



City Resilience Index

# Research Report Volume 5

---

## Lessons from the Pilots

---

Issue | March 2016



ARUP

## Acknowledgements

Arup extends our warmest gratitude to The Rockefeller Foundation for giving Arup International Development the opportunity to undertake this study. Our special thanks go to Dr. Nancy Kete and Sundaa Bridgett-Jones for their support throughout. We would also like to thank our pilot city authorities: Liverpool City Council; Arusha District Council; Municipalidad de Concepción and Shimla Municipal Corporation and our local partners: Institute for International Urban Development (I2UD); Aga Khan University (AKU); Fundación Alto Río; Centro de Desarrollo Urbano Sustentable (CEDEUS); Oficina Nacional de Emergencia del Ministerio del Interior, Chile (ONEMI); and ICLEI South Asia. Their support and collaboration have been very valuable to our work.

Jo da Silva

**Director**

Arup International Development

On behalf of Arup International Development's study team: Samantha Stratton-Short; Belinda Hewitt; Sachin Bhoite; Siddharth Nadkarny; Andrew Charles; María Montero; José M. Ahumada; Kieran Birtill and Braulio Eduardo Morera.

Unless specified, all images are copyright Arup

# Contents

---

<b>Executive summary</b>	<b>1</b>
<b>Introduction</b>	<b>5</b>
<b>Methodology</b>	<b>9</b>
• Pilot approach	9
• Stage 1: City selection engagement	12
• Stage 2: Assessment	13
• Stage 3: Analysis and Reporting	15
<b>Case studies</b>	<b>19</b>
• Phase 1: Hong Kong and Liverpool	19
• Phase 2: Arusha, Concepción and Shimla	30
<b>Reflections</b>	<b>55</b>
<b>Key lessons</b>	<b>67</b>
<b>Appendices</b>	<b>71</b>
• A: Pilot methodology	
• B: Pilot timelines	
• C: Pilot outputs	
• D: Indicator results	









# Executive summary

---

Cities internationally are facing increasing risk as a result of rapid urbanisation, concentration of assets, and a range of natural and man-made pressures – including climate change, terrorism, and increasing vulnerability to natural hazards. Many of these pressures are complex, interrelated, and difficult to predict with any accuracy into the future; leading to a growing interest in the notion of resilience and the capacity of cities to survive and thrive no matter what shocks and stresses they face.

The City Resilience Index (CRI) is being developed by Arup with support from The Rockefeller Foundation in order to help city administrations, investors and other stakeholders to measure and understand the systems, processes and functions that shape their resilience profile. The CRI operationalises extensive research undertaken by Arup to establish an accessible, evidence-based definition of urban resilience; published in 2014 as the City Resilience Framework (CRF)<sup>1</sup>.

The CRI generates Qualitative and Quantitative Resilience Profiles based on assessments of 156 Scenarios and 156 Metrics, respectively. The detailed results are aggregated to summarise the cities performance across 58 Indicators within 12 Goals.

## **Piloting the CRI**

From July - October 2015, the CRI was piloted in the cities of Hong Kong, China; Liverpool, England; Arusha, Tanzania; Concepción, Chile; and Shimla, India. The purpose of the Pilot program was to validate the content of the CRI (scenarios and metrics), to test the proposed assessment approach and to inform finalisation of the CRI Online Platform (beta-version). The Pilot program was designed around a set of research questions to test both the usability and effectiveness of the CRI.

Arup undertook up to three weeks of fieldwork in each city in partnership with city governments and a range of local organisations. The assessment approach in each city was customised to suit the local context, but based upon a standardised methodology which involved extensive multi-stakeholder engagement.

This report summarises the process, challenges and outcomes of the Pilot in each city and provides an analysis of key findings from the overall Pilot program. Findings from this work have informed improvements to the content and structure of the CRI, recommendations to enhance usability and effectiveness of future CRI assessments. Findings and recommendations

(1) Arup (2014),  
City Resilience  
Framework.

(Image Opposite)

Market in Arua,  
Uganda

can also inform and validate the way in which assessment outcomes are interpreted, understood and communicated, as a baseline from which cities can understand their resilience, and identify and prioritise actions to manage risk, build resilience, and track progress over time.

### **Key lessons from the pilots**

The Pilots produced a wealth of information and data from which we learned about the process, the outputs and the outcomes of the CRI. Several lessons are highly influential to our future strategy for CRI development.

#### **1. City ownership is vital; cities need support to carry out assessments**

In order to ensure the CRI promotes action through better understanding, cities need to take ownership of the assessment process, understand findings in detail, and plan for change. Although ownership of the CRI assessment should be encouraged, our research indicates that most cities will require some level of support when undertaking an assessment. The level and type of support required will vary depending on a city's institutional structures, capacity and resources. The types of support fall across four main categories – technical assistance, concept guidance, stakeholder engagement and consistency assurance.

#### **2. Support has long-term value beyond completing the assessments**

Cities are likely to need support in some form to complete the assessment. We have found that provision of this support has many lasting benefits, including capacity building of City Assessors to better understand resilience and systems thinking. It is also valuable to have an external party that can extract and summarise lessons learned and examples that can contribute to the overall development of the CRI and field-building more generally.

#### **3. Qualitative Scenarios are transferable across city contexts; data availability for Quantitative Metrics limits global applicability**

One hundred percent of the Qualitative Scenarios were completed in the Pilot Cities (with the exception of Hong Kong, where Qualitative Scenarios were not completed). When coupled with some form of stakeholder validation exercise (for example, a City Resilience Workshop) this enables any city to develop a holistic profile of the direction of resilience for their city. The Qualitative assessment ensures the CRI is useable even where cities have very limited data.

Pilot research has reinforced our understanding of the challenges faced by cities in gathering credible objective data to measure resilience. A number of strategies can enhance data availability, such as comprehensive data source mapping, senior endorsement, and guidance to derive Metric scores from multiple data sources. Nevertheless, limits to data availability observed even across Phase 1 cities (which were assumed to be data-rich) have implications for the global applicability of the Metrics.

#### **4. Limited data availability suggests the benefits of secondary and alternative metrics**

Phase 1 Cities tested only the primary Metrics, while Phase 2 Cities were given the choice of primary, secondary, or alternative Metrics, but asked to prioritise primary Metrics<sup>2</sup>. For the CRI to be applicable in more cities, especially lower capacity cities, an approach that formalises the Quantitative Metrics as a tool for baselining and monitoring could leverage and benefit from the use of secondary and alternative Metrics.

#### **5. Data source & stakeholder mapping is fundamental to launching assessments**

Regardless of the strategy for the Quantitative Metrics, the effectiveness of assessments can be greatly improved by enhancing the process of mapping data sources and stakeholders prior to launching assessments. This task could form a recommended pre-requisite for the actual assessment.

#### **6. Resilience profiles provide a snapshot of a city's resilience at Goal-level; while Indicator-level results unpack performance issues.**

Workshop Participants endorsed the Qualitative Resilience Profile as an accurate summary of city resilience at Goal-level. This validation was only possible once results were investigated at the Indicator-level. Diagnosis of city performance also takes place at Indicator level and therefore an output visualisation at this level will be critical for the CRI's usability.

Similar findings emerged in relation to the Quantitative Metrics. The Quantitative Resilience Profile (Goal-level output) provides a summary of the city's past performance, but to obtain sufficient understanding to develop resilience-building planning, city performance needs to be investigated at Indicator-level. Where cities complete multiple CRI assessments to measure change over time, progress between monitoring points is likely to be too subtle in the short-term to be read at a Goal-level. As a result, it will be important to provide cities with a visual summary of their Quantitative Metrics baseline and progress at the Indicator-level.

Collectively, the Pilots have successfully demonstrated the value and effectiveness of the CRI as a measurement of city resilience. The Pilots have also uncovered a range of observations regarding process, content and outputs that can help to inform development of the next version of the CRI. Moving forward, the CRI will be launched as an online platform and for the benefit of cities, agencies, and stakeholders around the world.

(2) The alternative metrics function not only allowed the cities greater flexibility in completing their assessments but also provided suggestions for changes to the preferred metrics in future versions.







# Introduction

Cities internationally are facing increasing risk as a result of rapid urbanisation, concentration of assets, and a range of natural and man-made pressures – including climate change, terrorism, and increasing vulnerability to natural hazards. Many of these pressures are complex, interrelated, and difficult to predict with any accuracy into the future; leading to a growing interest in the notion of resilience and the capacity of cities to survive and thrive no matter what shocks and stresses they face.

## Measuring Resilience

The City Resilience Index (CRI) is being developed by Arup with support from The Rockefeller Foundation in order to help city administrations, investors and other stakeholders to measure and understand the systems, processes and functions that shape their resilience profile. The CRI operationalises extensive research undertaken by Arup to establish an accessible, evidence-based definition of urban resilience; published in 2014 as the City Resilience Framework (CRF)<sup>3</sup>.

The CRF is structured around four Dimensions and 12 Goals that can be collectively referred to as the city's 'immune system.' Findings can empower cities to diagnose key strengths and weaknesses, to baseline and monitor city resilience outcomes over time, and inform appropriate urban planning practices and investment decisions that contribute to an increasingly resilient development trajectory.

### Box 1: How the CRI works

The CRI provides cities with a comprehensive and globally relevant evidence base from which to assess and monitor their present day resilience alongside progress towards a more resilient future.

The CRI is made up of 156 Prompt Questions, each of which includes both Qualitative Scenarios and Quantitative Metrics. These are distributed to Pilot Participants within 'Questionnaires' (sets of Prompt Questions). Qualitative Scenarios require the assessor to assign a score between 1 and 5 based on 'best case' and 'worst case' descriptions of city performance, while Quantitative Metrics require measured performance data to be provided in a specific unit. Collectively, the Prompt Questions provide a comprehensive and holistic performance assessment across the 58 Indicators of city resilience identified in extensive city resilience research undertaken to date.

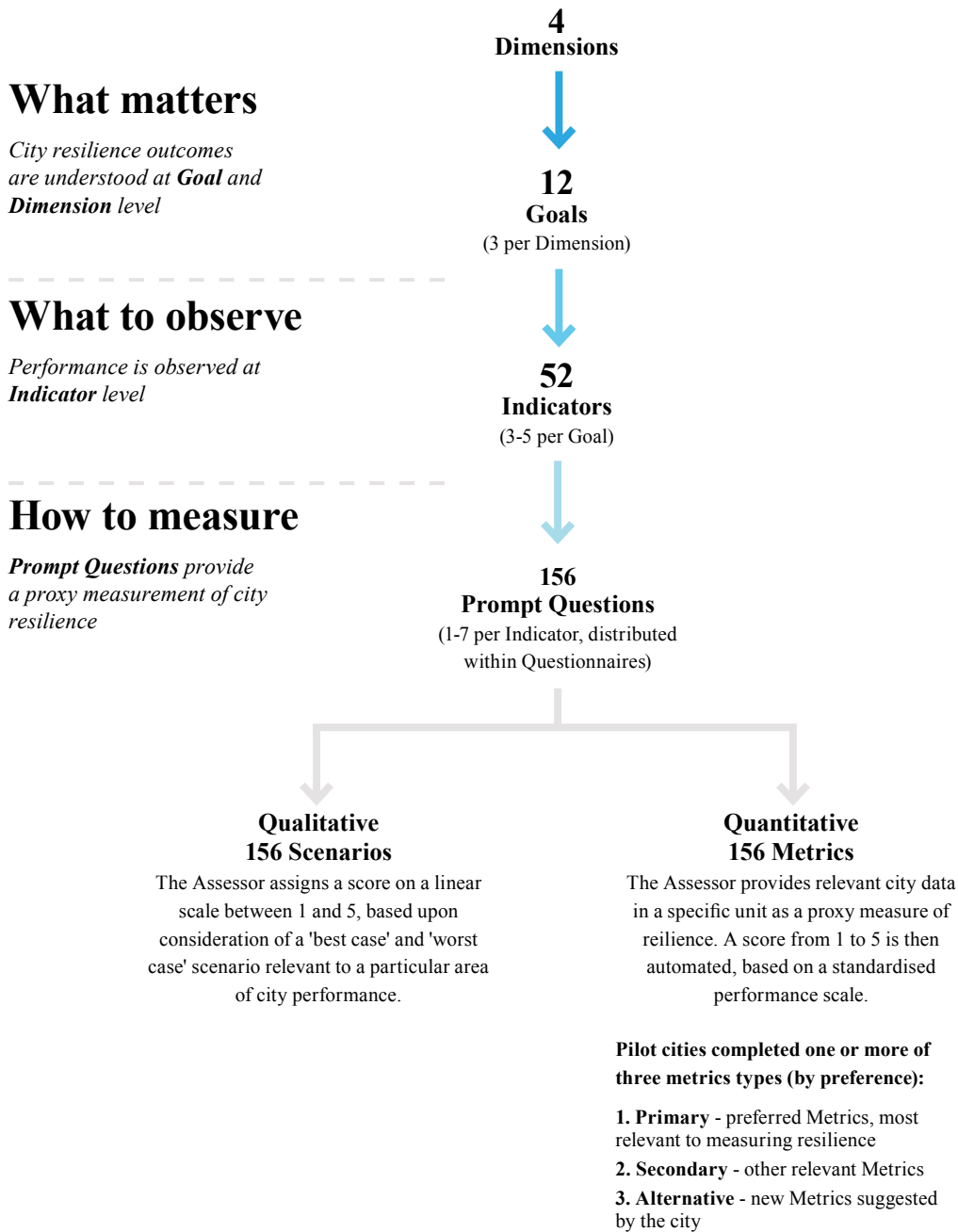
In order to generate Qualitative and Quantitative Resilience Profile for each city, Metric and Indicator Scores are aggregated to demonstrate outcomes against each of the 12 Goals (or indices) and four Dimensions of the City Resilience Framework. A detailed overview of the different components of the CRI is provided overleaf.

(3) Arup (2014),  
City Resilience  
Framework.

(Image Opposite)

Can Tho, Vietnam

Figure 1: Components of the City Resilience Index





## **Piloting the City Resilience Index**

During July, September and October of 2015, the CRI was piloted in the cities of Hong Kong, China; Liverpool, England; Arusha, Tanzania; Concepción, Chile; and Shimla, India. Arup undertook up to three weeks of fieldwork in each city in partnership with city governments and a range of local organisations. The Pilot approach in each city was customised to suit the local context, but based upon a standardised methodology which involved extensive multi-stakeholder engagement.

This report summarises the process, challenges and outcomes of the fieldwork in each city and provides an analysis of key findings from the overall Pilot program. Findings from this work have informed improvements to the content and structure of the CRI, recommendations to enhance usability and effectiveness of future CRI assessments. Findings and recommendations can also inform and validate the way in which outputs and outcomes are interpreted, understood and communicated, as a baseline from which cities can understand their resilience, and identify and prioritise actions to manage risk, build resilience, and track progress over time.

### **Structure of this report**

- **Section 1: Introduction**
- **Section 2: Methodology** – summarises the process developed for city engagement, assessment and reporting.
- **Section 3: Case studies** – provides an overview of the specific approach, challenges, outcomes, outputs and key messages from each Pilot City.
- **Section 4: Reflections** – a summary of the key themes which emerged across the overall Pilot program, both in regards to the process and the outcomes.
- **Section 5: Conclusions** – summarises important findings that will influence the application of the CRI and its ongoing development.



M-PESA  
VOCHA HAPA



# Methodology

## Pilot approach

### Purpose

The purpose of the Pilot program was to validate the content of the CRI (Qualitative Scenarios and Quantitative Metrics) to test the proposed assessment approach and to inform finalisation of the CRI Online Platform (beta-version). The Pilot program was designed around a set of research questions to test both the usability and effectiveness of the CRI (refer to Box 2).

Key learnings from Qualitative and Quantitative Scores and Data collected from each Pilot City provide insight regarding the usability of the CRI. Alongside this, review of CRI outputs and perspectives on resilience provided by a range of city stakeholders, Workshop Participants, and Facilitators helps to identify the effectiveness of the CRI as a comprehensive, globally-relevant measure of city resilience; both as a diagnostic tool for strengths and weaknesses, and as a baseline from which to track performance over time.

Figure 2: Pilot cities



- Phase 1 pilot cities
- Phase 2 pilot cities

(Image Opposite)

Arusha, Tanzania

## **Box 2: Pilot research questions**

### **Is it easy for cities to use CRI?**

- What are the key considerations for an effective and efficient CRI assessment process?
- How can the assessment process best enhance local ownership, learning and buy-in?
- What kind of support and guidance will cities most need in implementing future assessments? How might this differ between cities?

### **Does the CRI provide an effective measure of city resilience?**

- How does the CRI help stakeholders to understand and engage with the city's resilience?
- How well do CRI findings reflect the current state of city resilience?
- How can CRI findings enable cities to build resilience?

