

City Resilience Index

A Presentation to

The National Academies of
Sciences Engineering Medicine

12th November 2015

Nancy Kete, The Rockefeller Foundation



What we set out to do

The primary purpose of this grant is to develop a **comprehensive set of indicators, variables and metrics** – that can be used by cities to baseline and measure their resilience over time; thereby inform urban planning and investment decisions that will enhance their resilience

Purpose Statement, Arup's grant proposal, September 2014

By December 2015, to have designed a **comprehensive, credible, technically robust, and widely accessible tool** that enables cities to measure, assess and monitor their resilience in order to inform urban planning, practice, and investment patterns.

Beyond 2015, to use data from the assessments to **refine the tool, share knowledge, and inform best practice globally**

Opportunity Statement, RF/Arup inception meeting, November 2014

Our methodology

	Q4 -2014	Q1 -2015	Q2 -2015	Q3 -2015
Credibility	Literature review (Vol 3)	Reviewed 16 frameworks	Consultation with 64 sectoral experts	
		Analysis of 1,746 data points	Reviewed 32 new references (papers)	
Usability	NOLA 'salon' with 100RC CROs	Consultation with 9 Arup offices world-wide	Pre-pilot in 'data-rich' cities: <ul style="list-style-type: none">• <i>Hong Kong, China*</i>• <i>Liverpool, UK*</i>	Pilot in 3+ cities: <ul style="list-style-type: none">• Arusha, Tanzania• Concepcion, Chile• <i>Hong Kong, China*</i>• <i>Liverpool, UK*</i>• <i>New Orleans, USA</i>• <i>Sao Paulo, Brazil*</i>• Shimla, India
		Bangkok 'salon' with ACCCRN partners		
		NYC 'salon' with US-based practitioners		
		Cape Town 'salon' with a city government		

Our starting point



City Resilience Index

Research Report Volume 3 Urban Measurement Report

May 2014

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- Define a clear **purpose** and audience;
- Establish a ‘**universe of resilience**’ but not all cities will be able or want to measure all of them;
- Aggregate up to indicator level only based on 4-5 sub-indicators, 3-4 variables, ~**150 fields** (max)
- Include different **types of variables**: leading/lagging, qualitative/quantitative.
- Use **established variables** where possible and identify an ‘owner’ of each variable
- **Local ownership** is an opportunity to build capacity and promote change.

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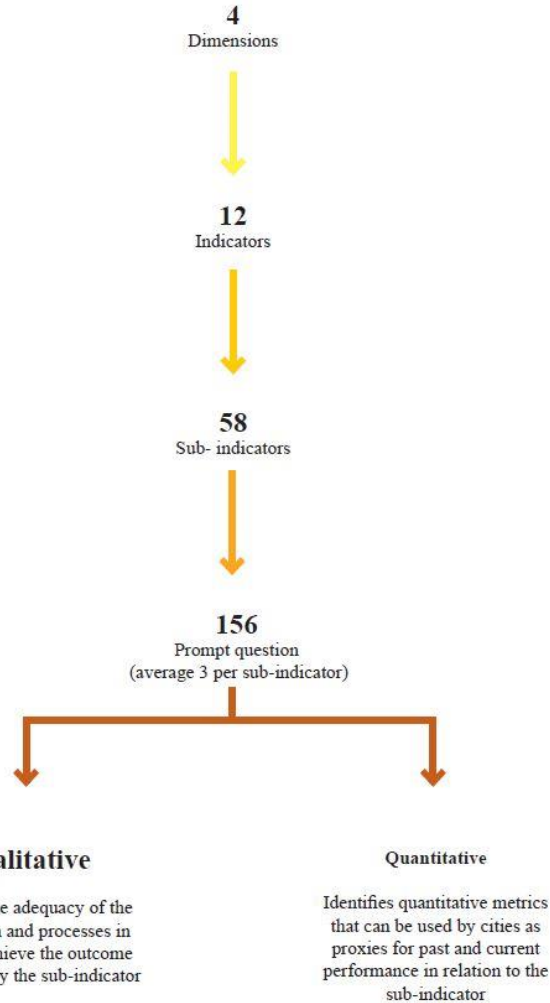
Our approach

