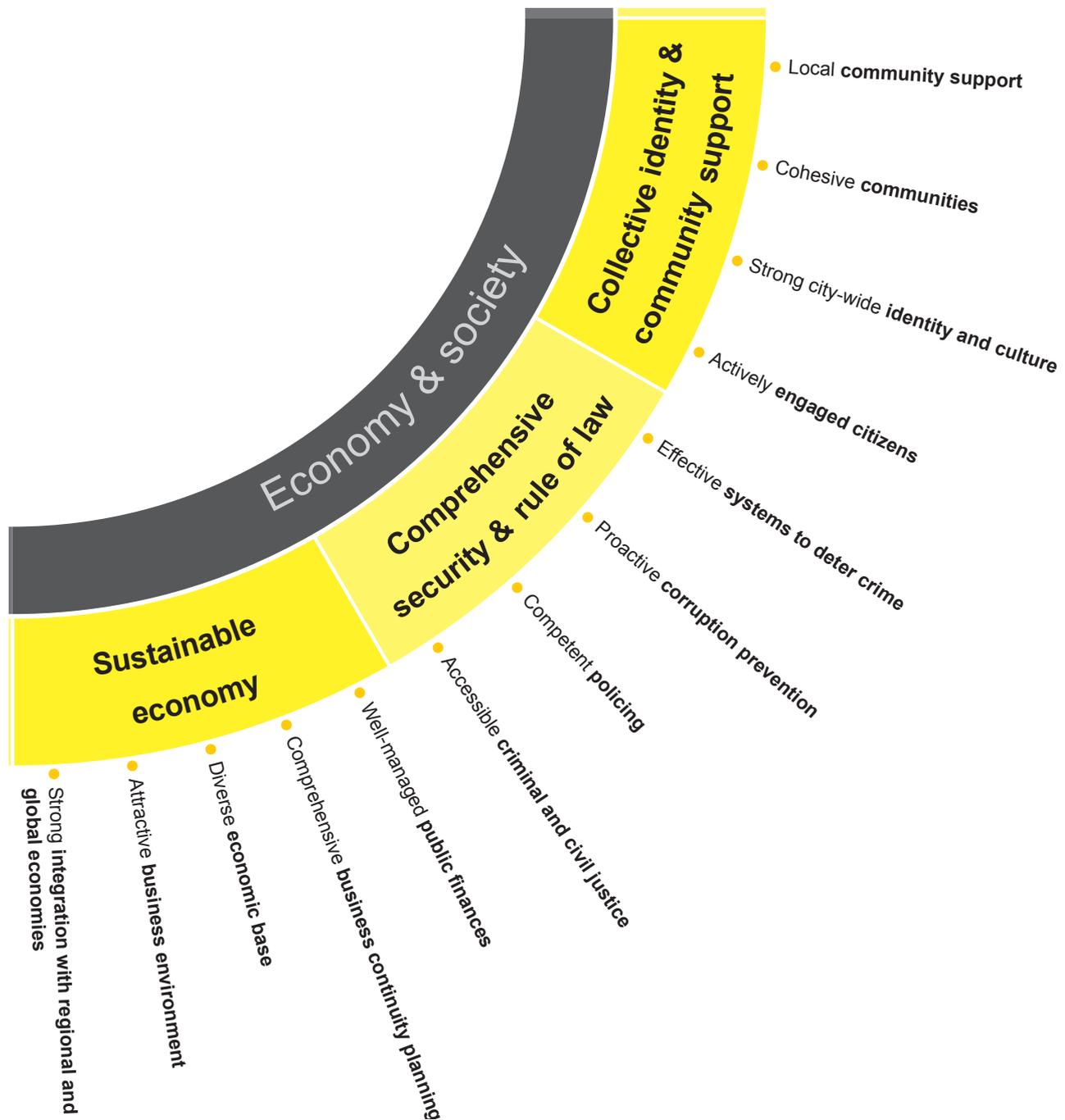


Effective safeguards to human health and life

This relies on integrated health facilities and services, and responsive emergency services.

- 3.1 Robust public health systems** Robust monitoring and mitigation of public health risks.
- 3.2 Adequate access to quality healthcare** Adequate and inclusive access to quality general healthcare.
- 3.3 Emergency medical care** Adequately resourced emergency medical services.
- 3.4 Effective emergency response services** Adequately resourced emergency response services.