## **Implementation approach**

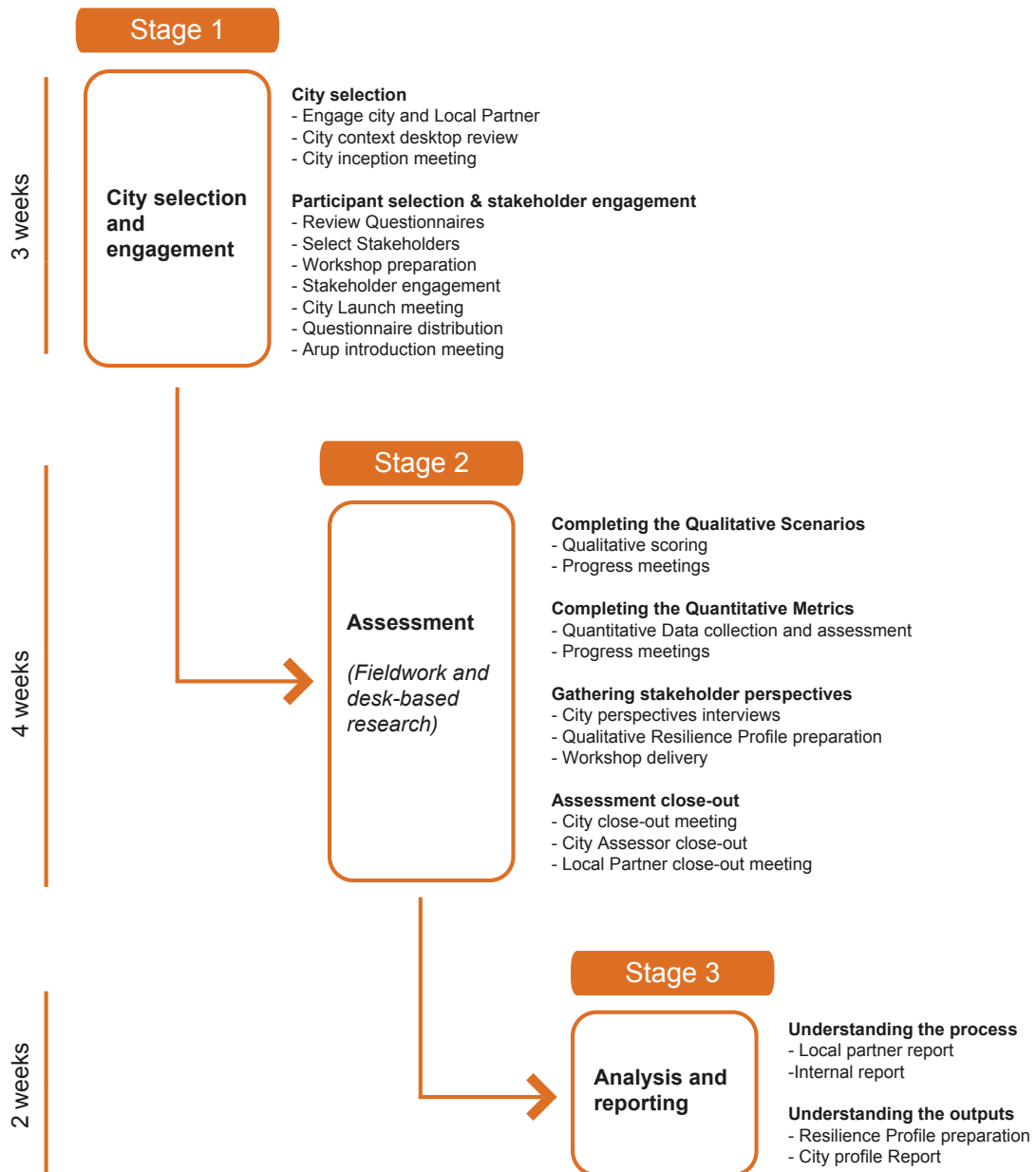
The Pilot assessment program can be understood as a three stage process commencing with city selection and engagement (refer to Figure 3). The Pilots were then carried out by city assessors with the support of Facilitators and Local Partners. Key activities included: a series of stakeholder engagement activities to obtain Quantitative Metric Data, assigning Qualitative Scenario Scores, and gathering diverse and informed perspectives on city resilience. Assessment findings from each Pilot City were then collectively analysed and reported upon.

## **Generic methodology**

A generic methodology was developed to guide the Pilot approach (including both desk-based and field-based research) across all cities. Although fieldwork in each Pilot City was guided by the key stages within the methodology, opportunity was provided to tailor each city's approach to local constraints, requirements, and context. Providing adequate flexibility in the research approach also enhanced the opportunity to observe and learn from challenges and successes around variations in method. Although some steps within the methodology were adapted, all Pilots addressed the same research questions. An overview of the generic Pilot methodology is provided in Figure 3. A detailed fieldwork methodology is provided in Appendix A. A summary of the roles of the stakeholders contributing to the Pilot process in each city is provided in Table 1.



Figure 3: Pilot methodology



# Stage 1: City selection and engagement

## City Selection

A geographically diverse range of cities from Africa, Asia, South America, and the United Kingdom were shortlisted for CRI Pilots. Within these regions cities were identified which had demonstrated an interest in resilience, and with which Arup has existing relationships (with municipalities, and with Local Partner organisations).

Of the cities engaged for the assessment process, four of these were medium-sized: Arusha, Concepción, Shimla, and Liverpool. The city size was assumed to ease engagement compared to larger cities where obtaining senior city leadership commitment can be more onerous and time consuming. In one further city – Hong Kong – the Quantitative assessment was carried out by a consultant team (Arup Hong Kong) based on publically available data and municipal data requests (without direct engagement of the city).

Table 1: Pilot assessment participants

Organisation	Role and responsibilities
Facilitators	Facilitators were responsible for managing and delivering each Pilot, including 2-3 weeks of fieldwork in each city.
Local Partner	In each city, Arup was supported by one or more Local Partner organisations, engaged in order to provide valuable local knowledge and city contacts. These groups also helped to deliver fieldwork activities during times when Arup was working remotely. Local partners were Institute for International Urban Development (I2UD) and Aga Khan University (Arusha); Fundación Alto Rio and Centre of Urban Studies (Concepción); ICLEI India (Shimla); Arup local offices in Liverpool and Hong Kong.
City Lead	Pilot Cities were encouraged to assign a City Lead, who acted as the assessment facilitator and main point of contact for the city. Key responsibilities included identifying, engaging, and coordinating assessors and stakeholders to take part in the assessment process. City Leads included the acting District Commissioner (Arusha), the Deputy Mayor (Shimla), and a representative of the Office of the Chief Executive (Liverpool). A City Lead was not identified in Concepción, and was not relevant to Hong Kong (the municipality was not directly engaged during the Hong Kong Pilot).
City Assessors	Within each city, the Pilot process was supported by a team of City Assessors; representatives from government and non-government departments who possess (or have access to) knowledge and data relating to city performance. City Assessors were responsible for gathering Quantitative Metric Data and assigning Qualitative Scenario Scores.
Data Contact	Data contacts are individuals from city government or other institutions who had direct access to relevant city data which was required to complete the Quantitative Metrics. It was anticipated that many Data Contacts would be identified at the outset of the assessment; however in reality these were largely identified throughout the process, and often after false leads.
Workshop Participants	A range of senior stakeholders were identified to provide informed, diverse perspectives on city resilience. These stakeholders spanned government, community, business, NGOs and academia; and the majority were not involved in any data collection. Workshop Participants attended the 'City Resilience Index Workshop' to feed in multi-stakeholder views and reflect on the Qualitative Resilience Profiles.

## **Participant selection and stakeholder engagement**

Each City Pilot engaged a variety of participants and stakeholders who helped to facilitate Pilots, or enriched the assessment process through provision of Quantitative Data, Qualitative Scenario Scores, perspectives on city resilience, and contextual information to help unpack, test and validate CRI outputs.

Table 1 provides a summary of the different types of participants who were identified and engaged in each Pilot City.

Key stages in participant selection and engagement included:

- City and Local Partner engagement: agreement of key terms, roles and responsibilities, communications and timeline for the Pilot.
- Stakeholder selection: discussions with the city and Local Partner to identify appropriate stakeholders to act as City Assessors, to provide data, to participate in interviews, and to attend the City Resilience Index Workshop.
- Stakeholder engagement: once identified, stakeholders were contacted by the city, the Local Partner, or Arup – as appropriate. The Pilot methodology includes ‘City Launch Meeting’ to brief City Assessors in person regarding the Pilot purpose, context, and instructions prior to distributing Questionnaires.

## **Stage 2: Assessment**

The primary activity associated with completing a CRI assessment is the completion of two Questionnaires, each made up of 156 Prompt Questions. Each Quantitative Prompt Question requires City Assessors to gather data from a range of sources to complete Metrics, while Qualitative Prompt Questions require City Assessors to assign a score from 1 – 5 using best and worst case Scenarios. For the purpose of the Pilots, Questionnaires were divided and distributed according to ‘topics.’ The topics relate to key services or functions that are typically managed by different departments or agencies within a city, such as water utilities, health, transport and justice.

### **Completing the Qualitative Scenarios**

The first task completed by City Assessors in Arusha, Concepción and Shimla was to score the 156 Scenarios to produce a Qualitative profile of city performance. The primary reason for prioritising this assessment was to ensure that a Qualitative Resilience Profile could be generated in time for the City Resilience Workshop (held during Week 4 of the Pilot).



## Completing the Quantitative Metrics

Upon completion of the Qualitative Questionnaires, City Assessors were asked to complete the Quantitative Questionnaires. This required most City Assessors to gather data from a range of sources. Facilitators and Local Partners provided ongoing support to identify data sources, review Metric quality, process (calculate or convert) Metric Data where it was not available in the correct format, and redistribute Prompt Questions to alternative Assessors where necessary.

## Gathering external stakeholder perspectives

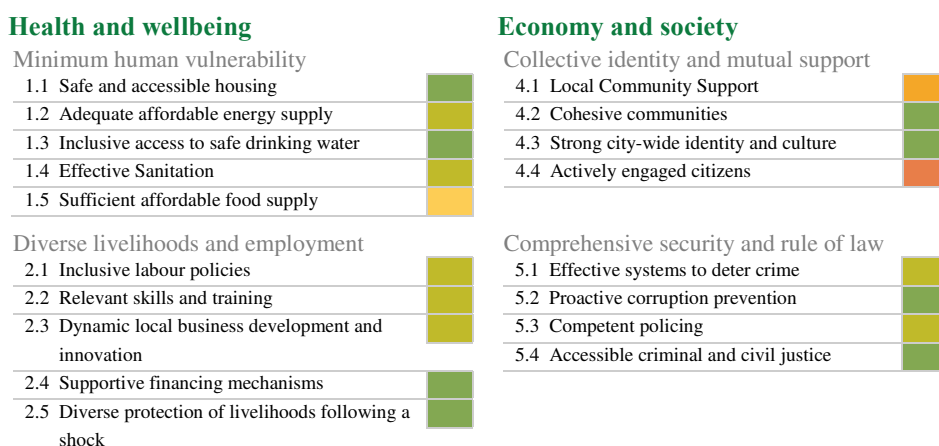
In order to better understand the variety of perspectives on resilience within any city and to provide valuable context for the scoring, a multi-stakeholder ‘CRI Workshop’ was held during Week 4 of the Pilot. Workshop Participants completed Qualitative Scenario assessments at the level of 58 Indicators through interactive group discussion. During a second activity, Workshop Participants were then asked to reflect upon the Qualitative Resilience Profiles (Goal-level results summaries) generated by City Assessors and provide feedback.

In many Pilot Cities, further stakeholder perspectives on city resilience were gathered through interviews with additional external stakeholders. These stakeholders often held senior positions within the city and were unable to attend the City Resilience Workshop due to time constraints. Interviews were held using a pro-forma template and semi-structured format.

## Collecting process feedback

Detailed feedback regarding the CRI Pilot process was gathered from the City Assessors using a standard feedback form, which included questions on the content of Prompt Questions, quality of briefing materials, and value of the assessment process. Feedback forms were distributed in hard copy or via an online survey, depending upon the most suitable format for each city.

Figure 4: Indicator results are grouped according to their respective Goals and Dimensions



## **Stage 3: Analysis and Reporting**

Upon completion of each City Pilot, the outputs from each task were consolidated and reviewed in order to identify and understand the key findings from the process, areas for improvement within the CRI content, opportunities to challenge and learn from resilience profiles, and recommendations for future use of the CRI.

### **Understanding the process**

Initial observations regarding the challenges, successes and outcomes from each Pilot City were captured in internal reports (prepared by Arup facilitators) and Local Partner reports.

### **Understanding the outputs**

Each City Pilot generated three main outputs demonstrating results at a Goal and Dimension level:

- A Qualitative Resilience Profile
- A Quantitative Resilience Profile
- A Quantitative Data Availability Profile

The purpose of the resilience profiles is to demonstrate perceived (Qualitative) and documented (Quantitative) resilience outcomes against each of the CRI Goals and Dimensions. The resilience profiles intend to help cities and stakeholders understand resilience performance and identify priority areas for resilience building activities. These outputs were issued collectively to each Pilot City the form of a 'City Profile Report.'

In addition, two further outputs were generated at an Indicator level:

- Qualitative Indicator Results
- Quantitative Indicator Results

Indicator level results intend to provide further granularity to understand and diagnose strengths and weaknesses relating to specific areas of city performance.

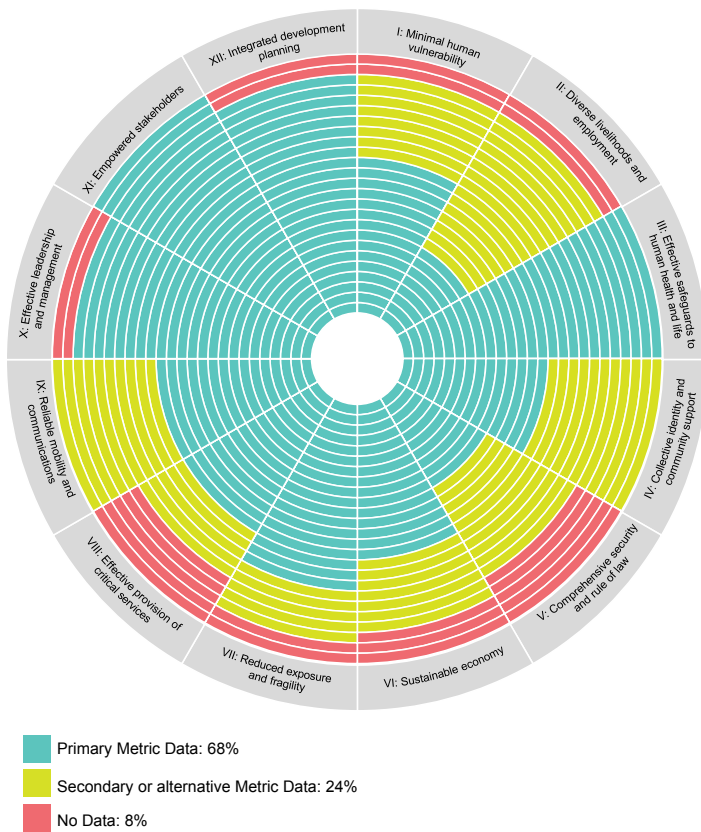
## Quantitative Data Availability Profile

Data availability has a number of implications for Quantitative assessments. An example of the Quantitative Data Availability Profile produced for each Pilot is provided above. Testing and understanding collective data availability across Pilot Cities can inform further development of the CRI by confirming which Metrics are most globally relevant. At the city level, data availability determines the level of confidence which can be assigned to Quantitative results. The Data Availability Profile can also help cities to understand areas which can be prioritised to improve data collection policies and practices.

Data ‘availability’ is defined as the percentage of primary Metrics for which an answer was provided. Answers provided for secondary and alternative Metrics are also shown; however these do not actively contribute to Quantitative resilience profiles<sup>4</sup>.

In addition, data quality information was also captured and analysed across the Pilot Cities, demonstrating how the relevance, date, and objectivity of data (and resultantly, the level of confidence associated with of any given Quantitative profile) varies across different Pilots. This additional level of analysis is provided in Appendix C1.

Figure 5: Quantitative data availability profile



(4) The current version of the CRI generates standardised scores for primary Metrics only, due to the limits of threshold data currently collected.

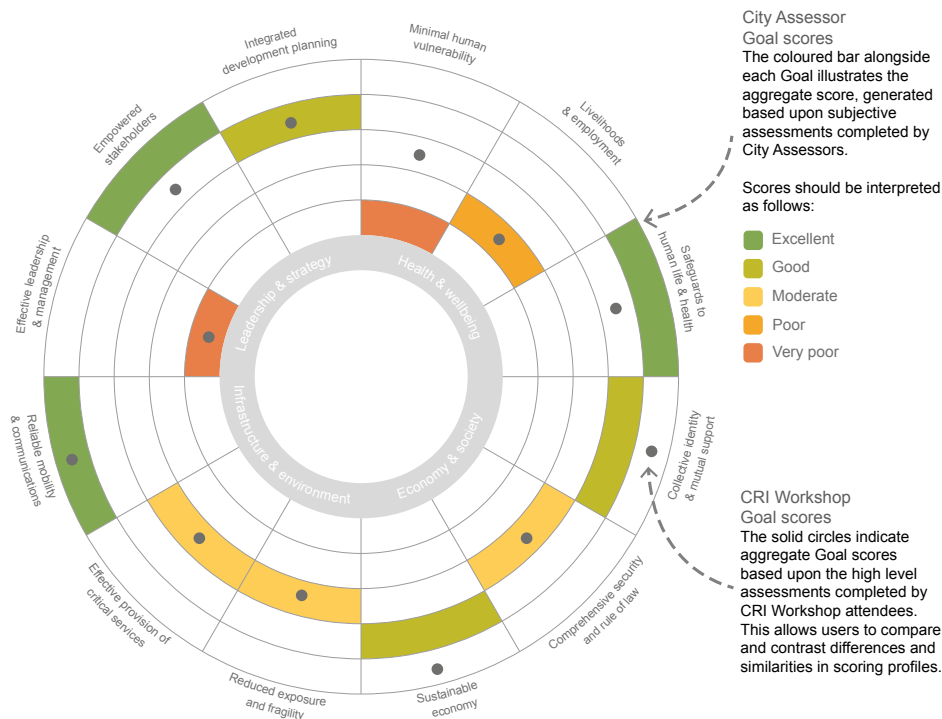


## Qualitative Resilience Profile

An example of a Qualitative Resilience Profile is illustrated below. The Resilience Profile is the composite of CRI Goals, based on the average scores of each relevant Indicator. Indicator Scores are generated from an average of the relevant Qualitative Scenario Scores assigned by City Assessors. In addition, Qualitative Indicator Scores generated by CRI Workshop Participants are demonstrated by solid circles.