What matters

What to observe

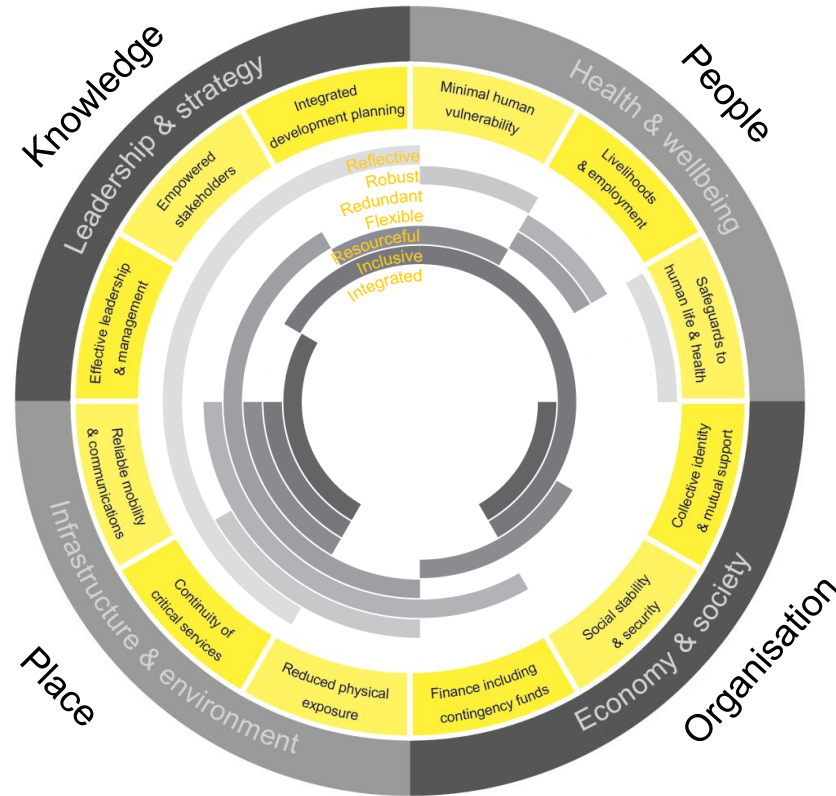
What to measure

How to measure

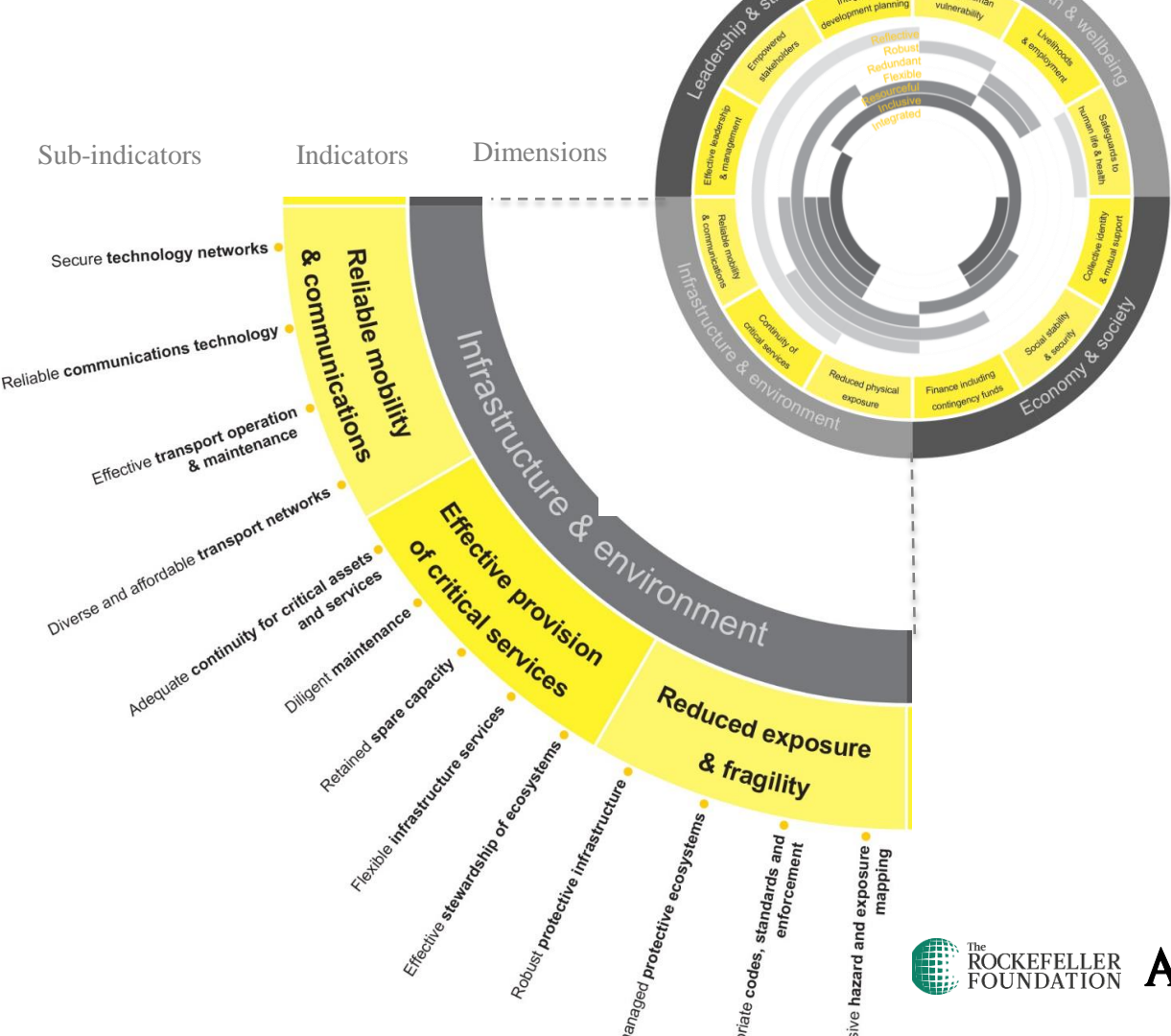


What matters: the City Resilience Framework

- 4 Dimensions
- 12 Indicators



What to observe: 58 sub-indicators



What to measure: ~150 variables

E.g.

7.3 Effectively managed protective ecosystems

Protective ecosystems have been identified and the inter-relationships with other ecosystems (within and beyond city boundaries) is understood

Policies and legislation are enforced to protect important ecosystems and natural resources

Active management and/or restoration of important ecosystems

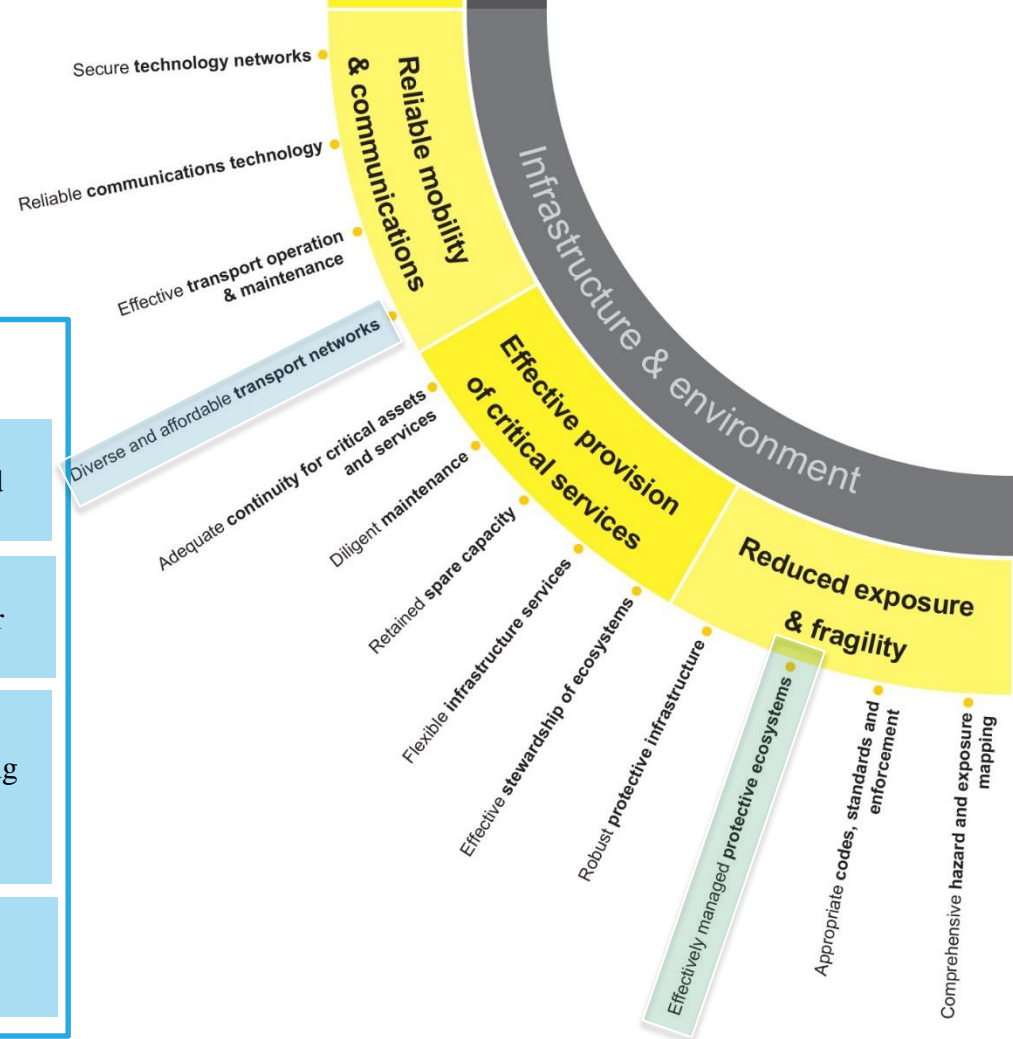
8.1 Diverse and affordable transport networks

Diverse road network with adequate route planning and navigation

Diverse public transport system that is affordable for all

Informal/personal travel options (car sharing, walking paths, cycle routes and associated infrastructure)

Diverse and effective transport links to other cities/regions



How to measure:
> 450+ potential metrics

E.g.