Economy and society

This dimension relates to the **organisation** of cities – how social and economic systems enable urban populations to live peacefully, and act collectively. Included within this dimension are the systems that enforce law and order and ensure fiscal management. The environment within a city that creates collective identity and mutual support is also considered – open spaces and cultural heritage play an important role in this.

Collective identity and community support

This is observed as active community engagement, strong social networks and social integration.

4.1 Local Community Support

Cohesive social structures providing support at individual, household and local community level.

4.2 Cohesive communities

Cohesive, harmonised communities across the city.

4.3 Strong city-wide identity and culture

Cohesive local identity and culture, in which all citizens feel a sense of belonging in the city.

4.4 Actively engaged citizens

Citizens actively engage, express opinion and participate within society.



Comprehensive security and rule of law

This includes law enforcement, fair justice, and prevention of crime and corruption.

5.1 Effective systems to deter crime

Integrated, collaborative and resourceful mechanisms to deter crime.

5.2 Proactive corruption prevention

Fair and transparent systems to fight corruption and promote justice.

5.3 Competent policing

Effective policing measures and systems for a safe and secure city.

5.4 Accessible criminal and civil justice

Effective, affordable, impartial and accessible mechanisms to promote justice and resolve civil disputes.



Sustainable economy

This is observed in sound management of city finances, diverse revenue streams, and the ability to attract business investment, allocate capital, and build emergency funds.

6.1 Well-managed public finances

Adequate public finances and sound fiscal management.

6.2 Comprehensive business continuity planning

Resourceful, reflective and flexible business continuity planning across both public and private sectors.

6.3 Diverse economic base

Robust, flexible and diverse local economy.