Detailed Qualitative Scores at an Indicator level are also provided in Appendix D.

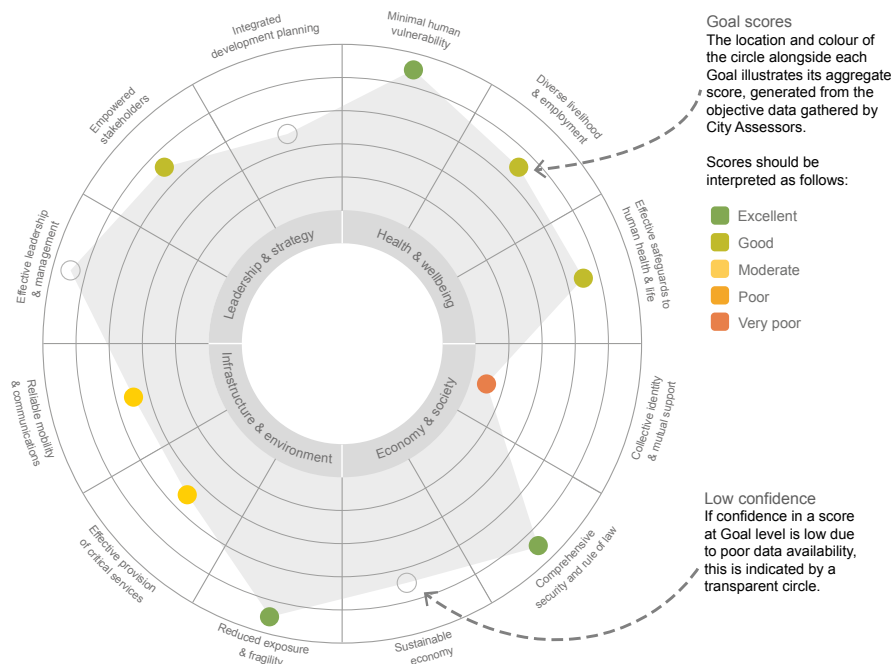
Figure 6: Qualitative resilience profile



## Quantitative Resilience Profile

An example output produced from the Quantitative Metrics is provided above. The Quantitative Resilience Profile is the composite of CRI Goals, based on the average scores of each relevant Indicator. Indicator Scores are generated from an average of normalised Quantitative Metric Data assigned by City Assessors. The location and colour of each circle within the profile demonstrates a score from ‘very poor’ to ‘excellent.’ Detailed summaries of Quantitative Scores for each city at an Indicator level are provided in Appendix D.

Figure 7: Quantitative resilience profile



### Box 3: Confidence level

It is unlikely that any city will be able to provide data for every single Quantitative Metric within the CRI. As such, the level of confidence that can be assigned to any aggregate Quantitative score will depend upon the proportion of Metrics that a city is able to provide data for. Metrics which are not complete (i.e. blank) do not contribute to Indicator or Goal Scores. As demonstrated by the legend, if an inadequate amount of performance data is available to generate a score for any Goal, ‘low confidence’ is indicated by a transparent circle.

A low confidence level is determined using the following approach, which is based on a ‘50%’ minimum threshold for data availability:

- At an Indicator level, Scores are determined to be of low confidence if data has been provided for less than half of total Metrics relevant to that Indicator.
- At a Goal level, Scores are determined to be of low confidence if data has been provided for less than half of total Metrics relevant to that Goal (regardless of which Indicator the Metrics fall within), or if less of half the Indicators have already been determined to be of low confidence.

# Case studies

---

## Phase 1: Hong Kong and Liverpool

Hong Kong and Liverpool were selected as initial Pilot Cities in June 2015 in order to gather, test and refine the primary Quantitative metrics

### Hong Kong, China

Hong Kong is a major global financial hub and trade centre located on the south-eastern coast of mainland China. A former British colony, the city spans 1,100 square kilometres and is home to over 7.2 million people. It is one of the most densely populated cities in the world, averaging 6,690 persons per square kilometre.

The city comprises the world's 45th largest economy, largely based on service sectors. It ranks in the top ten GDP per capita globally, yet experiences among the most severe levels of income inequality of any city in this category. The municipality has one of the world's lowest birth rates and longest life expectancies; the full impacts of the resulting aging population are yet to be seen.

(Image Below)

Hong Kong harbour





Under the ‘One Country, Two Systems’ constitutional principle established during Hong Kong’s reunification with the People’s Republic of China, Hong Kong is a Special Administrative Region (SAR) which retains financial independence and relative autonomy. The SAR maintains a separate capitalist economic and political system, while defence and foreign policy falls under the authority of China. The government of Hong Kong is an executive authority which is led by a nominated Chief Executive, and administered by a range of Principal Officials.

### Shocks and stresses

- Typhoon
- Flooding
- Landslides
- Social conflict and civil unrest

### Overview

**Pilot stages 1 – 2 duration:** 3 weeks

**Pilot stages 1 – 2 time:** 135 hours (Arup staff)

**Fieldwork duration:** *Not applicable*

**Estimated time per Indicator** (objective aspects only): 2 hours

**City Partner:** *Not applicable*

**Local Partner:** Arup Hong Kong

**Number of Arup Facilitators:** Not applicable

**Number of City Assessors:** 3 (Arup staff)

**Number of Data Contacts engaged:** 20

### Pilot Process

The Pilot focused solely on completing the Quantitative assessment based on publically available data collected and processed by ‘third party’ consultants (Arup Hong Kong) who acted as the equivalent of City Assessors. Qualitative assessments were not undertaken as part of the Hong Kong Pilot.

The statistical system in Hong Kong is very well established. A census is held every 5 years, and a large range of data is free to access in the public domain. The city census department acts as a centralised focal point for data management between other government departments. The three Arup staff involved in the Pilot had a very good understanding of city data sources based on previous experience working with government and private sector on major research projects. CRI Indicators were divided between the three staff according to technical, governance, and planning domains. Available data was collected from known sources; while specific data which was not available (such as emergency response Indicators) was requested from a range of individual government departments and external sources, including statutory agencies and private sector.

## Key challenges

The most time consuming aspect of Quantitative assessment in Hong Kong involved conversion of data into the correct units, which often required use of multiple data sources. For example, instances where a given number of services or assets needed to be rationalised in terms of area, proportion or population. This was undertaken relatively efficiently due to the experience of consultants in managing data.

## Outcomes

The CRI Hong Kong Pilot demonstrates an effective approach to completing the Quantitative assessment of the CRI. This was due to excellent city data management practices and transparency. Beyond the publically available data, specific city departments were very willing and cooperative in responding to specific data requests. A small core team of Assessors was able to complete the Pilot in a focused, efficient manner.

The Assessors commented that in order to complete a Pilot independently, government would need to identify a suitable party to coordinate data and communication across a very large number of government departments (around 40 exist in Hong Kong) and non-government agencies. They believe that an external facilitation role would be helpful in providing cross-disciplinary support to process data, and to help overcome challenges relating to communication and coordination within and outside of government.

## Data Availability Profile

As a Phase 1 Pilot, the Quantitative assessment in Hong Kong focused on securing data for primary (preferred) Metrics. Data availability (see figure 8) in Hong Kong is reasonably high even though the government was not directly engaged to lead the Pilot and the Pilot was completed across a very short timeline (three weeks).

Particularly good data availability was observed across the Goals of **effective safeguards to human health & life (III) comprehensive security & rule of law (V)**. Weaker areas include **effective leadership and management (X) and empowered stakeholders (XI)**.

## Quantitative Resilience Profile Dimensions

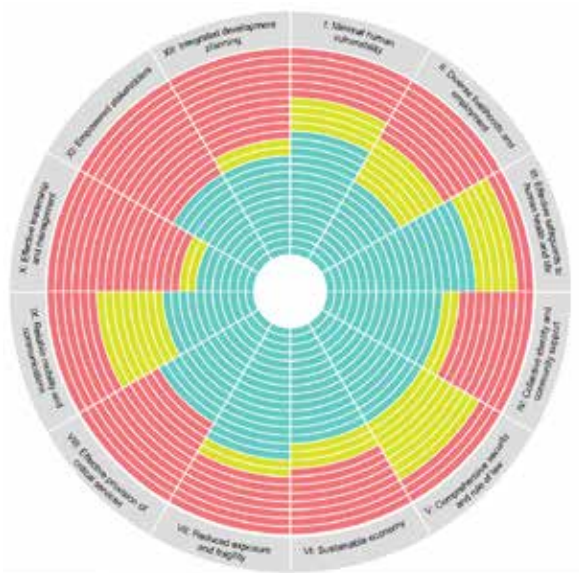
The Quantitative Profile for Hong Kong exhibits particularly good outcomes across **health & wellbeing**. Results are more varied across other Dimensions at extreme ranges (excellent to very poor).

### Goals

Quantitative results across **collective identity and mutual support (IV)** are particularly poor. This is consistent with feedback from Pilot staff, who suggest that Hong Kong is experiencing significant social problems alongside poorly managed population growth due to migration, shortage of space and resources, and civil unrest.

Good or excellent performance is observed across a number of Goals, in particular **minimal human vulnerability (I)**, **comprehensive security and rule of law (V)**, and **reduced exposure and fragility (VII)**.

Figure 8: Hong Kong Data Availability Profile



■ Primary Metric Data: 54%  
■ Secondary or alternative Metric Data: 13%  
■ No Data: 32%

Figure 9: Hong Kong Quantitative Resilience Profile



■ Excellent  
■ Good  
■ Moderate  
■ Poor  
■ Very poor

## **Key observations**

### *Is it easy for cities to use CRI?*

- The Hong Kong Pilot demonstrates how, where a large amount of data is publically available, the Quantitative assessment can be delivered in a very efficient and focused manner by a third party, over a short period of time.
- Other important factors of success included very efficient centralised government data management practices, and willingness of government departments to assist by sourcing and providing specialised data for specific requests.
- Although more data may have been available if government was formally engaged in the CRI Pilot, Local Partners believe that an external facilitation role would still be very important in order to provide cross-disciplinary guidance and support inter-department coordination.

### *Does the CRI provide an effective measure of city resilience?*

- The Quantitative profile for Hong Kong provides a starting point and evidence base for measuring and understanding and the relationship between city performance and resilience outcomes.
- As the government of Hong Kong was not formally engaged in the CRI process, issues around data availability are unlikely to be addressed for future reassessment. This means the confidence level associated with parts of the Quantitative baseline will remain limited across certain Goals and indicators where data availability is low.



## Liverpool, United Kingdom

The city of Liverpool is situated to the northwest of England, on the eastern side of the Mersey Estuary facing the Irish Sea. The city has a population of approximately 470,000 with the wider region supporting a population of 1.5 million. 42% of the population is below the age of 30, compared with 38% for England.

The city's main economic opportunities advanced manufacturing, tourism, and big data. The city is also a centre for academic and research excellence offered by the city-region's universities.

The city of Liverpool is governed by the elected mayor of Liverpool and Liverpool City Council, and is one of six metropolitan boroughs that make up the Liverpool City Region. The City Council carries out most of the day-to-day city administration activities. However, since April 2014 some responsibilities have been pooled with neighbouring authorities and subsumed into the Liverpool City Region Combined Authority, led by the elected mayor.

### **Pilot Process**

The initial purpose for the Liverpool Pilot was placed upon identifying data to complete primary, rather than secondary Metrics. 'Alternative' Metrics (suggestions provided by the city for suitable data where no other data was available) were not included in the Liverpool Pilot.

The timeline for collection of Qualitative data was longer than anticipated; 9 weeks in total. As Qualitative data had not been gathered on full city-scale before, much initial time was spent identifying and engaging data sources both within and outside of government. Valuable insight from Liverpool regarding the best ways to frame data collection and CRI questionnaire 'topics' was has been used to frame future assessments.

(Image Below)

Liverpool  
© Alex Liivet



### **Shocks and stresses identified during the Pilot**

- Terrorism
- Economic instability and unrest
- Pandemics
- Extreme weather events – high wind, rainfall, and flash flooding
- Economic deprivation, austerity, and resultant health outcomes
- Climate change

### **Overview**

**Pilot stages 1 – 2 duration:** 17 weeks

**Pilot stages 1 – 2 time:** 320 hours (Arup, City Assessors)

**Fieldwork duration:** 3 weeks

**Estimated time per Indicator:** 3 hours

**City Partner:** Liverpool City Council

**Local Partner:** Arup Liverpool

**Number of Arup Facilitators:** 1

**Number of City Assessors:** 17

**Number of departments and organisations engaged:** 10 (including Council and private service providers)

### **Key challenges**

The Pilot benefited from support from the Liverpool City Council Executive's Office in engaging with stakeholders and securing in-kind input. Nevertheless there were significant delays in obtaining data in Liverpool in comparison to other Pilots which suggests that stronger or more official demonstration of senior leadership buy-in would have been beneficial.

City Assessors did not have the benefit of an official Pilot 'launch,' to inform them of the process and get their buy-in. This may have reduced the importance and priority various City Assessors placed upon these requests. Data from the private sector and service providers was particularly difficult to obtain, with slow turn-around on responses, or in some cases no response (despite initial success in engagement).

### **Outcomes**

The Pilot process in Liverpool was a success; a range of stakeholders were highly engaged with and supportive of the CRI process; and stakeholders demonstrated an improved understanding of the city resilience agenda. All Pilot stakeholders and participants – including those from government, community organisations and private sector – expressed interest in viewing the results of the Pilot as a way to identify and improve resilience-building activities for the city.

The City Lead was crucial in identifying, engaging and coordinating Quantitative data, and subsequent Qualitative assessments (all assessments were undertaken fully in electronic format).

## Data Availability Profile

Data availability from the Liverpool Pilot is relatively low, despite extended timelines granted for data collection. Particularly low data availability is observed across the following Indicators in all four Dimensions:

- **Comprehensive security and rule of law (V)**
- **Effective provision of critical services (VIII)**
- **Reliable mobility and communications (IX)**
- **Empowered stakeholders (X)**

Poor participation and responsiveness from the private sector and public bodies which are not directly connected with Council meant that less data was provided than might actually be available.

## Qualitative Resilience Profile

### Dimensions

Qualitative results reflect strong overall performance at Dimension level. City Assessors have consistently rated outcomes as ‘good’ across **health & wellbeing** and **infrastructure & environment**, while more varied performance is identified across **economy & society** and **leadership & strategy**.

Figure 10: Liverpool Data Availability Profile

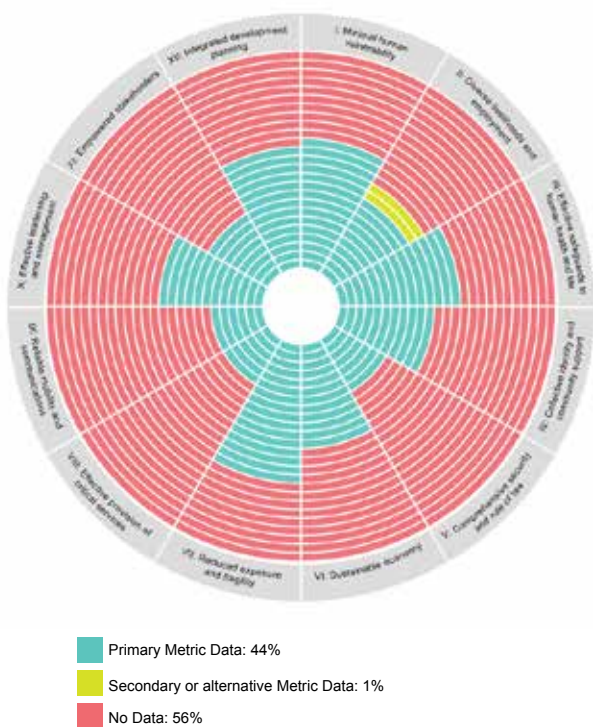


Figure 11: Liverpool Qualitative Resilience Profile



## Goals

Liverpool's Qualitative profile suggest that City Assessors and Workshop Participants are experiencing good performance across the majority of resilience Goals; in particular, **comprehensive security & rule of law (V) and integrated development planning (XII)**. This reflects strong performance in enforcement of law; a well-resourced justice system; and comprehensive, inclusive city planning.

**Empowered stakeholders (XI)** shows moderate performance. A growing 'digital divide' in the city is seen as affecting government engagement and stakeholder communication, particularly for emergency prevention, preparedness and hazards. Mid-level scoring around **sustainable economy (VI)** reflect concern regarding employee rights and skill shortages, a weak (but improving) business environment, dependency upon national government revenue, and ongoing cuts to council finances.