Average journey time (mins) for commuting catchment by transport mode (road, rail, long-distance bus, air)

Number of other cities to which this city has daily connections by:

- rail
- air
- bus

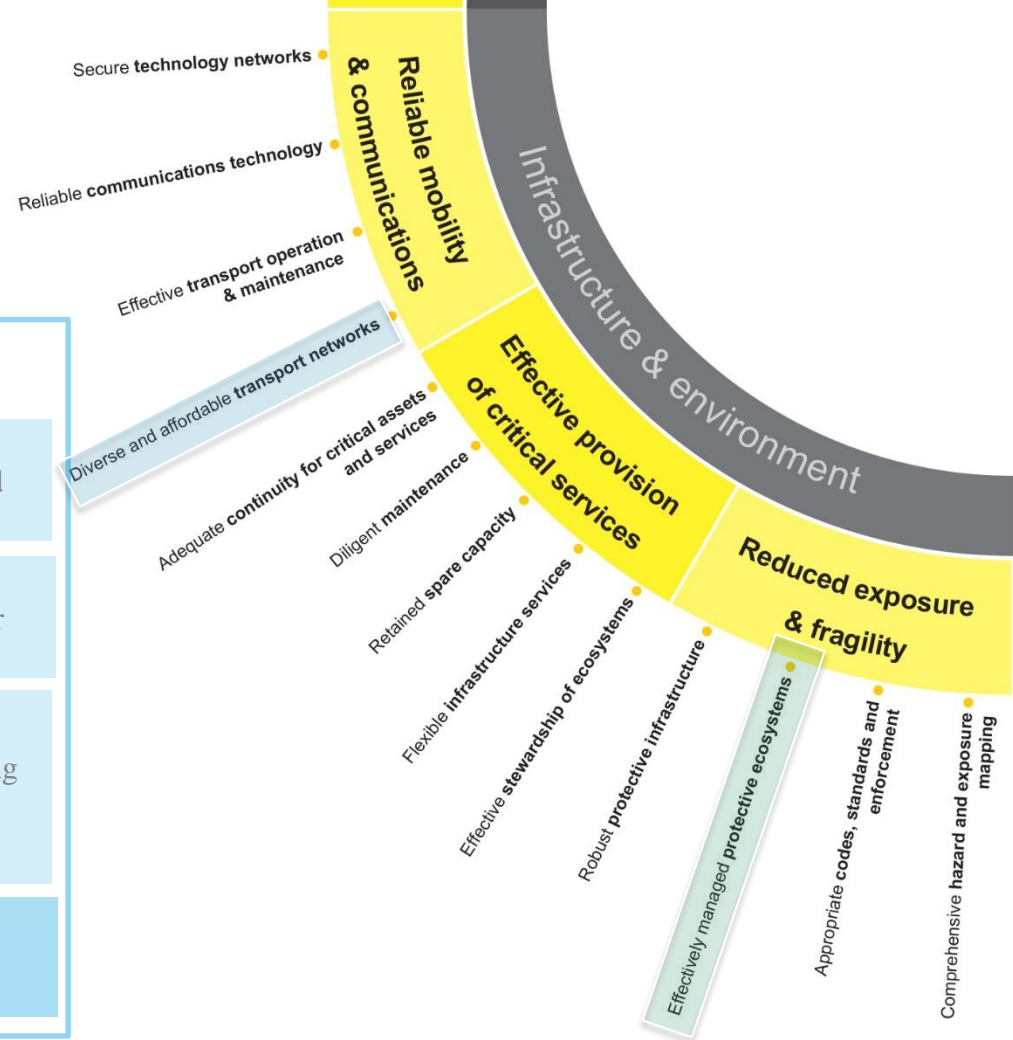
8.1 Diverse and affordable transport networks

Diverse road network with adequate route planning and navigation

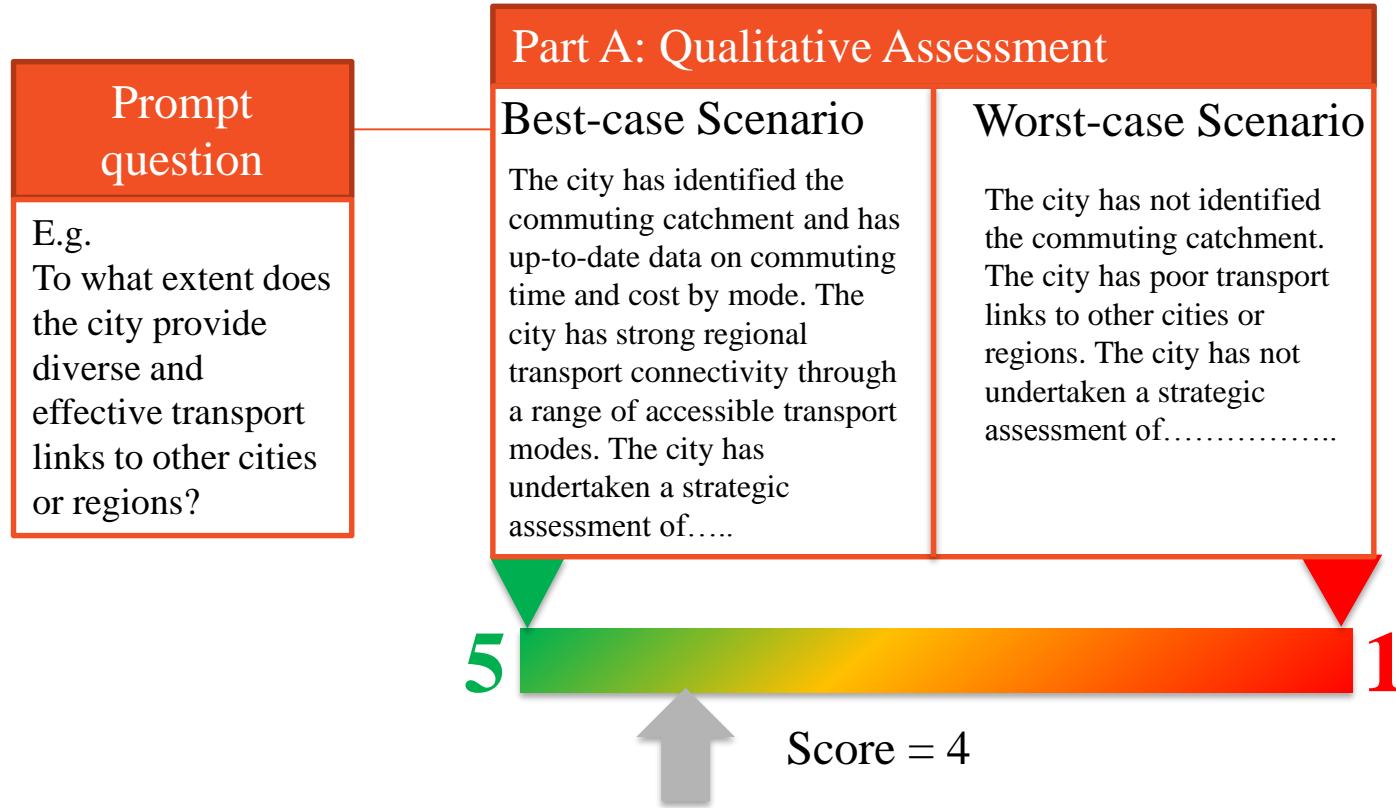
Diverse public transport system that is affordable for all