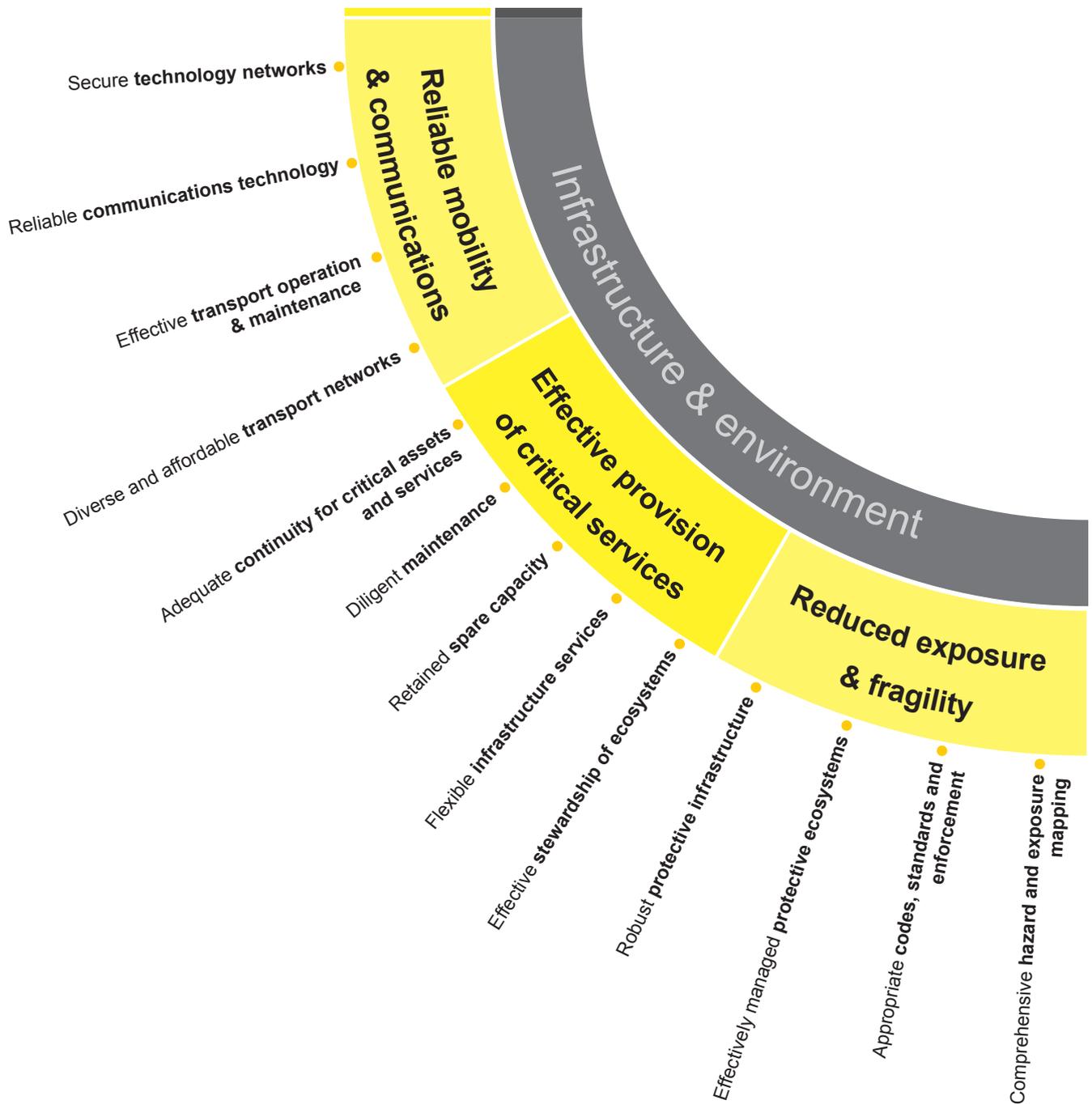
6.4 Attractive business environment

Diverse and resourceful investments within the city, driven by a strong urban brand and economic and social environment.

6.5 Strong integration with regional and global economies

Strong integration between the city's economy and wider economic systems.





Infrastructure and ecosystems

This dimension relates to **place** – the quality of infrastructure and ecosystems that protects, provide and connect us. The CRI considers the robustness of infrastructure and ecosystems that protect us from natural hazards. The continuity of critical services, under shock or stress situations are also important within this dimension. In particular, water supply, power distribution, and solid waste management; the transportation systems that enable the flow of goods, services, people, and information.

Reduced exposure & fragility

This relies on a comprehensive understanding of the hazards and risks to which a city is exposed, the extent to which this understanding that informs the development of integrated strategies to physically protect the city combining sound environmental stewardship, robust design and maintenance of man-made infrastructure, and enforcement of appropriate building codes and regulations.

7.1 Comprehensive hazard and exposure mapping

Robust systems in place to map the city's exposure and vulnerability to hazards based on current data.

7.2 Appropriate codes, standards and enforcement

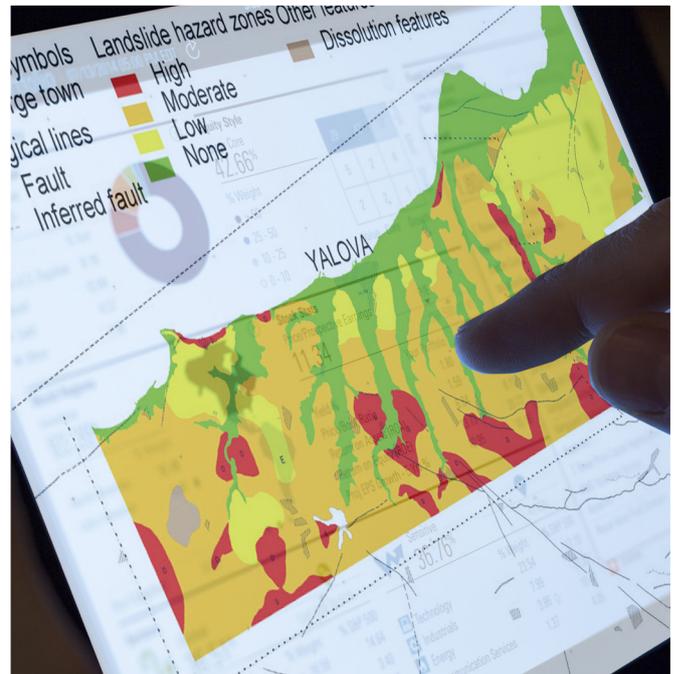
Building and infrastructure codes and standards are forward looking, appropriate to local context and risk profiles, and enforced.

7.3 Effectively managed protective ecosystems

Well-developed understanding and acknowledgement of the role of ecosystems in providing physical protection to the city.

7.4 Robust protective infrastructure

Integrated, forward-looking and robust network of protective infrastructure that reduces vulnerability and exposure of citizens and critical assets.



Effective provision of critical services

This results from active management and maintenance of ecosystems, and from diversity of provision, redundant capacity, and adequate maintenance of essential utility services, combined with robust contingency planning.

8.1 Effective stewardship of ecosystems

Robust mechanisms are in place to maintain and enhance the ecosystem services that benefit city residents

8.2 Flexible infrastructure

Critical services within the city are supported by diverse and robust infrastructure, which has been appropriately planned and delivered

8.3. Retained spare capacity

Demand on critical infrastructure is minimised through the resourceful and flexible use of key resources.