### The City Resilience Workshop

The Liverpool City Resilience Index workshop was held on 30 September 2015, and attended by a diverse range of 20 senior stakeholders representing transport, health, utility, education and housing providers, charity, business, police, media. Stakeholders were highly engaged throughout the workshop process and provided a range of valuable feedback and reflections on assessment scores and city resilience performance.

Themes which emerged during the workshop related to the Goals **sustainable economy (VI) and minimal human vulnerability (I)**. In relation to minimal human wellbeing, issues identified included access to utilities, access to services, affordability of services and food security. In relation to the economy, concerns centred upon skill shortages and labour conditions, while social enterprise and supportive financing were seen as strengths.

Participant feedback indicates that the workshop was a valuable process in embedding and enhancing stakeholder understanding of resilience, as a basis from which Liverpool City Council may progress this agenda over the coming years.

## Workshop and assessor profiles

There is a very close relationship between City Assessor and Workshop Participant scores. Workshop Participants were supportive of Assessor scores at a Goal and Dimension level and suggested minor variances could be attributed to different between assessment methods. Both City Assessors (in written scoring rationales) and Workshop Participants (during workshop activities) emphasised that they anticipate Qualitative Profiles may change in the near future, as a number of city spending cuts are scheduled to occur – including around legal and justice services. There was an interest to understand how scores may reflect these changes in future reassessment.



## Quantitative Resilience Profile

### Dimensions

The Quantitative profile for Liverpool demonstrates excellent outcomes across **leadership & strategy**, and moderate outcomes across **health & wellbeing**. It is noted that many Workshop Participants emphasised that spending cuts will occur over the next year in relation to health services, which is important context when considering how outcomes in this area may change over time.

Outcomes across other Dimensions are less clear due to data constraints, but appear to sit within a moderate to high range.

### Goals

At a Goal level, Liverpool experiences particularly good outcomes in a number of areas, including **reduced exposure and fragility (VII)**, **empowered stakeholders (XI)**, and **integrated development planning (XII)**. Areas of greater relative concern include **minimal human vulnerability (I)**. Poor scores in this area relate to affordable energy supply and provision of alternative (back-up) fuel systems. The Quantitative Profile reflects Workshop Participant feedback, which emphasised that ‘energy poverty’ is widespread across the city.

### Comparison to Qualitative Profile

The Quantitative and Qualitative profiles for Liverpool correlate in many areas. City Assessor scores are more positive across the health & wellbeing Dimension, and more critical across the leadership & strategy Dimension, particularly in relation to empowered stakeholders (XI).

Figure 12: Liverpool Quantitative Resilience Profile



## **Key observations**

### *Is it easy for cities to use CRI?*

- There was a high level of commitment from Liverpool City Council, however the data collection process was significantly delayed. Increased senior buy-in, official branding and a more visible launch process may have improved levels of motivation and responsiveness across City Assessors and Data Contacts.
- Liverpool City Council and external stakeholder organisations are well-resourced in comparison to those cities within developing countries (such as Arusha and Shimla), however delays still occurred due to issues around stakeholder resourcing (mainly time) and motivation.
- Stakeholder engagement and coordination would have benefitted from an agreed approach to manage and follow-up unresponsive data providers, particularly those outside of the jurisdiction of Council. CRI briefing materials should include instructions on the temporal scope of Qualitative assessments. Some stakeholders needed clarification regarding whether to include the impact of likely future events (such as government spending cuts) in scores.
- City Lead feedback indicates that the technical advisory role which was provided by Arup throughout the Pilot was valued, and may still be needed for future use of the tool by high capacity cities such as Liverpool. It was adequate that this advice was provided in a remote manner, for example, via email.
- Liverpool City Council has adequate internal capacity to undertake future assessments independently.

### *Does the CRI provide an effective measure of city resilience?*

- As an initial Pilot focusing on Quantitative data availability based on preferred Metrics, the Liverpool Pilot provided valuable feedback regarding the suitability of Metrics and availability of Metric Data, to improve and refine CRI content for the benefit of future assessments.
- Qualitative assessment activities provided an opportunity for Liverpool government and wider stakeholders to engage with the concept of resilience, understand the context for Quantitative findings, examine stakeholder perceptions around city performance, and build momentum for a coordinated approach to progressing the emerging city resilience agenda.

## Phase 2: Arusha, Concepción and Shimla

Arusha, Concepción and Shimla were selected as further Pilot Cities in August 2015 in order to comprehensively assess the content, usability and effectiveness of the CRI.

### Arusha, Tanzania

Arusha, Tanzania's second largest city, is located along the African Rift Valley at the base of Mount Meru; a dormant Volcano within one of the most biodiverse regions of the world. At 2012, the City of Arusha had a population of 416,442, and the metropolitan 1,007,784. It is currently one of the fastest growing cities in Tanzania.

Arusha's growing urban economy is strengthened by its strategic location, mineral resources, and tourism attractions. The city sits on the transnational transport corridor to Nairobi and is the starting point for safaris to the world famous Serengeti and Ngorogoro Crater National Parks. Arusha is also the centre of the global tanzanite mining trade. It hosts a number of international institutions, and in 2012 was designated the headquarters of the East African Community.

In the context of the CRI Pilot, 'Arusha City' is defined as the metropolitan area which includes the entire Arusha City Council, parts of Arusha District Council and Meru District Council. All three councils lie within the Arusha region. Arusha City is managed by an elected City Council, while both Arusha District and Meru District are managed by appointed District Commissioners and elected District Councils. Resilience is an emerging agenda item for the Arusha District Council. The city was selected for the 100 Resilient Cities (100RC) program in December 2014. Pilot process

#### Pilot Process

Arusha was considered a very 'low capacity' Pilot City, therefore the Pilot methodology was altered to provide the city with additional field staff time and support. Progress was initially slow due to government activities associated with upcoming national elections.

(Image Below)

Informal settlement  
in Arusha and Mount  
Meru



### Shocks and stresses identified during the Pilot

- Volcanic activity - eruption and earthquake
- Flooding
- Industrial hazards
- Disease outbreak
- Terrorist attack
- Arson and fire
- Drought
- Unemployment
- Rapid urbanisation
- Climate change
- Corruption
- Environmental degradation

### Overview

**Pilot stages 1 – 2 duration:** 8 weeks

**Pilot stages 1 – 2 time:** 750 (Arup, City Assessors and Local Partner)

**Fieldwork duration:** 3 weeks

**Estimated time per Indicator:** 6 hours

**City Partner:** Arusha District Council

**Local partners:** Institute for International Urban Development (I2UD), Aga Khan University (AKU)

**Number of Arup facilitators:** 1

**Number of City Assessors:** 11

**Number of Data Contacts engaged:** 27 (city government, academia and NGOs)

A team of 11 City Assessors, known as the ‘task force,’ was established by the city. City Assessors were selected primarily on the basis of their sector background and understanding of city context. The City Assessors in Arusha tended to act as intermediaries by circulating and re-circulating Questionnaires to relevant experts and specialists within the city to provide the required inputs (rather than directly completing the Prompt Questions themselves). In most cases, the same Assessor or Data Contact completed both Qualitative and Quantitative assessments. The Questionnaires were completed entirely in hard copy (written) format, as electricity supply and internet access are intermittent.

All City Assessors were provided with a high level of coaching and guidance. In addition to the initial launch meeting, Arup and I2UD held ‘drop in sessions’ where one-on-one support was provided to interpret questions and review responses. A key role of the City Assessors turned out to be translating the Questionnaires into the local language of Kiswahili. In addition to translating the technical text within the Prompt Questions, another significant challenge was interpreting the Questions within the local context. For example, for Metric 9.3.1: *‘percentage of people with access to the internet’*, the meaning of ‘access’ was unclear: direct access to their homes, or to a community facility?

The Local Partners in Arusha – I2UD and AKU, played important roles supporting the City Assessors to identify alternative stakeholders and data sources, and to navigate local political and institutional pathways. I2UD also sourced additional Quantitative Data through their previous work in the city, bringing data availability from 60% to 67%.



## Key challenges

Key challenges included identifying and obtaining Quantitative Data. Record keeping practices are not a well-established in Tanzania. Little is known about the availability and location of existing data, and once identified it can be difficult to access through onerous government channels. In many cases Quantitative Metrics were populated using informed expert opinions rather than official data. Data was sometimes sourced from non-specific departmental records, without a documented source. With regards to the Qualitative Scenario Scores, feedback from Facilitators, Local Partners and Workshop Participants indicates that government City Assessors inflated Scenario Scores assigned to their own departments due to fear of reprisal or a cultural reluctance to criticise their own performance.

After initial challenges for City Assessors in gaining access to Data Contacts, an official letter of introduction for the project was developed, in the local dialect (Kiswahili) and signed by the acting District Commissioner. This was then presented to each government department or external agency engaged in the process. This approach was generally effective, however some departments (particularly those relating to legal and justice systems) were still unwilling to provide data.

## Outcomes

Overall, the Pilot was received very well by the city and stakeholders, who related well to the concept of resilience. The team of City Assessors showed high levels of commitment to the process and made themselves readily available to participate. Feedback from City Assessors and Workshop Participants suggests the process was found to be valuable, as well as enjoyable. All those involved keenly anticipate the results of the Pilot, and how findings might be used to build resilience within Arusha.

Variations within the generic methodology, such as the intermediary role of City Assessors, were successful in addressing many contextual challenges. In some cases, bureaucratic challenges were overcome by the presence of external consultants, who were not constrained by local procedures around convening meetings and gathering information

## Data Availability Profile

Data availability in Arusha appears high, however much data was provided in response to secondary, rather than primary Metrics. Furthermore, many Metrics (54%) were completed using estimates provided by relevant experts, rather than formally documented data sources (refer to Appendix C1).

Goals where very limited primary data was available include **diverse livelihoods and employment and comprehensive security and rule of law**. In contrast, almost all data was sourced across the Goals of **effective safeguards to human health & life, effective leadership and management, empowered stakeholders**, and integrated development planning.

Figure 13: Arusha Data Availability Profile

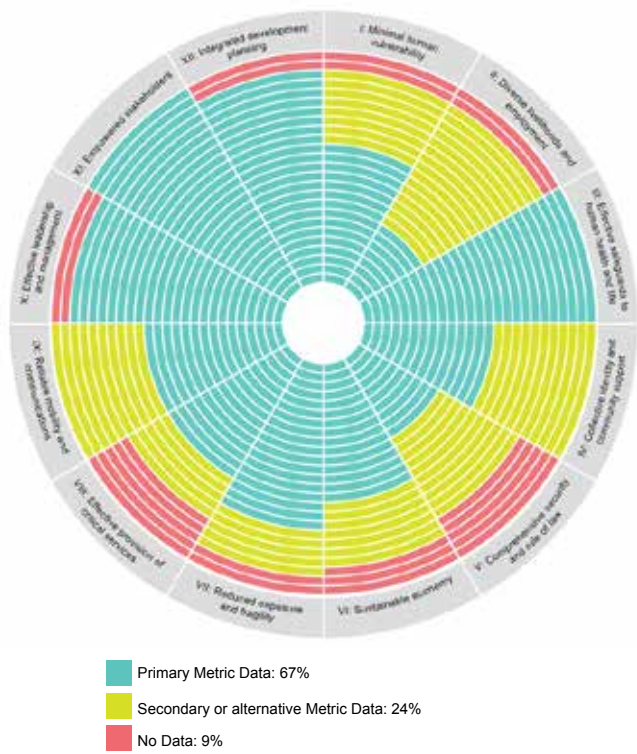


Figure 14: Arusha Qualitative Resilience Profile



## Qualitative Resilience Profile

### Dimensions

Arusha has undergone tremendous change over the last decade, with much of the population having relocated from rural to urban areas where they have access to a range of new utilities and services. At a Dimension level, results seem more positive than expected in many areas. Results across **leadership & strategy**, **health & wellbeing**, and **infrastructure & environment** Dimensions sit almost consistently in the middle range, while scores across **economy & society** are more positive. Discussion with City Assessors and Workshop Participants suggests that the profile reflects a sense of optimism which results from the improvements in lifestyle experienced in recent years, as many have relocated from rural areas to the city where they experience improved quality of life. In particular, the economy and society has transformed through rapid urbanisation, bolstered by the local mineral trade and tourism.

### Goals

Both city and workshop assessments reflect positive outcomes in relation to **collective identity & mutual support (IV)**. Although Workshop Participants provided more critical feedback for this Goal, within each assessment it was comparatively highly rated. Tanzania has a history of strong community

identity and cultural identity. Until quite recently, government policies were in place to actively promote community cohesion and reduce tribalism. Over the last few years, Tanzanian cities have increasingly open economies, and are experiencing global influences such as individualism and capitalism for the first time. While Workshop Participants believe outcomes around collective identity and mutual support are still relatively positive, they discussed how these outcomes deteriorated over recent years as a result of rapid economic and social change. This is important context for future resilience building activities.

In contrast, particularly weak outcomes were identified within **reduced exposure & fragility (VII)**. A key theme across this Goal was poor legal enforcement of policies, codes and standards, including building codes and policies for managing or protecting ecosystems. Both engineered infrastructure and natural assets provide little in the way of protection due to lack of funds and resources to carry out maintenance or upgrades and ongoing environmental degradation. Little work has been undertaken to date to characterise and address the hazards faced by the city.

Consultation during the Qualitative assessment process also highlighted the importance of the informal sector in Tanzanian cities to **sustainable economy (VI)**. The informal sector is seen to be more resilient than the formal sector, and Workshop Participants went so far as to assign separate scores under ‘sustainable economy’ for formal and informal aspects (the informal sector was considered to have good performance overall, while the formal sector was unsatisfactory). There was consensus that the local economy is diverse, however significant barriers exist which stop businesses from moving from the informal into the formal sector. Endemic corruption is seen as a major barrier to business expansion which is hindering economic growth. Tanzania underwent a major nationalisation process at independence and many local industries died off at this time. Government policies are still not conducive for business, though this is slowly changing. A similar divide was found to exist between formal and informal financing mechanisms, with informal rated much more highly. Land ownership is required to access loans, which restricts access to formal finance, along with high interest rates. Informal financing systems are widespread and help to address these gaps.

### **Workshop and assessor profiles**

**Collective identity & mutual support (IV)** and **sustainable economy (VI)** are important areas where Qualitative Scores of Workshop Participants were more critical than those of assessors. City Assessors were visibly reluctant to assign critical scores in some areas – particularly those relating to governance and justice – largely due to political pressure. Workshop Participants emphasised corruption within city government and institutions as an area of concern which has far-reaching implications for many resilience outcomes – including justice, policing, economy and society. Particular divergence of

views suggest these may be priority areas for stakeholder consultation during future assessments; though by its very nature meaningful engagement on this issue may prove challenging.

Beyond these Goals, the City Assessor and Workshop Participant profiles follow similar trends, though the Workshop Participants are generally slightly more critical than Assessors. To some extent, this may reflect that overarching themes such as corruption can be overrepresented in workshop scores which were undertaken at a high level (by Indicator); while in contrast the City Assessor Profile is based on aggregation of more detailed Qualitative Scenario Scores (using Prompt Questions) focusing on very specific areas of performance. Beyond that trend, the variance does speak of a divide in viewpoints between government and non-government stakeholders which should be considered and addressed for future resilience building actions.

### **The City Resilience Workshop**

The Arusha City Resilience Index workshop was held on 9 September, and attended by 12 senior stakeholders from government, NGOs, civil society, and academia. The workshop provided an opportunity for a diverse range of Arusha's stakeholders to bring their multitude of views, understanding and experience of local context to the Pilot.

Workshop Participants provided more critical views of a number of resilience indicators, and offered valuable context for the many interrelated shocks, stresses, actors and systems which influence urban resilience outcomes. Workshop Participants emphasised corruption within city government and institutions as a significant area of concern which has far-reaching implications for many resilience outcomes – including justice, policing, economy and society. They also emphasised important relationships between economy, income and the likelihood of crime. At the time of the Pilot, Arusha was preparing for a national election and security issues were heightened which may explain why issues relating to safety and security resounded strongly.

## **Quantitative Resilience Profile**

### **Dimensions**

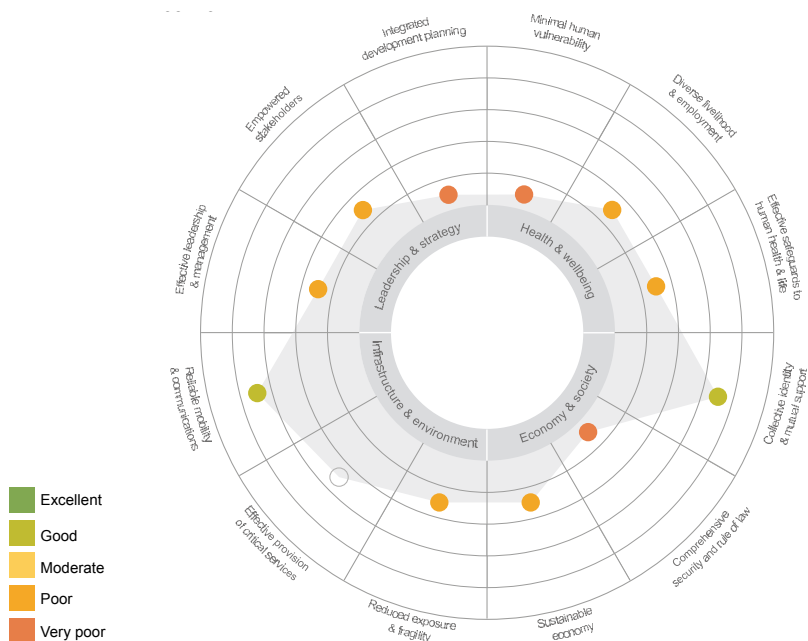
The Quantitative profile for Arusha demonstrates poor overall outcomes across all Dimensions, particularly **health & wellbeing** and **leadership & strategy**. This is not surprising given the significant range of challenges which Arusha faces, including rapid urbanisation and resource constraints.