Informal/personal travel options (car sharing, walking paths, cycle routes and associated infrastructure)

Diverse and effective transport links to other cities/regions

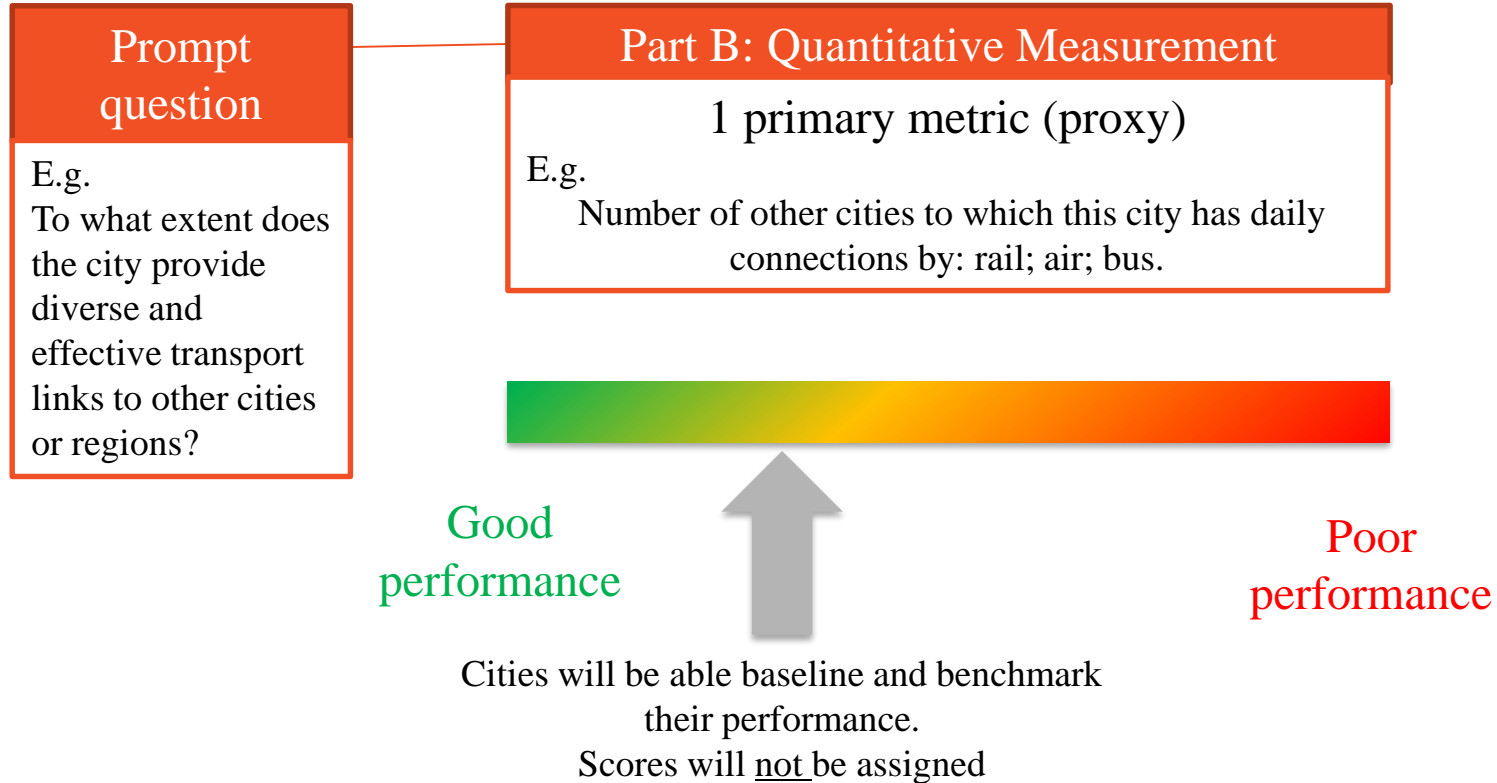


CRI Part A: qualitative



Assessor makes judgement on where their city lies on the scoring scale

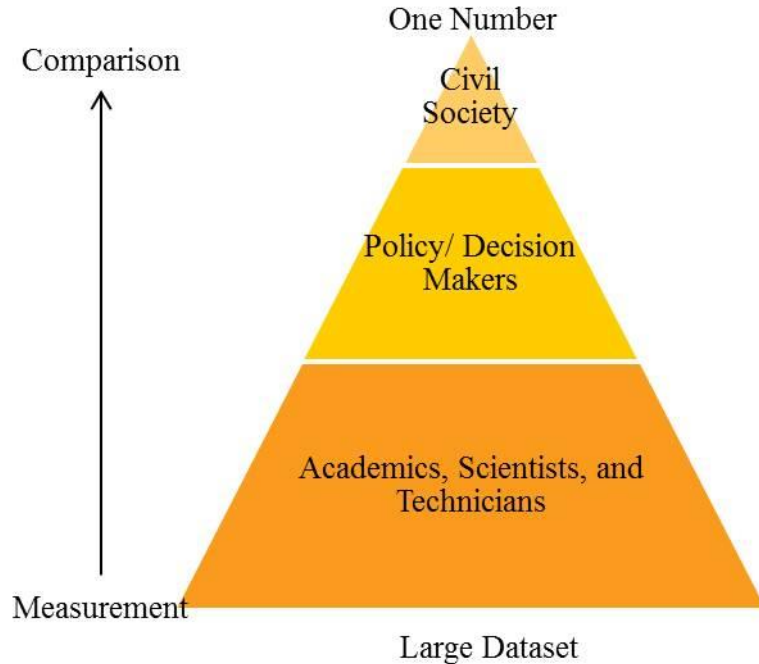
CRI Part B: quantitative



Agenda

1. Research and development
- 2. Key Challenges and Lessons Learned**
3. Online tool
4. What next?

Key Issues: Who is the CRI for?