8.4 Diligent maintenance and continuity

Robust monitoring, maintenance and renewal of essential utility infrastructure, with effective contingency planning.

8.5 Adequate continuity for critical assets and services

Resourceful, reflective and flexible continuity plans to maintain utility services to critical assets during emergency situations.



Reliable mobility and communications

This is enabled by diverse and affordable multi-modal transport systems and information and communication technology (ICT) networks, and contingency planning.

9.1 Diverse and affordable transport networks

Diverse and integrated transport networks, providing flexible and affordable travel around the city for all.

9.2 Effective transport operation & maintenance

Effective management of the city's transport network to provide quality, safe transport.

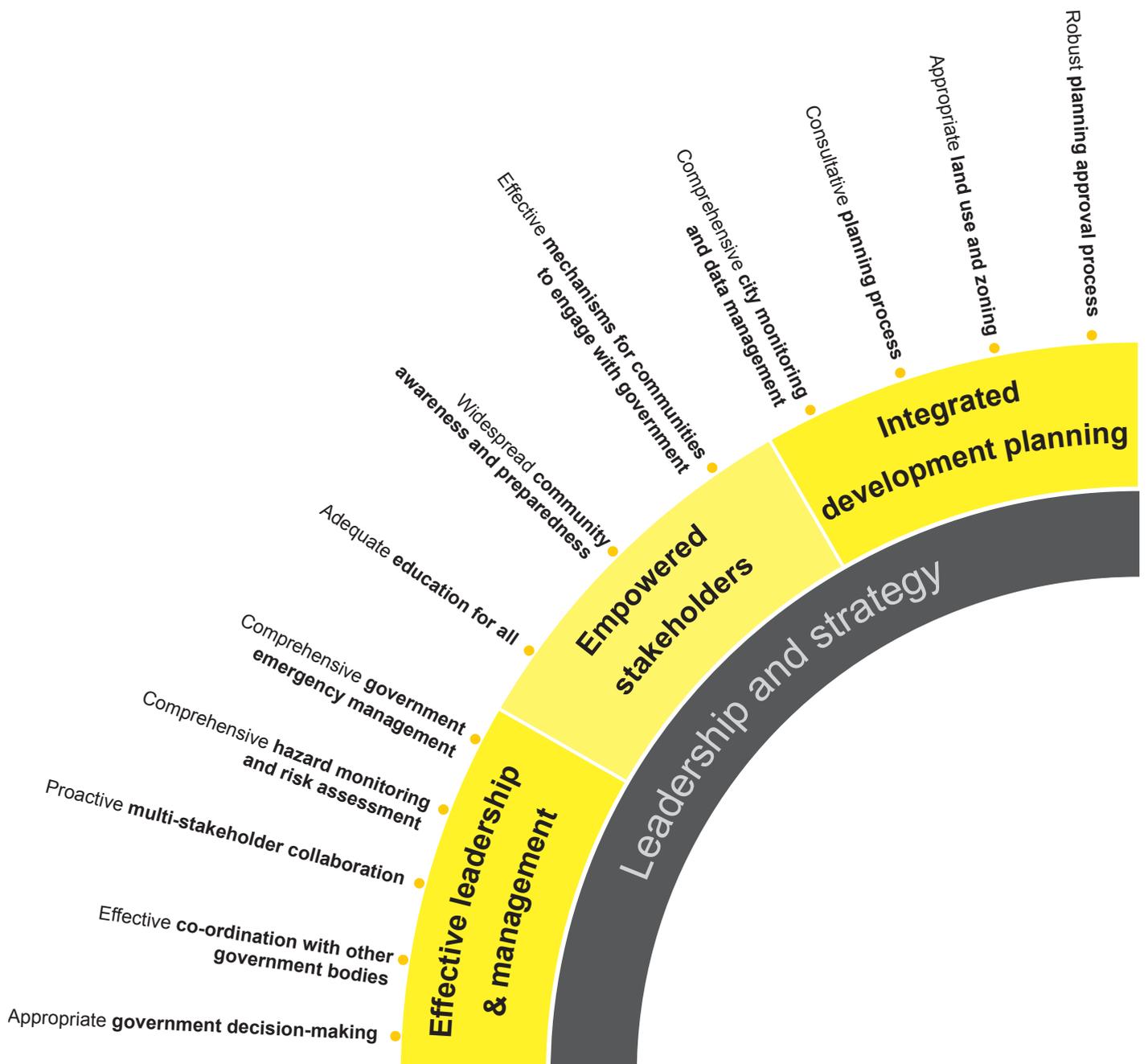
9.3 Reliable communications technology

Effective and reliable communication systems that are accessible by all.