### **Goals**

Arusha experiences particularly good outcomes across two Goals: **collective identity & mutual support (IV)**, and **reliable mobility & communications (IX)**. Good performance in the former area correlates with a range of feedback received throughout the Pilot process regarding Arusha's extensive history and culture of progressive, inclusive social policy. It is well documented that Quantitative data often serves as a 'lagging' Indicator in



Figure 15: Arusha Quantitative Resilience Profile



any research, so feedback regarding current rapid change (and deterioration) in social and community outcomes should also be taken into account when understanding the bigger picture.

Arusha experiences particularly poor outcomes across **comprehensive security and rule of law (V)**, **integrated development planning (XII)**, and **minimal human vulnerability (I)**. This relates closely to interview and workshop feedback regarding how the city faces a range of difficult challenges across these areas.

### Comparison to Qualitative Profile

The Quantitative profile for Arusha diverges almost entirely from the Quantitative profile produced by City Assessors. Conversely, the Quantitative profile is very closely aligned with the Qualitative profile produced by Workshop Participants; both these profiles are much more critical than that prepared by the city. Although Qualitative and Quantitative Scores are not directly comparable, the strength and correlation of this trend appears to support observations and feedback from fieldwork teams and stakeholders regarding overly-positive Scenario Scores cores assigned by City Assessors, due to a range of political influences.

## Key observations

### *Is it easy for cities to use CRI?*

- Flexibility in the Pilot methodology was helpful in navigating delays in timeline and institutional processes.
- There would be significant benefit in taking additional time before assessments began to understand the most effective government processes and pathways for engagement and mapping of data sources.
- Demonstration of senior government support was helpful in providing improved access to data from many government sources.
- Ensuring City Assessors and other stakeholders have a good understanding and appreciation of the concept of resilience before commencing the assessment helped to ensure an effective process with high levels of engagement.
- In Arusha, assessors and stakeholders would have liked to have a local language version (Kiswahili) of the Questionnaires. However, this issue was largely circumnavigated by City Assessors providing verbal translation for the data contacts.
- Although many City Assessors in Arusha felt positively about their ability to deliver the process independently based on their learning from the experience, a range of institutional support, technical guidance and resourcing would likely be required to ensure a similar level of rigour and transparency is maintained for future assessments.
- Consultant teams in Arusha were exempt from some political and bureaucratic constraints which applied to City Assessors. This was additional benefit of the external facilitation role provided by Arup Facilitators and the Local Partners.
- Filling out the Qualitative questions before the Quantitative questions was found to be helpful for City Assessors when understanding the context and terminology of subsequent Quantitative assessments.

### *Does the CRI provide an effective measure of city resilience?*

- Feedback from the City Assessors suggested that the Prompt Questions could be expanded to better capture the contribution of the informal sector to the local economy.
- Data availability was a challenge to building a comprehensive Quantitative Profile. Expert estimates and opinions were used in many cases as a substitute where measured data is not available. While this was a useful proxy, results are unlikely to be completely accurate and replicable at a Metric level.
- In Arusha, some of the Scenario Scores within the Qualitative assessment were influenced by political or cultural bias, and may not be a true reflection of Assessor perspectives on resilience. These areas of the assessment proved useful talking points during the workshop, and stimulated stakeholder conversation around bias and corruption which may have otherwise been difficult to facilitate.

## Concepción, Chile

Concepción lies in Central Chile, 500 kilometres south of the capital, Santiago. The city sits within the larger urban area of Greater Concepción, where a population of 1,026,425 reside across 10 municipalities. As the 11th largest municipality in Chile, Concepción is home to 231,233 people.

Located 10 kilometres upstream of the mouth of the river Biobio, the city is also a capital, major port, important economic centre and an administrative hub for the wider Bio-Bio region. Concepción was among the areas most severely impacted by the 2010 Chile earthquake.

Concepción is governed by a Mayor who is directly elected every four years. The municipality has 19 departments, which are responsible for linking citizens and city regulations. In addition to administrative duties, the Mayor also leads the City Council, composed of 10 publicly elected City Councillors who oversee city budgets and monitor major city projects.

### **Pilot process**

Concepción demonstrated strong government commitment to the CRI process. The city convened a press conference at the onset of the Pilot with participation of local authorities including the Mayor, the Local Partners, and members of the National Emergency Office, and city media; in order to spread the news of the city's interest in measuring its resilience. This initial meeting created momentum which was carried forward throughout the Pilot process.

(Image Below)

Concepción, Chile

©Amy Gizienski



**Shocks and stresses identified during the Pilot**

- Earthquake
- Tsunami
- Economic inequality
- Poor social housing
- Poor access to basic services, such as healthcare and education

**Overview****Pilot stages 1 – 2 duration:** 9 weeks**Pilot stages 1 – 2 time:** 750 (Arup, City Assessors and Local Partner)**Fieldwork duration:** 2 weeks**Estimated time per Indicator:** 3 hours**City Partner:** Municipalidad de Concepción**Local partners:** Fundacion Alto Rio and Centro of Urban Studies (CEDEUS)**Number of Arup facilitators:** 3**Number of City Assessors:** 23**Number of Data Contacts engaged:** 25 (city government, academia and NGOs)

Progress was slow prior to Arup's arrival in the city. Important activities such as stakeholder mapping (which were to be led by the municipality and Local Partner) were delayed. Due to lack of time the City Launch Meeting for Assessors was not held, and Questionnaires were distributed without proper briefing. This resulted in a lack of clarity around the meaning and purpose of the Pilot, instructions, communications, and time requirements. Many Assessors had to redistribute sections of Questionnaires as they were unable to advise on more than a few questions.

In order to improve support to City Assessors, Arup Facilitators established an 'operation centre' at a municipal unit in the city centre for two weeks. The physical presence of Facilitators to provide ongoing guidance improved the efficiency and speed of the Pilot and Questionnaire completion.

Fieldwork teams recognised the importance of gaining official city support for the process by preparing a letter of Mayoral endorsement to distribute to all those engaged in the Pilot. This proved beneficial in navigating official channels to access data and stakeholders. However, a City Lead was not identified as a communication point for the Pilot, which led to difficulties in project management. The Pilot would have benefited from a well-connected municipal contact providing continuous support.

Local Partners provided a range of important support for the Pilot. Fundación Alto Rio (FAR) acted as a political link with city stakeholders and authorities; while the Centro de Desarrollo Urbano Sustentable (CEDEUS) helped to identify respondents, to organise the workshop, and to gather data after Arup left the city.



## Key challenges

As described, key challenges included the slow rate of initial engagement and building momentum for the process, which was overcome by physical presence of Arup Facilitators in the city, providing direct mentoring for assessors.

Mapping and accessing data sources was more time consuming than anticipated. Arup's official support came from the City Mayor, and it was initially assumed that most of the required information could be provided by municipal departments. However, significant amounts of city data is held at regional branches of national ministries. As a result, two groups were engaged throughout the process: the municipality and national government.

City departments in Concepción operate independently and do not generally have direct communication with each other; no data-sharing systems are in place. This required Arup Facilitators and the Local Partners to identify and coordinate a larger number of data sources and City Assessors than originally anticipated, since most could only engage with a very small part of the CRI questionnaire 'topic'.

Data held outside of government was very difficult to access, including data by private sector utility service providers. In some cases this was overcome where Arup Facilitators or Local Partners directly reached out to these agencies on behalf of government.

## Outcomes

The city completed Qualitative assessments in a timely manner, and data quality was very high. Local Partners, particularly CEDEUS, played an important role in facilitating the Pilot by improving access to data sources and stakeholders through their extensive local research experience. After initial delays, buy-in was well achieved across all participants due to Arup Facilitators' physical presence in the city and official senior endorsement.

## Data Availability Profile

Primary Metric Data availability for the Concepción Pilot varied significantly across the CRI Goals. Almost all data was sourced for the Goals of **empowered stakeholders (XI)** and **integrated development planning (XII)**, while very limited data was available for a number of Goals including **diverse livelihoods and employment (II)** and **reliable mobility and communications (IX)**.

Data quality in Concepción was very high (refer to Appendix C1). Almost all data comes from formal sources, as opposed to being sourced from expert estimates or derived from multiple sources.



Figure 16: Concepción Data Availability Profile

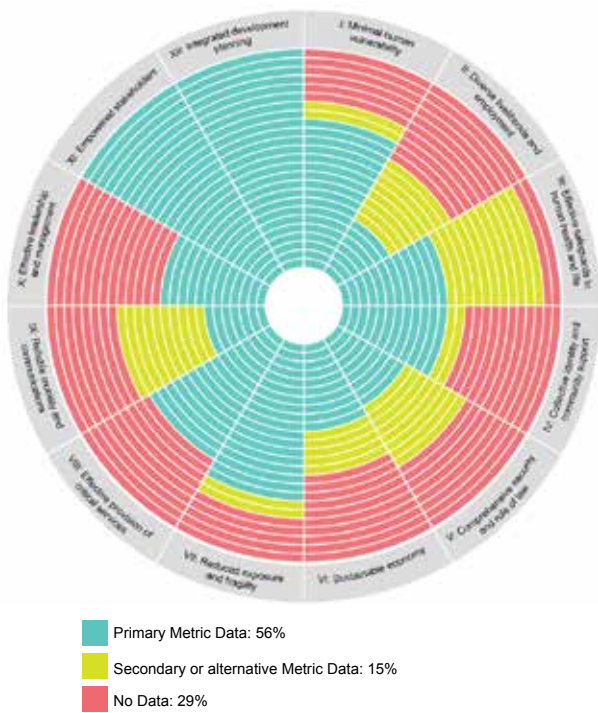


Figure 17: Concepción Qualitative Resilience Profile



## Qualitative Resilience Profile

### Dimensions

The resilience profile completed by City Assessors indicates that government perceives Concepción is experiencing moderate to good outcomes across **health & wellbeing, economy & society, and leadership & strategy**; while outcomes are weaker across infrastructure & environment. Key recurring themes across **infrastructure & environment** include poor maintenance and protection of natural assets and built infrastructure, inconsistent distribution of utilities and services, and inadequate emergency preparedness. Although many governmental agencies in Concepción have improved their capacity to respond to major disasters, stakeholders emphasised that a number of crucial challenges still remain.

### Goals

With consideration to individual resilience Goals, both City Assessors and Workshop Participants highlighted effective provision of critical services (viii) as a particular area where outcomes are weak. Much of the city infrastructure is aging and poorly managed, and underperforming assets are causing ongoing social and economic stress. Asset protection and emergency continuity measures are considered to be inadequate. Policies and safeguards to protect and manage natural ecosystems are inadequate, or absent altogether.

**Minimal human vulnerability (I)** was rated relatively highly by both City Assessors and Workshop Participants. Utility services are considered to be a particular strength, however accessibility varies across the city, and the services are unaffordable for some. Some services and standards are considered to have improved in response to the 2010 earthquake alongside improved emergency preparedness, including provision of emergency shelter and enforcement of building codes.

### The City Resilience Workshop

The Concepción City Resilience Index workshop was held on 29 September and attended by 12 senior stakeholders from the Consejo de la Sociedad Civil (Civil Society Council, or COSOC). This group represents a range of civil groups – mainly neighbourhood organisations, but also NGOs and business. The workshop was not attended by any government representatives. At the time of the pilot, Concepción was commencing preparations for the October 2016 municipal election (cities in Chile follow a 4 year election cycle). Local Partners suggested that in this context it may be difficult to create a relaxed environment with government present.

For the Workshop Participants, inequality was a key theme which emerged in relation to a number of goals and indicators, including employment, training, legal and justice systems, health, and access to services. It was felt that Scenario Scores provided by assessors may be overly positive because although a range of economic and social initiatives do exist, they are not reaching a large proportion of poor and marginalised people. The need for ‘renewal’ was a recurring theme; both in relation to maintenance of aging physical infrastructure, and improvements to longstanding political and legal systems.



## Workshop and assessor profiles

Workshop Participants were considerably more critical in relation to many Goals; in particular – **comprehensive security & rule of law (V)**, **empowered stakeholders (XI)**, and **integrated development planning (XII)**. In relation to Empowered Stakeholders, Workshop Participants highlighted the importance of city participation as a foundation for building resilience. While Workshop Participants suggest that government has made significant progress over the last few years to increase civil involvement in policy making, they believe the city still has a long way to go in improving levels of engagement and participation.

Much discussion at the workshop centred upon **safeguards to human life & health (III)** and **reduced exposure & fragility (VII)** – both areas of greater alignment between city and workshop scoring. CRI Pilot participants in Concepción agreed that the city has undergone significant transformation since the 2010 earthquake. Most public services have developed or improved emergency plans, while the National Emergency Office (ONEMI) has increased staff numbers by three-fold and launched a continuous 24-hour service. Several civil society-led initiatives were established in the last five years to create a more resilient society through education, awareness, and disaster risk reduction.

Overall, the Qualitative assessment scores produced by City Assessors and external stakeholders in Concepción are divergent across all Dimensions and many Goals. Workshop Participants commented that they believe government and politicians lack perspective and are ‘not really embedded in the reality that poor people lived in the everyday life in the City’, because they rarely spend time in poor areas of the city or take part in civil activities. Understanding and reflecting upon these differences will provide government with important context to prioritise and implement resilience-building activities in a meaningful way.

## Quantitative Resilience Profile

### Dimensions

The Quantitative Profile (see figure overleaf) exhibits moderate to good performance across **leadership & strategy** and **health & wellbeing**. Outcomes across **economy & society** are varied but weaker, while results across **infrastructure & environment** appear positive are difficult to gauge with certainty due to poor data availability in this area.

### Goals

At a Goal level, scores for Concepción vary significantly. Particularly weak outcome areas include **sustainable economy** and **collective identity & mutual support**.

Figure 18: Concepción Quantitative Resilience Profile



Positive results are observed across **minimal human vulnerability (I)**, **comprehensive security & rule of law (VI)**, **reduced exposure and vulnerability (VII)**, and **empowered stakeholders (XI)**. These outcomes may partly reflect progress Concepción has achieved since the 2011 earthquake, in improving critical services, disaster preparedness and citizen engagement.

### Comparison to Qualitative Profile

There is limited consistency between the Qualitative and Quantitative Profiles for Concepción. The Qualitative Profiles for Concepción City Assessors and Workshop Participants demonstrate significant variance. When compared to results at a Goal level, City Assessor Qualitative Scores are very similar in relation to **leadership & strategy** and **economy & society**, while Workshop Participant scores converge with Quantitative Data around **health & wellbeing**.

Review at a sub-indicator provides a more useful depth of information regarding similarities and differences in Quantitative and Qualitative scoring. Differences may also reflect a range of other influences and factors, for example - Concepción has undergone, and is undergoing, significant change and redevelopment since the 2011 earthquake. As Qualitative Scenario Scores tend to be leading while Quantitative Metric data tends to be lagging, a range of short term or rapid trends and influences may be driving greater divergence in scoring.

## **Key observations**

### *Is it easy for cities to use CRI?*

- The Concepción Pilot would have benefited from additional time and support to map and engage stakeholders before commencing the Pilot process.
- City Assessors needed to know not just ‘how to’ complete the assessment, but more information regarding ‘what’ resilience is, ‘why’ the process is important, and clarity on the time commitment required. The City Launch Meeting normally provides this briefing.
- Mapping of stakeholders and data sources in Concepción went beyond the city administrative boundaries, to state and national level. Data management is influenced by governance structures which vary widely across Latin America, and internationally.
- The lack of a ‘City Lead’ as a single, centralised point for communication and decision-making reduced the initial efficiency and effectiveness of the Pilot process.
- The physical presence of Arup Facilitators and Local Partners to provide step-by-step guidance was important in translating government commitment into action.
- The role of independent facilitators (Local Partners and in this case Arup Facilitator’s) was important to overcome poor communication and barriers to data sharing, particularly in bridging the gap between the public and private sector due to a particular institutional divide between these groups in Concepción.
- Stakeholders believe that ‘the city is not capable to conduct future assessments by itself, due to the lack of administrative capabilities and of a central body capable to gather all the city data... a specialised academic or research body’ is needed.

### *Does the CRI provide an effective measure of city resilience?*

- The Pilot demonstrated to the municipality the importance of a sharing data between government departments, between public and private sector, and with national government.
- City Assessor views as captured by Scenario Scores and Workshop Participant views varied significantly.
- Quantitative data availability for Concepción was good, and of good quality. Even more data may have been available with a longer timeline for Quantitative data collection and processing or more dedicated resources.



## Shimla, India

Shimla is the capital of Himachal Pradesh, a state in Northern India. The city was the ‘summer capital’ of India under the British rule, situated in the south-western ranges of the Himalayas. Located on hilly terrain at an average elevation of 2200 meters from sea level, Shimla enjoys a sub-tropical highland climate which is an ideal vacation destination for Indian and international tourism. Key sources of employment are government and tourism. The population of the city is 169,578 and an additional floating population of around 76,000 people is present during peak summer tourist periods.