Perceived benefits

- Identify areas where action is required
- Baseline and demonstrate improvement over time
- Common basis of assessment facilitates peer-to-peer exchange
- Potential to understand relative performance ie. compare cities

Potential challenges

- Multiple stakeholders contributing to assessments;
- Allocation and ownership of input data;
- Conflict between formal city data, and data collected through surveys.
- Managing complexity

Key Issues: A global index



● Primary data (CRI-1 2013)

● Arup offices that consulted with their cities

● Ongoing pilot (CRI-2 2015)

Key Issues: Operationalizing qualities

Indicators		Sub-indicators	Qualities						
			Integrated	Inclusive	Reflective	Resourceful	Robust	Redundant	Flexible
People	1 Minimal human vulnerability	1.1 Safe and affordable housing							
		1.2 Adequate affordable energy supply							
	2 Diverse livelihood and employment	1.3 Inclusive access to safe drinking water							
		1.4 Effective sanitation							
		1.5 Sufficient affordable food supply							
3 Effective safeguards to human health and life	2.1 Inclusive labour policies								
	2.2 Relevant skills and training								
	2.3 Dynamic local business development and innovation								
	2.4 Supportive financing mechanisms								
Organisation	4 Collective identity & community support	2.5 Diverse protection of livelihoods following a shock							
		3.1 Robust public health systems							
	5 Comprehensive security and rule of law	3.2 Adequate access to quality healthcare							
		3.3 Emergency medical care							
		3.4 Effective emergency response services							
Place	6 Sustainable economy	4.1 Local community support							
		4.2 Cohesive communities							
	7 Reduced exposure & fragility	4.3 Strong city-wide identity and culture							
		4.4 Actively engaged citizens							
		5.1 Effective systems to deter crime							
8 Effective provision of critical services	5.2 Proactive corruption prevention								
	5.3 Competent policing								
	5.4 Accessible criminal and civil justice								
	6.1 Well-managed public finances								
Knowledge	9 Reliable mobility and communications	6.2 Comprehensive business continuity planning							
		6.3 Diverse economic base							
	10 Effective leadership and management	6.4 Attractive business environment							
		6.5 Strong integration with regional and global economies							
		7.1 Comprehensive hazard and exposure mapping							
11 Empowered stakeholders	7.2 Appropriate codes, standards and enforcement								
	7.3 Effectively managed protective ecosystems								
	7.4 Robust protective infrastructure								
	8.1 Effective stewardship of ecosystems								
12 Integrated development planning	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								
		9.1 Diverse and affordable transport networks							
		9.2 Effective transport operation & maintenance							
		9.3 Reliable communications technology							
		9.4 Secure technology networks							
		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							
		11.1 Adequate education for all							
		11.2 Widespread community awareness and preparedness							
		11.3 Effective mechanisms for communities to engage with government							
		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							

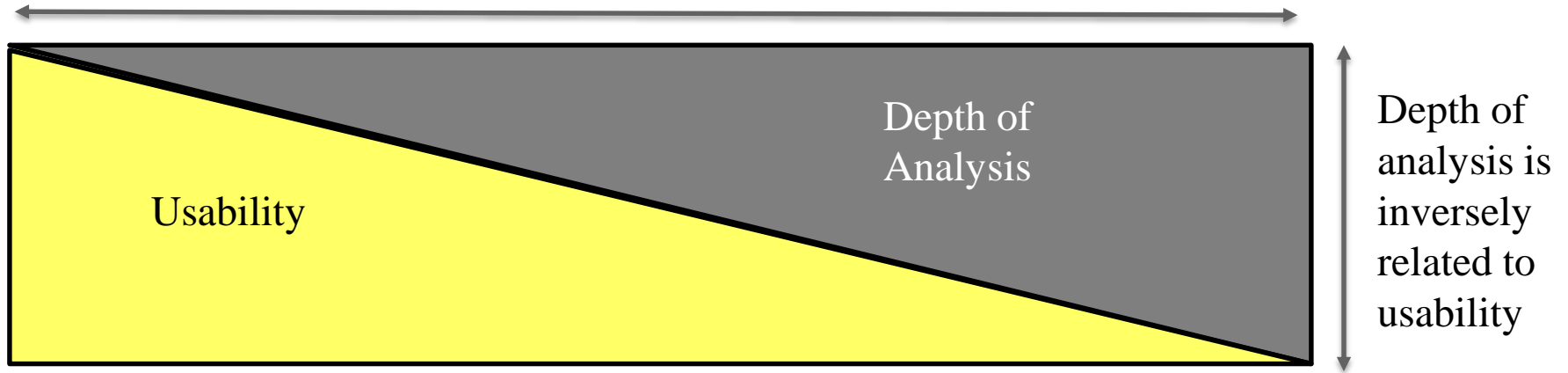
E.g. *robust* and *inclusive* housing is better understood as *safe* and *affordable* housing.

Useful intellectual construct, used as ‘scaffold’ to develop the sub-indicators.

Key issues:
Managing complexity

A balance needs to be struck between the **breadth of issues** contributing to resilience and the **depth of analysis**. Our research and feedback from consultation suggested that ~150 data points was appropriate.

Breadth of assessment is set – all 12 indicators and 58 sub-indicators are important



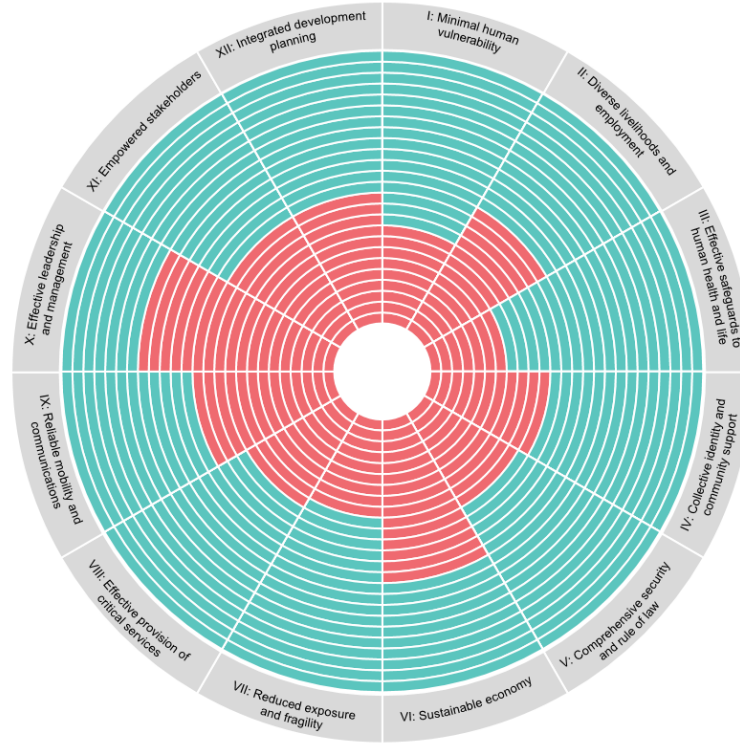
Key issues:
Quantitative and qualitative indicators

Both are necessary to develop a comprehensive basis of assessment. But, cannot readily be combined.