9.4 Secure technology networks

Robust, effective mechanisms in place to protect the information and operational technology systems on which the city is dependent.





Leadership and strategy

This dimension is underpinned by **knowledge**. A resilient city learns from the past and takes appropriate action based on evidence. This means a city must have effective leadership and urban management, characterised by inclusive governance involving the government, business and civil society, and evidence-based decision-making. A city must also empower its stakeholders by providing access to information and education, so that individuals and organisations can take appropriate action. It is equally important to ensure that the city develops in an integrated way that aligns the city's vision with sectoral strategies and plans and individual projects.

Effective leadership and management

This is enabled by trusted individuals, multi-stakeholder consultation, evidence-based decision-making and disaster risk reduction activities.

10.1 Appropriate government decision-making

Transparent, inclusive and integrated government decision-making and leadership.

10.2 Effective co-ordination with other government bodies

Integrated and flexible communication and collaboration between city, state and national government.

10.3 Proactive multi-stakeholder collaboration

Inclusive and constructive collaboration between all actors involved in city decision-making.

10.4 Comprehensive hazard monitoring and risk assessment

Effective systems to monitor potential hazards and assess risk.

10.5 Comprehensive government emergency management

City leadership that has sufficient capacity and flexibility to effectively manage emergencies.



Empowered stakeholders

This is underpinned by education for all, and relies on access to up-to-date information and knowledge to enable people and organisations to take action.

11.1 Adequate education for all

Affordable, quality education for all.

11.2 Widespread community awareness and preparedness

Inclusive efforts to build public awareness of risks.

11.3 Effective mechanisms for communities to engage with government

Inclusive, integrated and transparent mechanisms for communication and coordination between the city government and citizens.



Integrated development planning

This is indicated by the presence of a vision, an integrated development strategy, and plans that are regularly reviewed and updated by cross-departmental groups.

12.1 Comprehensive city monitoring and data management

Regular monitoring and analysis of relevant data undertaken to inform city planning and strategies.

12.2 Consultative planning process

Transparent and inclusive process to develop planning policies and strategies.

12.3 Appropriate land use and zoning

Integrated and flexible land use and zoning plans that ensure appropriate development of the city.

12.4 Robust planning approval process

Transparent, robust planning approval mechanisms, consistent with planning policy and strategy.



Qualities of resilient systems

The CRI assesses the qualities of resilience in city systems. These qualities are important characteristics that prevent breakdown or failure: inclusiveness, integration, reflectiveness, resourcefulness, robustness, redundancy, and flexibility.

Our research suggests that some qualities – integration and inclusiveness – should be promoted across all city systems, whilst others are more important in some systems than others. The diagram below illustrates the relevance of each quality to each CRI indicator.

Goals	Indicators
1 Minimal human vulnerability	1.1 Safe and affordable housing
	1.2 Adequate affordable energy supply
	1.3 Inclusive access to safe drinking water
	1.4 Effective sanitation
	1.5 Sufficient affordable food supply
2 Diverse livelihoods and employment	2.1 Inclusive labour policies
	2.2 Relevant skills and training
	2.3 Dynamic local business development and innovation
	2.4 Supportive financing mechanisms
	2.5 Diverse protection of livelihoods following a shock
3 Effective safeguards to human health and life	3.1 Robust public health systems
	3.2 Adequate access to quality healthcare
	3.3 Emergency medical care
	3.4 Effective emergency response services
4 Collective identity and community support	4.1 Local community support
	4.2 Cohesive communities
	4.3 Strong city-wide identity and culture
	4.4 Actively engaged citizens
5 Comprehensive security and rule of law	5.1 Effective systems to deter crime
	5.2 Proactive corruption prevention
	5.3 Competent policing
	5.4 Accessible criminal and civil justice
6 Sustainable economy	6.1 Well-managed public finances
	6.2 Comprehensive business continuity planning
	6.3 Diverse economic base
	6.4 Attractive business environment
	6.5 Strong integration with regional and global economies
7 Reduced exposure and fragility	7.1 Comprehensive hazard and exposure mapping
	7.2 Appropriate codes, standards and enforcement
	7.3 Effectively managed protective ecosystems
	7.4 Robust protective infrastructure
8 Effective provision of critical services	8.1 Effective stewardship of ecosystems
	8.2 Flexible infrastructure services
	8.3 Retained spare capacity
	8.4 Diligent maintenance and continuity
	8.5 Adequate continuity for critical assets and services
9 Reliable mobility and communications	9.1 Diverse and affordable transport networks
	9.2 Effective transport operation & maintenance
	9.3 Reliable communications technology
	9.4 Secure technology networks
10 Effective leadership and management	10.1 Appropriate government decision-making
	10.2 Effective co-ordination with other government bodies
	10.3 Proactive multi-stakeholder collaboration
	10.4 Comprehensive hazard monitoring and risk assessment
	10.5 Comprehensive government emergency management
11 Empowered stakeholders	11.1 Adequate education for all
	11.2 Widespread community awareness and preparedness
	11.3 Effective mechanisms for communities to engage with government
12 Integrated development planning	12.1 Comprehensive city monitoring and data management
	12.2 Consultative planning process
	12.3 Appropriate land use and zoning
	12.4 Robust planning approval process