For the purposes of the Pilot, the city is defined as the area covering 378 square kilometre area under the jurisdiction of Shimla Municipal Corporation (MCS), including New Shimla, Totu and Dhalli. The MCS executive arm is headed by a Mayor and Deputy Mayor, both elected directly by the city’s eligible residents. The Municipal Commissioner is the administrative head of the city, appointed by the Himachal Pradesh State Government.

(Image Below)

Commercial street in Shimla



### **Shocks and stresses identified during the Pilot**

- Earthquake
- Landslide and subsistence
- Traffic infrastructure failure
- Storms and flash floods
- Poor livelihood diversity

### **Overview**

**Pilot stages 1 – 2 duration:** 9 weeks

**Pilot stages 1 – 2 time:** 740 (Arup, City Assessors and Local Partner)

**Fieldwork duration:** 3 weeks

**Estimated time per Indicator:** 1 ½ hours

**City Partner:** Shimla Municipal Corporation (MCS)

**Local partners:** ICLEI India

**Number of Arup facilitators:** 2

**Number of City Assessors:** 55

**Number of Data Contacts engaged:** 35 (city government, academia and NGOs)

### **Pilot process**

The Shimla Pilot involved significant levels of staff time to provide technical support, coaching, and to navigate institutional pathways. The fieldwork in Shimla was extended from two to three weeks, largely due to delays in stakeholder engagement and a need to provide greater levels of support. All Questionnaires were completed in hard copy rather than electronic format. After a slow start, the engagement process improved once the Local Partner met with the Mayor of the city and obtained official written endorsement.

The Local Partner provided support by identifying local stakeholders and data sources, coordinating meetings, helping to navigate the city, and locating government departments.

### **Key challenges**

Identifying City Assessors proved difficult in Shimla. City and state government departments in India often have a shortage of technically experienced staff at the middle management level. Junior staff are usually not well placed to complete Scenario Scores due to issues around objectivity (pressure to provide positive Qualitative Scenario Scores) and lack of experience. As a result, the majority of City Assessors were senior staff who were particularly time-poor.

Identifying and engaging external stakeholders to attend the City Resilience Index Workshop also proved difficult. Senior city stakeholders are commonly under-resourced, time-poor and overcommitted. As a result, around half of the Workshop Participants were also City Assessors.

City Assessors required a high level of facilitation by the Facilitators and the Local Partner to achieve the necessary level of progress against Pilot timelines. The Facilitators needed to be present while questionnaires were completed in order to provide translation and technical or conceptual guidance. To improve progress, one-to-one meetings were held with City Assessors to discuss and complete the Scenario Scores.

Data quality and accessibility was a significant challenge. Shimla has a complex governance structure where many city functions are fragmented across several different government departments. As a state capital, some city functions also lie with state government. In some cases up to three different stakeholders and departments had to be consulted in order to gain a credible response for a single question. City Assessors required ongoing support to understand what data was needed, identify data sources, screen data quality, and process answers into the correct format (where needed). Due to strong silos between government departments, staff were frequently not aware of any data which existed outside of their direct jurisdiction.

### **Outcomes**

Overall assessment outcomes and data availability in Shimla improved once City Assessors were provided with support to understand different components of questions and how answers might be calculated from multiple sources. In many cases, lack of published data sources for Quantitative questions was overcome by basing answers on well-informed expert estimates. All such weaker data has been labelled, so that it can be treated appropriately if used as a baseline for future reassessment.

### **Data Availability Profile**

Shimla's Data Availability Profile demonstrates a varied range of primary Metric Data across the CRI Goals. Positive areas include **sustainable economy (VI), reduced exposure and fragility (VII), reliable mobility and communications (IX)** and **effective leadership and management (X)**. Conversely, very limited data is available for some Goals, such as **diverse livelihood and employment (II)**.

While overall primary data availability in Shimla is relatively high, it should be noted that much data (55%) was obtained from weaker sources such as expert opinions, rather than measured data points (refer to Appendix C1).

Figure 19: Shimla Data Availability Profile

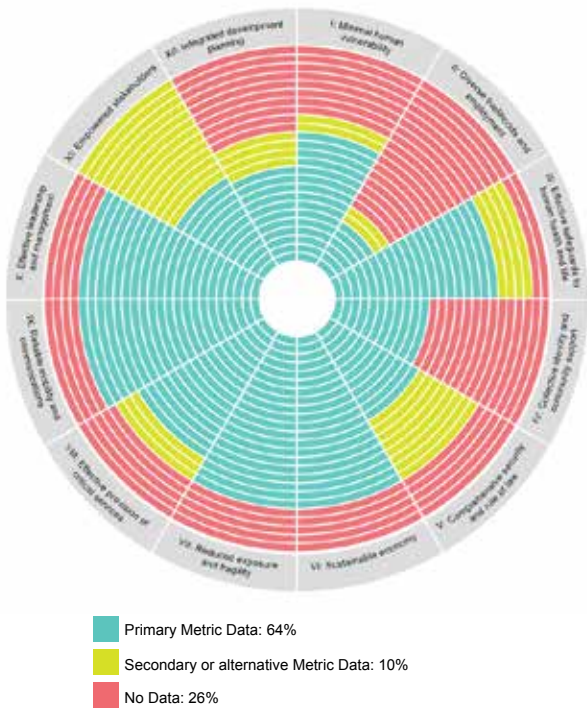
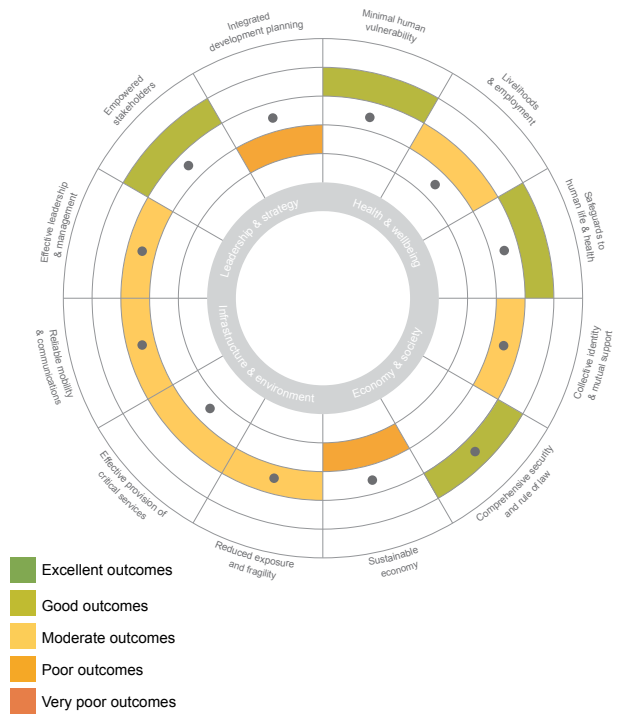


Figure 20: Shimla Qualitative Resilience Profile



## Qualitative Resilience Profile

### Dimensions

The Qualitative profile for Shimla demonstrates mid-level outcomes across all Dimensions. With relation to **infrastructure & environment**, participants emphasised that Shimla, alongside many other Indian cities, experiences a severe shortfall in infrastructure. Pilot Participants showed a keen interest in understanding how the CRI can help unlock the issues which the city is facing across this Dimension.

### Goals

The Qualitative profile for Shimla demonstrates good performance across **minimal human vulnerability (I)**, **safeguards to human health & life (III)**, **comprehensive security & rule of law (V)**, and **empowered stakeholders (XI)**. Assessor rationale and Workshop Participant feedback supports these findings, illustrating a city with a strong sense of community, social cohesion and wellbeing, security and justice, good access to healthcare, education, and other basic services.



Poor areas of performance are **sustainable economy (VI)** and **integrated development planning (XII)**. These scores reflect local challenges in planning, zoning, and poor economic diversity. The city is not considered to have experienced any major shocks – physical, economic or otherwise. Consequently, consideration of safeguards and risk reduction with planning and policy has been limited to date.

The path forward to address Shimla’s challenges is not simple. For example, some Workshop Participants emphasised the need to move towards a larger and more diverse economy, yet there was also a resistance to change demonstrated through comments such as: ‘Shimla should not try to be like Delhi,’ in reference to a perception that the benefits of opening up the city to global economies may result in loss of local character.

### **Workshop and assessor profiles**

City Assessor and Workshop scores are similar at Goal level. Workshop Participants suggested they were comfortable with the Qualitative profile produced by the City Assessors. Minor variance in Workshop and City Assessor scoring may lie largely in the methodology used to obtain the scores.

The workshop process was valuable in gaining buy-in and understanding for the process, and for unpacking the diversity and interconnected nature of the many systems and factors which influence the city’s resilience issues from a ‘citizen’s perspective’. As Shimla has not historically experienced any major shocks, the Qualitative findings also provide valuable contextual information about resilience outcomes to allow proactive identification and prioritisation resilience-building activities which may have otherwise been overlooked.





### **The City Resilience Workshop**

The Shimla City Resilience Index workshop was held on 30 September, and was attended by 42 senior stakeholders. Roughly half of attendees were from government (this group was largely made up of City Assessors), and half from other NGOs and development organisations working within the city such as the United Nations Development Program (UNDP) and TARU.

Key themes which emerged during the workshop related to **livelihoods and employment** and **integrated city planning** which were consistent with lower Scenario scores assigned by the City Assessors. Discussion around these issues was valuable in unpacking complexities and resilience outcomes associated with this issue. Other themes included poor government interdepartmental coordination and provision of critical services. In general, Workshop Participants endorsed the scores provided by City Assessors (it should be noted that although many City Assessors were at the workshop, they were asked to provide input and feedback on sections of the assessment which they had not been involved in to date).

Participants provided positive feedback in relation to the value and importance of the assessment process. They suggested that the level of engagement and cooperation would not have been possible just ten years earlier, and that it demonstrates a 'city in the making.' Participants also suggested that there would be value in running additional, more focused workshops on specific Dimensions or Indicators within the CRI, and that reassessing over time will be particularly useful to understand the impact of forthcoming initiatives such as the Atal Mission for Rejuvenation and Urban Transformation (AMRUT).

## **Quantitative Resilience Profile**

### **Dimensions**

The Quantitative Profile for Shimla (see overleaf) illustrates poor performance across the **Health & wellbeing** Dimension, and moderate or varied results across other Dimensions. **Infrastructure & Environment** performs the best of all areas.

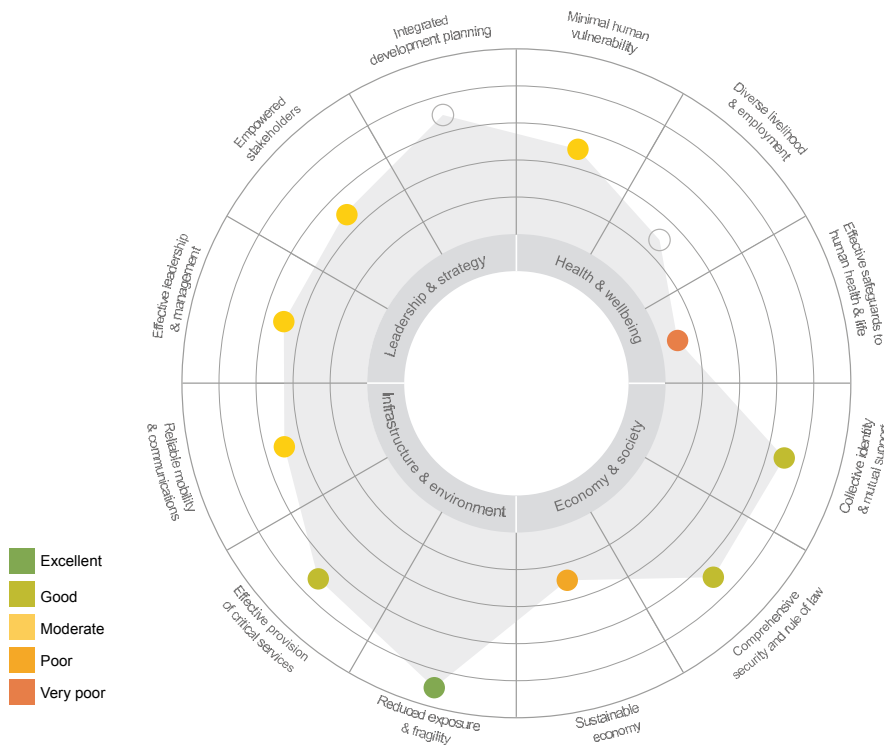
### **Goals**

At a Goal level, results are varied. **Effective Safeguards to Human Health & Life** and **Sustainable Economy** are areas of poor performance. The latter resonates with stakeholder feedback, and reflects poor diversity of livelihoods across the city.

### **Comparison to Qualitative Profile**

The Quantitative Profile for Shimla demonstrates similar overall trends to Qualitative Profiles produced by City Assessors and Workshop Participants, although there are some key areas of variance. In particular, Goals under the **Safeguards to Human Health and Life** is rated much more critically within the Quantitative Profile. The reason for this may be more readily uncovered through comparison at an Indicator level, where questions are focused on emergency services and health. Interviewees and workshop stakeholders emphasised that Shimla has not experienced any major shocks in recent history. As such, positive Qualitative scoring may reflect limited

Figure 21: Shimla Quantitative Resilience Profile



understanding of whether appropriate systems and safeguards are in place for such a shock, or whether those that are will function well when tested. This may be an area for further investigation, as the likelihood (and uncertainty) of future shocks and chronic stresses may increase due to the effects of climate change and rapid urbanisation.

### Key observations

*Is it easy for cities to use CRI?*

- In Shimla, obtaining senior city leadership buy-in was a critical factor in getting the Pilot process off the ground. The City Lead acted as a champion for the Pilot, helped articulate its relevance and importance, and mobilised and motivated stakeholders.
- The Pilot would have benefited from more time invested in a stakeholder mapping exercise before it commenced. The mapping exercise needed to broaden across a variety of government departments, and also state government.
- Support from a Local Partner with extensive knowledge of local politics and good relationships with key city officials was also important, particularly in identifying stakeholders and data across many levels of government.

- City Assessors found the questionnaire format to be complex, and suggested it could be simplified – both in structure and language. Part of the challenge was the need for translation between English and Hindi. Data that required multiple data points to be processed was often seen as difficult and dismissed as ‘not available.’ Some context was also probably lost in translation as junior staff were often assigned to complete the quantitative Metrics. These challenges were navigated with ongoing coaching and support.
- Overall, observations from the Pilot process and government feedback indicate a fully independent CRI assessment would not yet be possible in Shimla. To reassess, government will need support and guidance from a suitable party with good local knowledge and a physical presence throughout the assessment.
- Embedding the concept of resilience at the outset proved to be an important consideration for the Pilot. Though the concept is well understood by many senior government officials, some technical officials did not initially understand its relevance, or understood it solely from the perspective of climate hazards.
- The City Assessors found the process valuable, however there might have been greater learning and benefit if the City Lead and City Assessors played a more active role in organising the Pilot and identifying data sources.

*Does the CRI provide an effective measure of city resilience?*

- Recent changes or disruptions in the city were observed to have a significant influence on Scenario Scores. For example, a municipal solid waste system disruption occurred during the Pilot timeline, and City Assessors used this as rationale for critical scores.
- Although there was not much debate on the scoring due to consensus between Workshop Participants and City Assessor scores, the workshop still helped unpacking resilience issues, encouraging proactive thought and debate around city challenges, and gaining senior stakeholder buy-in for future resilience building activities.
- Quantitative and Qualitative Profiles align in many areas, providing a strong starting point and evidence base for future resilience building activities.
- As Shimla has not historically experienced any major shocks, risk reduction activities to date have been limited. The CRI outcomes provide value as a basis and context for proactive, comprehensive risk-reduction through strategic resilience building.









# Reflections

---

The purpose the CRI Pilot program was to test the Prompt Questions, collect initial Qualitative Scenario Scores and Quantitative Metric Data, and to test the process, outputs and outcomes associated with using the CRI in different contexts. For this purpose, a diverse range of international cities were selected with varying levels of institutional capacity and resources. The Pilot process was developed specifically to address our research questions (refer to Box 2), and was structured around the themes of usability and effectiveness. Our reflections on how each of these questions was addressed are found below.

## Usability: Is it easy for cities to use the CRI?

### Implementation process

*What are the key considerations for an effective and efficient CRI implementation process?*

The CRI has been developed primarily for use by city governments, who are often in the best position to access and gather administrative data, to use findings from the assessment to inform policy and planning decisions, and to track progress in the city over time. There are several criteria that significantly influence this process.

- **Local leadership.** Leadership was important to ensure accountability of City Assessors, to maintain momentum throughout the assessment process, and ensure clear and effective communication pathways. In absence of a City Lead to act as a leader or champion at a senior level, the process stalled.
- **Senior endorsement.** This was the most important factor cited by City Assessors and Facilitators. In Pilots where official senior endorsement was absent or delayed, Pilots ran behind schedule or reached a standstill. Endorsement was most successful when sourced from the upper-most level (mayoral); when put into writing to distribute with CRI materials; and where made public. State or national endorsement may also have helped unlock relevant data and stakeholders at these levels.
- **Well-briefed City Assessors.** All CRI Pilots took care to brief City Assessors and other stakeholders in detail; primarily focusing on instructions for completing Qualitative and Quantitative questionnaires. Feedback indicates that more emphasis should be placed upon clarifying the context for the assessment: its purpose and anticipated outcomes, the concept of resilience, and its value to the city. This information can be distributed in briefing materials, but the best received briefing method was in person, at the City Launch Meeting during Phase 1 (Arusha and Shimla held assessor briefing events, however Concepción and Liverpool did not) and prior to distribution of Questionnaires.