Functions	Quantitative measurement	Qualitative assessment
Proxy for current performance (can act as 'red flags')	✓	✗
Track year-on-year change	✓	✗
Determine if the right processes are in place for building resilience long-term (track long-term trajectories)	✗	✓
Succinctly capture the complexity associated with each sub-indicator	✗	✓
Indicate if qualities of resilient systems are in place	✗	✓
Indicate actual resilience to shocks	✗	✓

Key Issues: Data Availability

‘What matters’
implies new things
that cities don’t
currently measure.



Hong Kong

Indicator	Sub-indicator	Data Measurability
I: Minimal human vulnerability	1.1 Safe and accessible housing	67%
	1.2 Adequate affordable energy supply	33%
	1.3 Inclusive access to safe drinking water	100%
	1.4 Effective Sanitation	50%
	1.5 Sufficient affordable food supply	67%
II: Diverse livelihoods and employment	2.1 Inclusive labour policies	50%
	2.2 Relevant skills and training	50%
	2.3 Dynamic local business development and innovation	75%
	2.4 Supportive financing mechanisms	0%
III: Effective safeguards to human health and life	3.1 Robust public health systems	100%
	3.2 Adequate access to quality healthcare	75%
IV: Collective identity & community support	4.1 Local Community Support	33%
	4.2 Cohesive communities	67%
	4.3 Strong city-wide identity and culture	50%
	4.4 Actively engaged citizens	100%
V: Comprehensive security and rule of law	5.1 Effective systems to deter crime	100%
	5.2 Proactive corruption prevention	50%
	5.3 Competent policing	100%
	5.4 Accessible criminal and civil justice	0%
VI: Sustainable economy	6.1 Well-managed public finances	67%
	6.2 Comprehensive business continuity planning	33%
	6.3 Diverse economic base	100%
	6.4 Attractive business environment	67%
	6.5 Strong integration with regional and global economies	50%
VII: Reduced exposure & fragility	7.1 Comprehensive hazard and exposure mapping	50%
	7.2 Appropriate codes, standards and enforcement	67%
	7.3 Effectively managed protective ecosystems	100%
	7.4 Robust protective infrastructure	33%
VIII: Effective provision of critical services	8.1 Effective stewardship of ecosystems	100%
	8.2 Flexible infrastructure	86%
	8.3. Retained spare capacity	100%
	8.4 Diligent maintenance and continuity	25%
	8.5 Adequate continuity for critical assets and services	0%
IX: Reliable mobility and communications	9.1 Diverse and affordable transport networks	75%
	9.2 Effective transport operation & maintenance	33%
	9.3 Reliable communications technology	67%
	9.4 Secure technology networks	0%
X: Effective leadership and management	10.1 Appropriate government decision-making	0%
	10.2 Effective co-ordination with other government bodies	0%
	10.3 Proactive multi-stakeholder collaboration	0%
	10.4 Comprehensive hazard monitoring and risk assessment	33%
	10.5 Comprehensive government emergency management	60%
XI: Empowered stakeholders	11.1 Adequate education for all	100%
	11.2 Widespread community awareness and preparedness	33%
	11.3 Effective mechanisms for communities to engage with government	100%
XII: Integrated development planning	12.1 Comprehensive city monitoring and data management	67%
	12.2 Consultative planning process	33%
	12.3 Appropriate land use and zoning	50%
	12.4 Robust planning approval process	50%