Basis of assessment and measurement

The index operationalises the framework by providing the means to assess and measure the extent to which a city is achieving the 12 goals. It will provide cities with a comprehensive, credible, and technically-robust means to assess and monitor their resilience in order to inform urban planning and investment decisions. In this way, cities will be better able to survive and thrive in the face of diverse stresses and shocks.

The CRI enables cities to assess and measure their present-day performance and also assess their trajectory towards a more resilient future. This is achieved through assessment and measurement of both qualitative and quantitative information.

Cities can use the CRI to identify and understand their trajectories towards resilience by considering what they are currently doing to improve their performance (within each indicator area). As it is generally not possible to quantitatively measure future performance, the CRI gathers qualitative data that will help signpost the city's resilience trajectory. This assessment process involves the city contemplating their own performance (including the actions they are undertaking) against each indicator, based on a series of qualitative scenarios. Cities assign a score based on guidance that defines what worst and best performance could look like.

Cities can also measure their present-day performance based on quantified data where possible. As resilience is an abstract concept that can only be truly measured following a real-life shock or period of stress, this part of the CRI is based on proxy measurements within each indicator which indicate how the city is currently performing. This quantitative part of the CRI allows cities to establish a baseline, identify aspects of their resilience profile that may need strengthening, compare performance between jurisdictions and track progress over time.

Combined, these two complementary perspectives will enable cities to develop a deeper understanding of the systems, processes and functions that shape a city's resilience profile. Armed with this knowledge, they will be able to understand their current performance and assess their future trajectories, identify appropriate action to strengthen resilience and track progress over time.

Key to adjoining diagram



4
Dimensions

For example: health and well-being



12
Goals

For example: minimised human vulnerability



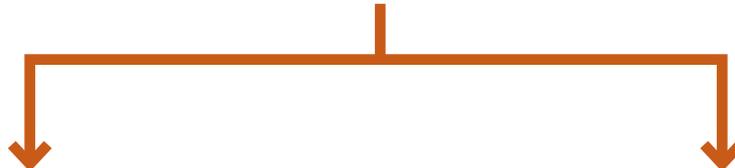
52
Indicators

For example: protection of livelihoods following a shock



156
Prompt questions
(average of 3 per sub-indicator)

For example: to what extent are households and businesses within the city insured against high risk hazards facing the city?



Qualitative

Assesses the adequacy of the mechanism and processes in place to achieve the outcome articulated by the sub-indicator

Quantitative

Identifies quantitative metrics that can be used by cities as proxies for past and current performance in relation to the sub-indicator

Worse case

Best case



The majority of households and businesses are understood to be uninsured in respect of the high risk hazards facing the city. Affordable insurance cover is not available to most household and businesses. The city government does not have access to adequate, available funds capable of covering the estimated uninsured household losses following a major shock event ...

Assessments have been undertaken to assess the proportion of households and businesses within the city that have adequate insurance against high risk hazards facing the city. Measures have been put in place to encourage all households and businesses to obtain adequate levels of insurance for losses that could be incurred by high risk hazards facing the city ...

For example: percentage of buildings with insurance cover for high risk hazards relevant to the city- %

For more information

Arup

13 Fitzroy Street
London W1T 4BQ
United Kingdom

Jo da Silva

E-mail: Jo.da-Silva@arup.com
Tel: +44 20 7755 3037

Braulio Eduardo Morera

E-mail: Braulio.Morera@arup.com
Tel: +44 20 7755 4820