(Image Opposite)

Shimla, India

- **Stakeholder and data source mapping.** The process of mapping stakeholders and data sources was underestimated in terms of complexity and time in all the Pilot Cities. The greatest challenge was in identifying accurate data sources. In addition to not being familiar with the Quantitative Metrics beforehand, the roots of this challenge generally laid in a lack of understanding regarding whether data existed (especially between different sectors or departments), and – where data did exist – who might actually have it. The Pilots highlighted the importance of looking beyond the physical or administrative boundaries of the city, across the public and private sectors, and to data sources within state or national government where relevant.
- **Flexible approach.** A number of modifications to the generic methodology were explored in the different cities, including number and role of Local Partners and duration of tasks. On the whole, flexibility in the approach helped overcome local time, resource, and communication challenges which proved very difficult to predict. Changes in the process were less helpful where they involved omission of activities, or changing the purpose of activities. For example, the re-defining of the City Launch Meeting in Concepción, which did not provide essential briefing to the City Assessors as originally intended.

#### **Consultant-led Assessments**

In the future, it is anticipated that the CRI will provide value to other agencies within cities, government departments (for example, at state or national level), and stakeholders beyond cities. These groups may have an interest in city resilience for a variety of reasons ranging from academic purposes to better understanding the local business environment. Observations from the consultant-led Pilot in Hong Kong demonstrate that in order to achieve high quality assessments, access to data is the most important determinant of success. The city has a rich supply of publicly available data, and where data was not immediately available relationships with relevant stakeholders were able to help identify and facilitate access to alternative sources. This means that in most cases it would be very difficult for an out-of-town consultant to carry out an assessment.

### **Local ownership, learning and buy-in**

*How can the assessment process enhance local ownership, learning and buy-in?*

In contrast to a ranking or benchmarking tool, one of the key objectives of the CRI is to achieve local ownership and creates learning and buy-in for urban resilience.

#### **Local Ownership**

The generic methodology was designed to involve a variety of city stakeholders in different roles, enabling Facilitators to hand over responsibility for future assessments. For example, the role of the City Lead

was essential to the process and was able to be filled by different individuals depending on the local context; such as the Mayor of Concepción or the acting District Commissioner of Arusha. It was a challenge to secure a balance of diverse senior stakeholders attend Workshops, however the extent of positive discussion and feedback which resulted has reinforced their value for future assessments.

One of the most important findings was observed in relation to cities where there was limited data availability, poor clarity regarding the location of data, and/or challenges in gaining access to data once identified. The role of the City Assessors who were tasked to complete Quantitative Questionnaires in these cities was much more onerous. The City Assessors spent a considerable amount of time in meetings to track down data and persuade Data Contacts to release information. While this was partly due to insufficient effort invested in mapping at the beginning of the Pilot, this challenge will inevitably be difficult to mitigate in 'low capacity' cities where publicly available data is limited.

Table 2 (overleaf) provides a summary of the various Participant roles which were identified prior to the Pilots, the expectations associated with each, observations regarding what occurred in practice, and key learnings.

## **Learning**

Feedback from City Assessors and Workshop Participants across all Pilots indicate that the assessment process provided an opportunity for participants to develop their understanding of the concept of resilience. The Qualitative Scenarios were able to measure discrete aspects of city performance which contribute to broader resilience outcomes. Feedback across all Pilot Cities suggests that completing the Questionnaires provided City Assessors with an opportunity to better understand how the performance of city systems, processes, and assets can contribute to urban resilience. City Assessors in some cities found the best case descriptions to be particularly useful to expand their understanding of resilience beyond a specific city sector.

In Arusha and Concepción, Workshop Participant perspectives on the resilience Goals diverged from that of the City Assessors. Rather than attempting to gain consensus or aggregate the results, the different scores were interpreted independently and their disparity discussed in the Workshops. This process unearthed contextual information, for example – where City Assessors rated service provision highly due to quality and city coverage, but Workshop Participants explained how the most vulnerable groups in the city who would most benefit had very poor access or could not afford the service. This reflection also proved useful in prompting Participants to discuss scoring bias, which they were initially reluctant to raise.

Table 2: City team roles in practice

Role	What we planned	What happened	Comments
City Lead	<ul style="list-style-type: none"> <li>Act as the main point of contact for the city.</li> <li>Provide endorsement to facilitate city engagement</li> </ul>	<ul style="list-style-type: none"> <li>Often distracted by other background processes.</li> <li>Essential for commitment of local assessors and 'Data Contacts'.</li> </ul>	<p>The role is essential. It will help to highlight the need for early engagement with participants, and for a formal letters of endorsement and permission for 'Data Contacts'.</p>
City Assessors	<ul style="list-style-type: none"> <li>Representatives from city government and non-government departments who possess (or have access to) knowledge and data relating to city performance</li> <li>Complete Qualitative Scenario Scores, provide and process data to complete the Quantitative Metrics.</li> </ul>	<ul style="list-style-type: none"> <li>Qualitative Scoring progressed well, but in relation to the Quantitative Metrics City Assessors ended up acting more as intermediaries rather than completing the Questionnaires themselves.</li> <li>Provided translation where required; identified and followed up Data Contacts.</li> </ul>	<p>It is important to clarify from outset that City Assessors are responsible for completing Questionnaires under the guidance of the Facilitators and Local Partners. The process of data and stakeholder mapping must be improved in order to achieve appropriate selection of City Assessors from the start of the assessment.</p>
Data Contacts	<p><i>Not applicable. This was anticipated to be a minor role compared to City Assessors.</i></p>	<ul style="list-style-type: none"> <li>Provided data.</li> <li>Provided 'expert opinions'.</li> <li>Generally did not process data.</li> </ul>	<p>Data Contacts need to be identified as early as possible. It is also important to evaluate the likelihood of gathering data from each source, in order to concentrate efforts in the most productive areas and reduce loss of time. This process should be managed by the Facilitator.</p>
Workshop Participants	<ul style="list-style-type: none"> <li>Stakeholders from different functions and sectors of the city who were not part of the assessment process and ideally not directly responsible for city performance.</li> <li>Develop understanding and achieve local buy-in for the concept of urban resilience.</li> <li>Provide informed, diverse perspectives on the assessments.</li> </ul>	<ul style="list-style-type: none"> <li>Sometimes difficult to engage with government participants due to low availability and political commitments (for example, elections).</li> <li>Sometimes difficult to engage with non-government participants due to lack of time and resources in their organisations.</li> <li>Developed understanding and buy-in.</li> <li>Provided informed (if not always diverse) perspectives for the assessments.</li> </ul>	<p>Workshops were valuable for several reasons:</p> <ul style="list-style-type: none"> <li>Concept buy-in</li> <li>Stakeholder engagement</li> <li>Contextualising responses</li> <li>'Ground-truthing' the Scenario Scores</li> </ul> <p>The first three objectives are beneficial for the city, but do not contribute to assessments. The final objective is very valuable to the assessment. In order to achieve an appropriate outcome, City Assessors must represent less than 20% of Workshop Participants, and their backgrounds must be diverse and representative.</p>



## Buy-in

The Pilot process provided cities with an important opportunity to gain external stakeholder buy-in; both in understanding the relevance of resilience, and as an important basis for resilience-building activities. This occurred regardless of whether City Assessors and Workshop Participants reached consensus on resilience priorities. Pilot Participants across all cities provided feedback which emphasised renewed interest and support for the resilience agenda, as a result of both learning from the process and participation in the process.

One of the main themes which emerged from Pilot feedback related to how the assessment process provides an opportunity to overcome silos in communication; data sharing; and to improve cooperation between government departments, between different levels of government, and between public and private sector. Participants experienced the benefits of improved information management practices, and the opportunity to work together towards common city resilience Goals.

## Support and guidance

*What kind of support and guidance will cities most need in implementing future assessments? How might this differ between cities?*

In Liverpool, Arusha, Concepción, and Shimla, observations and feedback confirmed the need for some level of support for future assessments. Reflecting on the challenges faced during the Pilots suggests that support is required even by some high capacity cities. The roles played by different supporting agencies and the appropriate types of support will vary depending on local context and capacity.

## Support Roles

The generic methodology set out two roles to provide support to the cities. These roles were fully independent from each city, and did not have a formal or legal interest in the city's performance. These two roles were differentiated as follows:

- **Facilitator** (in this case, Arup). An organisation which is familiar with the CRI, and which has an international understanding of city resilience and its application.
- **Local Partner.** An organisation with local presence and knowledge.

The Facilitator set out to catalyse and guide the process. In practice, the Local Partners and City Assessors were more dependent on the Facilitator to navigate the challenges and push the process forward, particularly in supporting City Assessors to complete the Quantitative Metrics. There was

also more support in ‘processing’ the data (converting units or deriving answers from multiple data sources) than anticipated.

All Pilots emphasised the importance of local knowledge to navigate local governance and cultural contexts. Local Partners supported the following activities:

- Identification of, and engagement with stakeholders to participate in the Pilot process (all Pilots).
- Identification of, and access to data sources to complete Quantitative Metrics (all Pilots), including data sources that may not otherwise have been accessible by government (Arusha and Concepción).
- Appreciation of local governance context and the best way to navigate official procedures and processes (Shimla and Arusha).

Local Partners were also engaged in order to provide technical support to the Pilots. In Arusha and Shimla, the Local Partners relied heavily on City Assessors to locate data.

The Local Partner role was more demanding than expected. Ultimately these organisations relied heavily on other roles (such as the Facilitator and the City Assessors) to fill gaps in knowledge and to enrich the Pilot process with meetings and capacity building.

### **Independent facilitation**

Although independent facilitation is not always essential to deliver an effective assessment process, our research revealed two particular success factors for Facilitators and Local Partners.

- **Visiting Team’s Advantage.** Feedback indicates that the role of an external facilitator was important in overcoming silos both within, and outside of city governments to obtain Quantitative Data and complete Scenario Scores. These silos ranged from an absence of institutional structures and processes for data sharing, to an inherent distrust or poor relationship between government and private sectors or other parties. In some cases, facilitators were able to bypass or overcome barriers such as cultural expectations, or time-consuming bureaucratic procedures which would have otherwise inhibited or delayed aspects of the assessment.
- **Physical presence.** A message emerged from all cities that the presence of an external agent in the city, located within central government buildings if possible, considerably improved the rate and quality of process for a range of social and political reasons.

Table 3: Facilitator roles in practice

Role	What we planned	What happened	Comments
<p><b>Facilitators</b></p>	<ul style="list-style-type: none"> <li>• <b>Technically</b> familiar with concepts, assessment process, and <b>independent</b> of local politics.</li> <li>• Able to communicate concepts and understanding of assessments to all participants.</li> <li>• Collect data from City Assessors with support from Local Partners.</li> <li>• Review data.</li> <li>• 2 – 3 weeks on location in each city.</li> </ul>	<ul style="list-style-type: none"> <li>• Communicating and capacity building were more onerous processes due to a gap between the assessment requirements and local capabilities.</li> <li>• Provided coaching and capacity building for City Assessors, including support of efforts to find Data Contacts for Quantitative Metrics.</li> <li>• Reviewed and <b>processed</b> data.</li> <li>• 3 weeks in city.</li> </ul>	<p>There was much higher dependence on Arup Facilitators than anticipated (even for high capacity cities). This suggests that a Facilitator role will still be required in the future. Important factors for success in future assessments will include:</p> <ul style="list-style-type: none"> <li>• Spending more time in the cities prior to the onset of the assessment to get the process off to the right start.</li> <li>• Capacity building Local Partners to then capacity build City Assessors, rather than undertaking this with City Assessors directly.</li> <li>• Reviewing and processing data remotely.</li> </ul>
<p><b>Support Team</b></p> <p><b>Local Partners</b></p>	<ul style="list-style-type: none"> <li>• Provide valuable <b>local knowledge</b> and access to <b>city contacts</b>.</li> <li>• Deliver fieldwork activities during times when Facilitator was working remotely.</li> </ul>	<ul style="list-style-type: none"> <li>• Provided local knowledge and access to <b>senior</b> city contacts.</li> <li>• Provided appreciation of <b>local governance context</b>.</li> <li>• Supported Facilitators while in the field; continued to collect data when Facilitators left.</li> <li>• Reviewed and processed data where technically able.</li> </ul>	<p>In order to be more effective, it may help to view the Local Partners as Facilitators who possess up to three important functions that may or may not be found in a single organisation:</p> <ul style="list-style-type: none"> <li>• Able to support stakeholder engagement, provide local knowledge, access to city contacts, and ongoing engagement after the assessment.</li> <li>• Possess good technical capabilities and capacity building skills, allowing to support both Quantitative and Qualitative assessments. Ideally have an existing knowledge of where data can be found.</li> <li>• Good verbal translation skills.</li> <li>• Provide ongoing support in consistency assurance.</li> </ul>

## Types of support

For cities with less institutional capacity and poor data availability, support was critical to completing the Pilot. Cities undertaking the assessment for the first time are more likely to need support regardless of their institutional capacity. Four types of support are important – technical assistance, stakeholder engagement, concept guidance, and consistency assurance (support to maintain rigour and reduce bias). Not all types of support will be required to the same extent in each city; this must be gauged on a case-by-case basis.

- **Technical support.** In Shimla, Arusha and Concepción, ongoing support was provided to understand and interpret Metrics, particularly those which used technical or specialist language. Ongoing technical advice was also provided to facilitate calculation or unit conversion of Qualitative answers from relevant data sets.
- **Stakeholder engagement.** In some cities, stakeholder engagement may be difficult, or biased, if led by government due a range of political, social and cultural factors. External parties may play an important role in facilitating meaningful stakeholder engagement processes and finding appropriate ways to draw these perspectives into assessment findings and recommendations for resilience building activities.
- **Concept guidance.** Many assessors and stakeholders within cities such as Arusha and Shimla were new to the concept of resilience, or understood it purely from a disaster risk reduction perspective. Further, the CRI contains a number of concepts which may not have a consistent meaning locally for cultural or historical reasons, such as ‘access’ and ‘vulnerability.’ Facilitators played a role in ensuring these concepts were understood in accordance with the assessment. Importantly, guidance on the application of resilience requires an experienced, global perspective which is not an expectation of Local Partners.
- **Consistency assurance.** Facilitator guidance was beneficial to City Assessors to provide rationalisation for Scenario Scores, maintain objectivity when assigning Qualitative Scenario Scores, and encourage use of well referenced data sources for Quantitative Metrics. Providing City Assessors with an opportunity to discuss a Qualitative question in detail and develop a defensible rationale for their answer often resulted in a change to initial scoring.



## Effectiveness: Does the CRI provide an effective measure of city resilience?

### Snapshots of resilience

*How well do CRI findings reflect the current state of city resilience?*

Pilot findings demonstrate how the Qualitative Scenarios provide a comprehensive diagnostic tool to illustrate how any given group of Local Assessors perceive and experience city resilience. Performance outcomes at each level of result (Prompt Question, Indicator, and Goal) provide **important context** regarding the interconnected urban systems which may not be visible based upon Quantitative Metrics alone. On the other hand, interpretation of the Scenarios must allow for potential bias in the responses and unresolved divergent opinions.

- The Qualitative Scenarios measure perceptions on city resilience based on an aggregation of 156 different Prompt Questions. **Feedback from Pilot participants confirmed that the synthesised results (12 Goals) accurately reflected their overall perceptions of resilience outcomes in their city.**
- Across all Pilots, **the Scenario results helped Workshop Participants to identify drivers behind resilience outcomes.** For example, stakeholders suggested that the Qualitative Resilience Profile for Arusha demonstrates the negative effect of recent economic and social change on collective identity and mutual support. The value of contextual information provided by Qualitative Resilience Profiles is likely to be even greater when assessments are repeated over time.
- **The CRI Workshops were critical to expose areas of influence of social, political, and cultural factors** which otherwise reduced the reliability of Scenario Scores. For example, in Arusha, City Assessors answering questions regarding security and justice were reluctant (or unable) to assign critical scores of their own department due to severe political pressure, departmental corruption, and fear of reprisal. The Workshop in Arusha discussed this directly and the Workshop scores had a surprisingly positive correlation with the Quantitative Resilience Profile.
- **There was 100% data coverage of the Qualitative Scenario Scores, while coverage of the Quantitative Metrics and Indicators averaged 57% across Pilots<sup>5</sup>.** This level of data availability affects the reliability and confidence of the Quantitative Resilience Profiles. In most cases this affected only one or two Goals<sup>6</sup>, however low confidence was observed across a greater proportion of if data availability was more polarised between Indicators (for example, in Liverpool most data was concentrated across five Indicators and little data was provided for others, meaning that seven Indicators were classified ‘low confidence’).

(5) This figure includes primary Metrics only. Coverage across primary, secondary and alternative Metrics averaged at 70%

(6) The results of data availability are based on the availability and distribution of Preferred Metrics only, but does not discount the Preferred Metrics which were based on Expert Opinion. This has led to Concepción being represented with a lower availability than Shimla and Arusha even though the quality of the data in terms of referenced sources was considerably higher.