Key Issues: Summary

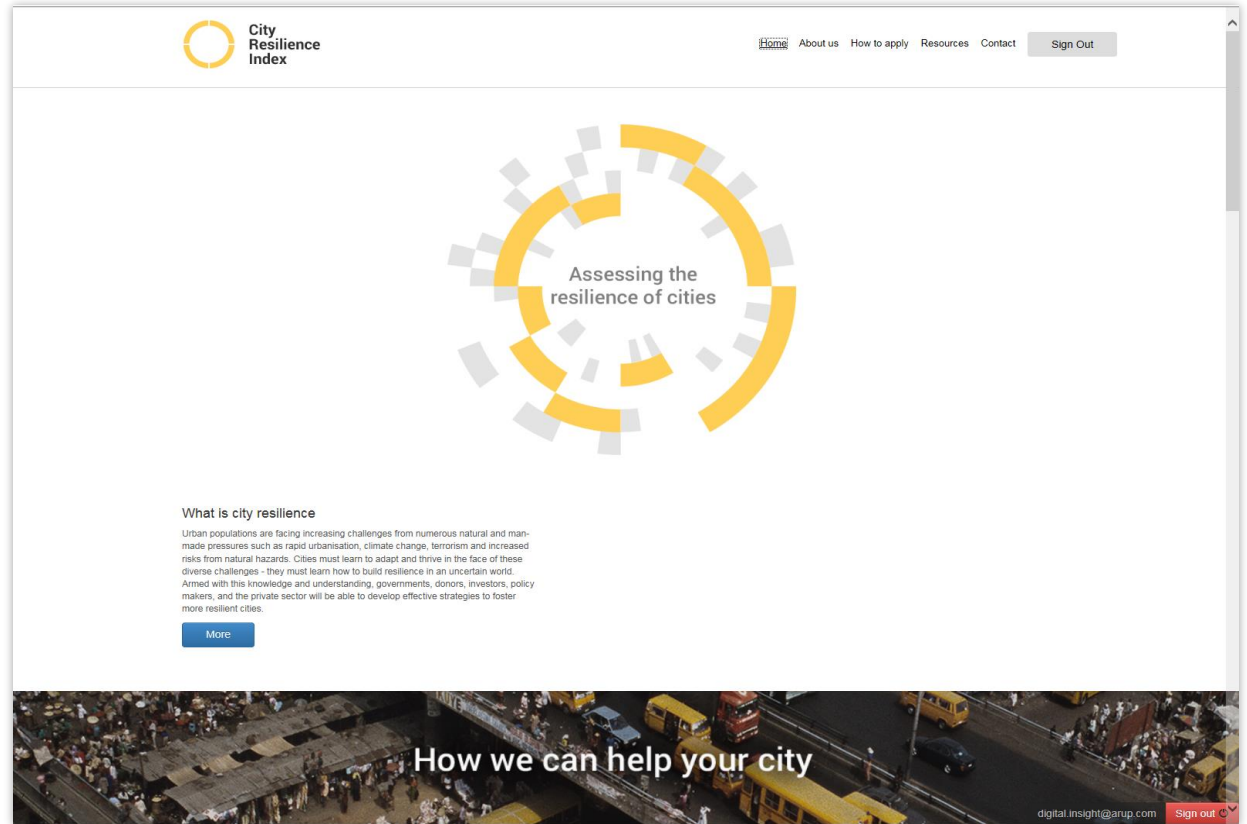


- Who is the CRI for?
- Global applicability
- Operationalizing qualities
- Managing complexity
- Combining qualitative and quantitative indicators
- Data availability

On-line Platform

The CRI provides a comprehensive set of city scale indicators, variables and metrics.

The **on-line platform** facilitates **data collection** and provides high quality auditable **outputs**.



The screenshot shows the City Resilience Index (CRI) website. At the top left is the logo for the City Resilience Index, which consists of a yellow circle with a gap and the text "City Resilience Index". To the right of the logo is a navigation menu with links for "Home", "About us", "How to apply", "Resources", "Contact", and a "Sign Out" button. The main content area features a large graphic of a circular city map with yellow and grey segments, and the text "Assessing the resilience of cities". Below this graphic is a section titled "What is city resilience" with a paragraph of text and a "More" button. At the bottom of the page is a banner image showing a busy city street with a large crowd of people and vehicles, with the text "How we can help your city" overlaid. In the bottom right corner of the banner, there is a "Sign out" button and the email address "digital.insight@arup.com".

Key requirements

Key Features

- Accessible to as wide range of stakeholder
- Promotes an inclusive and rigorous process
- Flexible to adapt to different types of cities/organisations

Value

- Education/ knowledge
- Assessment & measurement
- Cross analysis of data

Multiple cities

- Cross analysis individual cities
- Normalisation of scoring
- Data

City users

- Understand relevance
- Assessment
- Clear data input role
- Baselining and monitoring

Individual users

- Education
- Potential city user

CRI Admin and Moderator

- IT support
- Update index & resources
- Support cities
- Cross analysis

Key functions

Introduction and education

User information and data protection

Promote collaboration

Facilitate data collection

Review and validation

Homepage

Authentication

Team Management

Input data

Review output & assessment

Admin & Moderation

Maintenance and support

Feedback loop

Meta-analysis and optimisation

User-centric design



Patrick
(Public User)

Student/ Researcher

...wants to know how cities resilience can be measured and also if it is something he wants to pursue in his career



Nicholas
(CRI Team Member)

General Manager, Transportation Agency

...wants to complete the CRI assessment as efficiently as possible. He is keen to involve junior members of his team to support him with this task.



Freya
(CRI Team Leader)

Mayor / CRO

.. wants to understand where her city performs against resilience indicators. Wants to motivate her team/city to think about resilience

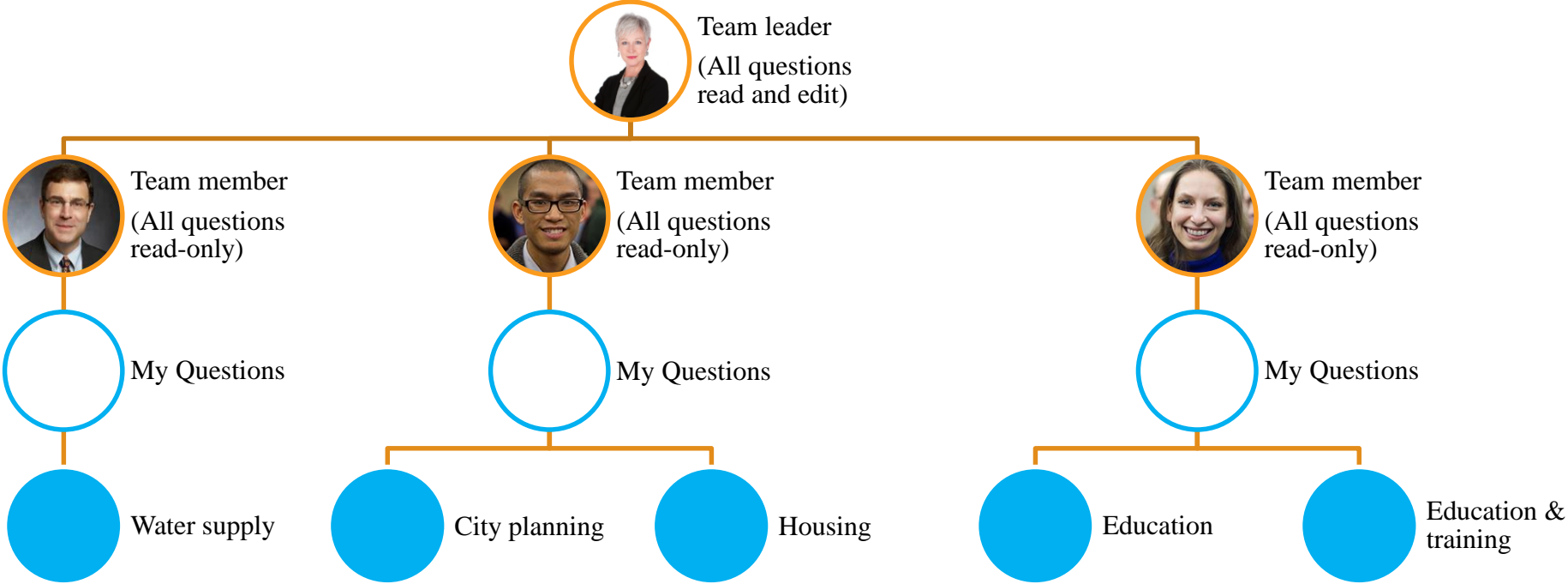


Belinda
(Arup/RF Admin)

Consultant/ developer

...wants to support cities, view the responses of cities and to keep the CRI assessment tool current

User-centric design



Uses city language

**CRI language
(Outcomes)**

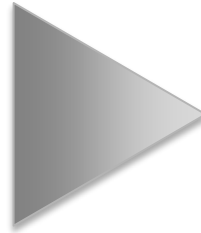
Comprehensive business
continuity planning
Appropriate codes, standards
and enforcement
Dynamic local business
development and innovation
Supportive financing
mechanisms
Attractive business
environment

**City language
(Who? What? How?)**

Budget
Buildings
Business & Finance
Citizen participation and awareness
City data
City planning
Community support

Data input by topic

Crime and Policing
Culture
Disaster Management
Drainage & Sanitation
Employment & Labour
Education & Training
Energy
Environment
Food
Housing
Health
Legal & justice
Support & welfare
Transport
Urban planning
Water Supply



Visual Outputs

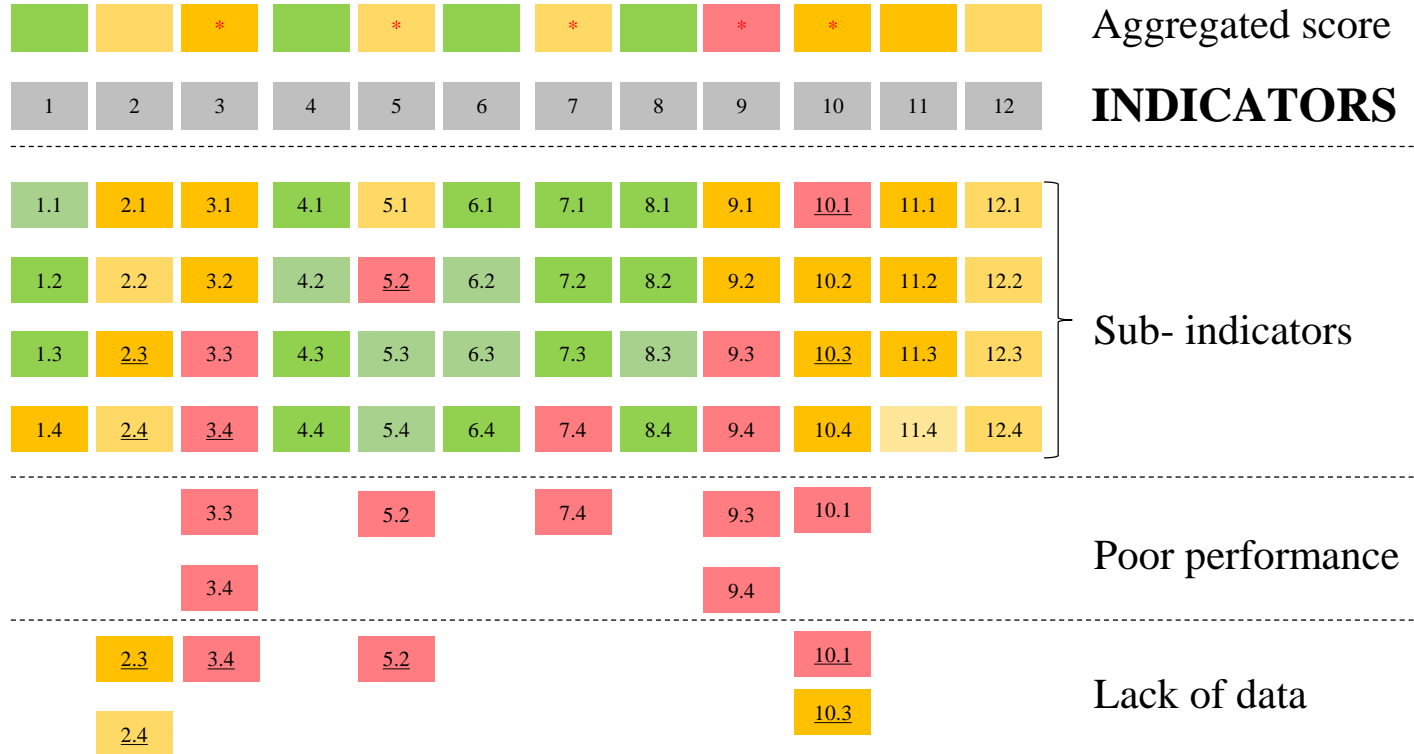
The CRI provides a holistic qualitative **visual assessment** based on an aggregation of best/worst case scenarios.

The CRI will also provide a quantitative assessment based on proxy indicators, **benchmarked** against pre-determined thresholds of acceptability.



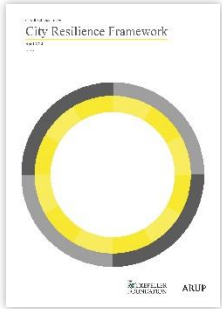
Reporting complex data

Cities will be able to download **further detail** in order to identify specific strengths, weaknesses or where data is not available.



By December 2015

Communication

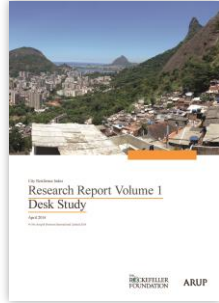


CRF 2014

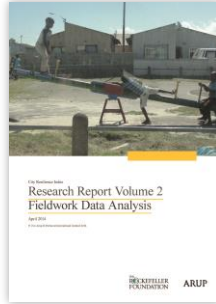


CRI intro 2015

Knowledge



Vol 1



Vol 2



Vol 3

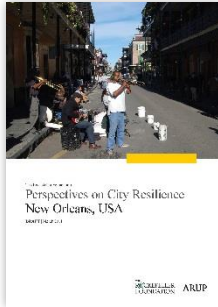


Vol 4

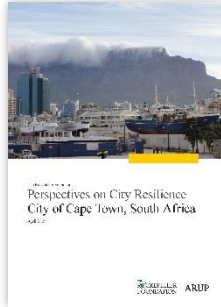


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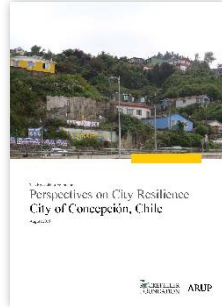
Case Studies



New Orleans



Cape Town

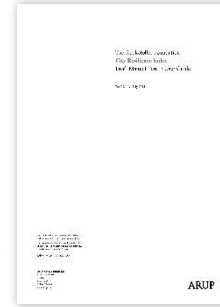
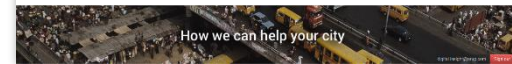
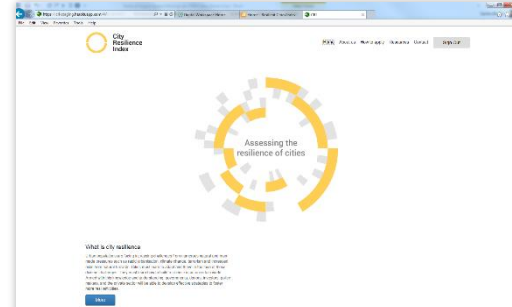


Concepcion



Others

Tool v1.0



ARUP

Beyond 2015

Beyond 2015, to use data from assessments to refine the tool, share knowledge, and inform best practice globally.

Opportunity Statement, RF/Arup inception meeting, November 2014