- **Quantitative Resilience Profiles across the Pilot Cities displayed consistency with Facilitator observations and Participant feedback about more exceptional (excellent or poor) areas of city performance**, for example, strong social cohesion in Arusha, and poor economic outcomes in Shimla.

#### **Capturing leading and lagging information**

The use of qualitative and quantitative data is well established as a complementary research approach. In application, qualitative indicators often have a leading effect, while quantitative indicators often have a lagging effect. This is because qualitative scores may take into account recent perceived changes in performance, which are yet to translate into outcomes. Conversely, quantitative scoring is based on measured outcomes; changes in performance may take months or even years to translate into real outcomes which are picked up through monitoring and measurement.

As the Pilots only represent one point in time, results can provide limited direct evidence as to whether a lagging effect is occurring across the **Quantitative Data**. In the future as cities reassess, it will likely be possible to monitor trends in Quantitative Data in order to relate changing performance scores to government initiatives and activities. Across the Pilots, significant diversity was observed in terms of data currency (most data was dated between 2011 and 2015). As such, the lagging effect is likely to be unavoidable, and will vary from city to city. For this reason, **Qualitative Scenario Scores** (which are more firmly grounded in the present) can provide important grounding and rationalisation for city performance areas that are undergoing rapid change. For example, much Quantitative Data from Concepción is from the 2011 census, and will not have taken into account significant changes in policy, infrastructure and investment that have taken place in the aftermath of the 2010 Chile earthquake.

With regards to Qualitative Scenario Scores, some small leading trends were observed based on conversations with City Assessors and Workshop Participants. For example, both groups in Liverpool rationalised low Qualitative Scores based upon upcoming government spending cuts. During the Workshop, Facilitators noted the importance of managing this effect by emphasising that the Scenario Scores should be grounded in current performance, to provide a better basis from which to track changes in resilience over time as planned initiatives take effect.

#### **Catalysing resilience thinking**

*How do the CRI outputs help stakeholders to understand and engage with the city's resilience?*

Regardless of their accuracy and currency, the Qualitative and Quantitative Resilience Profiles generated by the CRI can drive resilience thinking in cities.

**Workshop Participants found that the City Resilience Profiles (shown at Goal level) initiated discussion, but Indicator-level results provided more detailed clues about how resilience outcomes are affected by performance in different areas.** The Indicator results were found to be useful in helping

Participants to understand overall patterns in city outcomes across the 12 resilience Goals, however it was generally felt that Indicator-level results provide a more useful measure of the performance of the systems, assets and functions of a city which contribute to resilience. Indicator results were also found to be useful in catalysing discussion around strategies for improvement.

Workshop Participants felt that the City Resilience Profiles tended to mask some important trends due to aggregation of results. For example, a moderate score might mask extremes of very good and very poor performance at an Indicator level, while another moderate score might be generated from average performance across all relevant Indicators.

**The Qualitative Scenarios provided a platform to encourage and facilitate systems-thinking.** Analysis and discussion of Qualitative Scenario Scores provided Workshop Participants with an opportunity to reflect on the different systems, processes and activities – both within and beyond government – which contribute to resilience outcomes. In some places, results emphasised the importance of cross-departmental and private-public partnership as an opportunity to take a more integrated approach to city management and planning, in order to work towards common resilience Goals.

### **Building momentum around resilience**

*How can CRI Profiles enable cities to build resilience?*

One objective of the CRI Profiles is to provide cities with a way to understand and draw out the context for city resilience outcomes, or an understanding of the ‘why’ (the drivers) of resilience issues which cannot be identified through quantitative data alone. This contextual understanding is critical to identifying appropriate actions and strategies to address issues and build resilience.

**In summary, the Profiles supported Participants to build resilience by:**

- Generating contextual information regarding how well the intended outcomes of a particular city system or service are being realised within the city.
- Highlighting the inherent weakness of the proxy Metrics, for example the gap between funding a process or activity, and its performance improvement.
- Identifying the perceived strengths and weaknesses in performance of city systems, functions and assets.
- Stimulating discussion around ways to investigate, understand and address actual and perceived areas of poor performance.

- Exposing diverging perspectives on issues and leveraging the information to prioritise activities.
- Demonstrating benefits of taking an integrated, cohesive approach to resilience building activities.
- Illustrating the importance of working across departments or in partnership with private sectors to achieve resilience outcomes. Feedback from Shimla and Concepción indicates that in these cities, doing so will require an entirely new approach to working.



# Key lessons

---

Pilot assessments undertaken in Arusha, Concepción, Hong Kong, Liverpool, and Shimla provide valuable insight into practical application of the CRI. Through analysis of fieldwork findings, important observations have emerged which relate to how the CRI delivery process can be enhanced to ensure it provides an accessible, highly engaging platform for cities and stakeholders to understand city resilience, to identify and prioritise resilience building activities, and to measure progress over time. Key messages for future implementation of the CRI and use of Profiles are provided below.

## **1. City ownership is vital; cities need support to carry out assessments**

In order to ensure the CRI promotes action through better understanding, cities need to take ownership of the assessment process, understand findings in detail, and plan for change. Although ownership of the CRI assessment should be encouraged, our research indicates that most cities will require some level of support when undertaking an assessment. The level and type of support required will vary depending on a city's institutional structures, capacity and resources. The types of support fall across four main categories – technical assistance, concept guidance, stakeholder engagement and consistency assurance.

## **2. Support has long-term value beyond completing the assessments**

Cities are likely to need support in some form to complete the assessment. We have found that provision of this support has many lasting benefits, including capacity building of City Assessors to better understand resilience and systems thinking. It is also valuable to have an external party that can extract and summarise lessons learned and examples that can contribute to the overall development of the CRI and field-building more generally.

## **3. Qualitative Scenarios are transferable across city contexts; data availability for Quantitative Metrics limits global applicability**

One hundred percent of the Qualitative Scenarios were completed in the Pilot Cities (with the exception of Hong Kong, where Qualitative Scenarios were not completed). When coupled with some form of stakeholder validation exercise (for example, a City Resilience Workshop) this enables any city to develop a holistic profile of the direction of resilience for their city. The Qualitative aspect of the assessment ensures the CRI is useable even where cities have very limited data.

Pilot research has reinforced our understanding of the challenges faced by cities in gathering credible Quantitative Data to measure resilience. A number of strategies can enhance data availability, such as comprehensive data source mapping, senior endorsement, and guidance to derive Metric Data from multiple sources. Nevertheless, limits to data availability observed even across Phase 1 cities (which were assumed to be data-rich) have implications for the global applicability of the Metrics.

#### **4. Limited data availability suggests the benefits of secondary and alternative metrics**

Phase 1 Cities tested only the primary Metrics, while Phase 2 Cities were given the choice of primary, secondary, or alternative Metrics, but asked to prioritise primary Metrics<sup>4</sup>. For the CRI to be applicable in more cities, especially lower capacity cities, an approach that formalises the Quantitative Metrics as a tool for baselining and monitoring could leverage and benefit from the use of secondary and alternative metrics. This approach would imply a higher level of complexity in the CRI tool which will need to be validated using statistical methods. Exploring sets of metrics that are applicable to specific countries is also plausible.

#### **5. Data source & stakeholder mapping is fundamental to launching assessments**

Regardless of the strategy for the Quantitative Metrics, the effectiveness of assessments can be greatly improved by enhancing the process of mapping data sources and stakeholders prior to launching assessments. This task could form a recommended pre-requisite for the actual assessment.

#### **6. Resilience profiles provide a snapshot of a city's resilience at Goal-level; while Indicator-level results unpack performance issues.**

Workshop Participants endorsed the Qualitative resilience profile as an accurate summary of city resilience at Goal-level. This validation was only possible once results were investigated at the Indicator-level. Diagnosis of city performance also takes place at Indicator level and therefore an output visualisation at this level will be critical for the CRI's usability.

Similar findings emerged in relation to the Quantitative Metrics. The Resilience Profile (Goal-level output) provides a summary of the city's past performance, but to get sufficient understanding in order to develop resilience-building plan, the city performance needs to be investigated at Indicator-level. Where cities complete multiple CRI assessments to measure change over time, progress between monitoring points is likely to be too subtle in the short-term to be read at a Goal-level. As a result, it will be important to provide cities with a visual summary of their Quantitative Metrics baseline and progress at the Indicator-level.

(7) The alternative Metrics function not only allowed the cities greater flexibility in completing their assessments but also provided suggestions for changes to the preferred Metrics in future versions.

Collectively, the Pilots have successfully demonstrated the value and effectiveness of the CRI as a measurement of city resilience. The Pilots have also uncovered a range of observations regarding process, content and outputs that can help to inform development of the next version of the CRI. Moving forward, the CRI will be launched as an online platform and for the benefit of cities, agencies, and stakeholders around the world.



City Resilience Index

# Appendix A

## Pilot

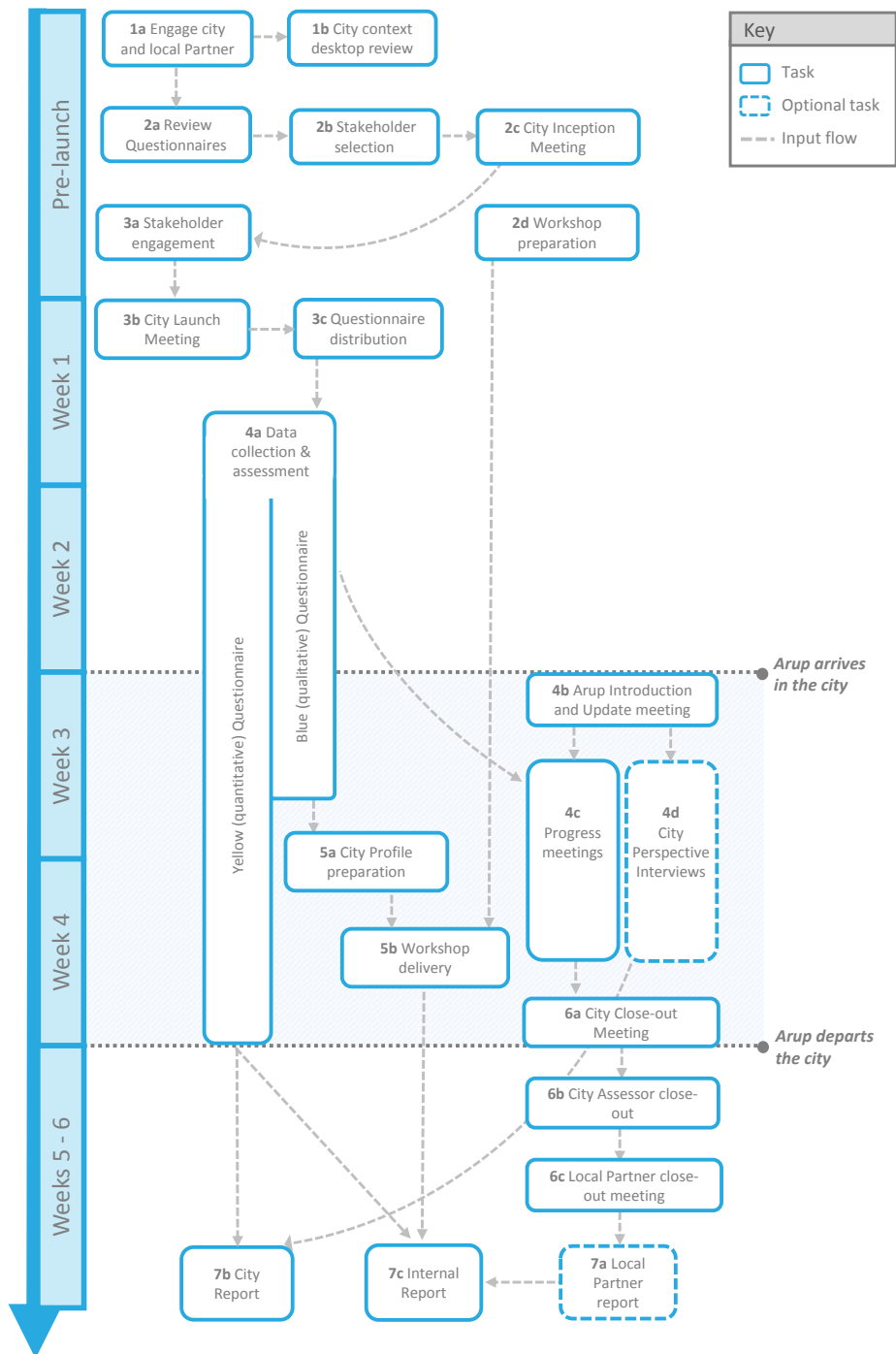
### methodology



# A1. Generic methodology

A detailed overview of the generic methodology and timeline which provided a basis for CRI Pilot assessment in each city is provided below.

Figure 22: Overview of the generic methodology

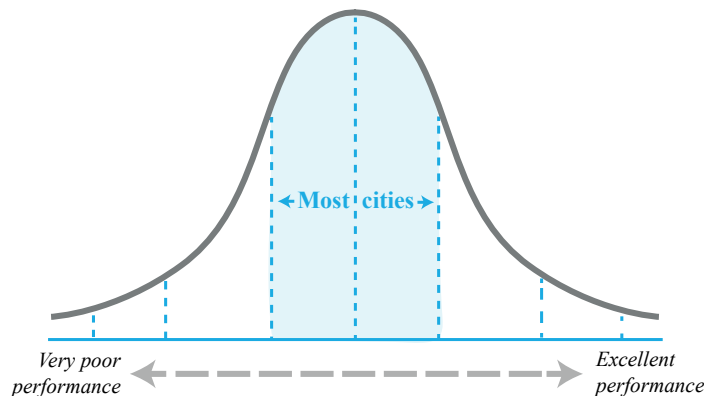


## A2. Approach to standardising Quantitative Data

Unlike the Qualitative Scenario assessments which are based on a linear scale (1 – 5), Quantitative Metrics are answered with 156 different data points of varying unit and content, which cannot be directly aggregated into ‘scores’. In order to aggregate and compare Metric profiles, and to allow cities to understand how they are performing within each Indicator and Goal, an approach was developed to present Metric Data on a standard (normalised) scale with a performance range (from poor to excellent).

In order to create a normalised scale demonstrating set performance intervals for every CRI Metric, a range of international best practice data sources were reviewed, and relevant specialists consulted<sup>8</sup>. Based on findings a series of 10 performance ‘thresholds’ were determined for each of the 156 Metrics, which identify a range of scores from ‘worst case’ to best case’ on a linear scale using the appropriate unit. Individual Metric Data is then normalised in order to generate a score from 1 to 5.

Figure 23: Example of a normalised scoring scale



(8) As agreed performance thresholds for good and poor performance are not internationally agreed or available for all of the 156 CRI Metrics, it is anticipated that the assumptions which form the basis for standardisation of each Metric may change over time. In particular, the assumed thresholds may be reviewed and improved as the CRI is implemented in an increasing range of cities, and more city performance data becomes available.



City Resilience Index

# Appendix B

---

## Pilot timelines

---

## B1. Pilot timelines

Timelines relating to Pilot Stage 1 (city selection and engagement) and Stage 2 (assessment) are provided below for each city.

### Hong Kong

TASK	WEEK BEGINNING					
	29-Jun	06-Jul	13-Jul	20-Jul	27-Jul	03-Aug
1a	Engage city and local partner(s)					
1b	City context desktop review					
2a	Review questionnaires					
2b	Stakeholder selection					
2c	City inception meeting					
2d	Workshop preparation					
3a	Stakeholder engagement					
3b	City launch meeting					
3c	Questionnaire distribution					
4a	Data collection and assessment - qualitative					
	Data collection and assessment - quantitative					
4b	Introduction/ update meeting					
4c	Progress meetings					
4d	City perspectives interviews					
5a	City profile preparation					
5b	Workshop delivery					
6a	City close-out meeting					
6b	City assessor close-out					
6c	Local partner close-out meeting					

**KEY**


 Task delivery

### Liverpool

TASK	2015 WEEK BEGINNING																
	29-Jun	06-Jul	13-Jul	20-Jul	27-Jul	03-Aug	10-Aug	17-Aug	24-Aug	31-Aug	07-Sep	14-Sep	21-Sep	28-Sep	05-Oct	12-Oct	19-Oct
1a	Engage city and local partner(s)																
1b	City context desktop review																
2a	Review questionnaires																
2b	Stakeholder selection																
2c	City inception meeting																
2d	Workshop preparation																
3a	Stakeholder engagement																
3b	City launch meeting																
3c	Questionnaire distribution																
4a	Data collection and assessment - qualitative																
	Data collection and assessment - quantitative																
4b	Introduction/ update meeting (Arup, Partner, City)																
4c	Progress meetings (with Assessors)																
4d	City perspectives interviews																
5a	City profile preparation																
5b	Workshop delivery																
6a	City close-out meeting																
6b	City assessor close-out																
6c	Local partner close-out meeting																
7a	Local partner report																

**KEY**

 Task delivery

 Arup fieldwork period



## Arusha

TASK		WEEK BEGINNING								
		03-Aug	10-Aug	17-Aug	24-Aug	31-Aug	07-Sep	14-Sep	21-Sep	
1a	Engage city and local partner(s)									
1b	City context desktop review									
2a	Review questionnaires									
2b	Stakeholder selection									
2c	City inception meeting									
2d	Workshop preparation									
3a	Stakeholder engagement									
3b	City launch meeting									
3c	Questionnaire distribution									
4a	Data collection and assessment - qualitative									
	Data collection and assessment - quantitative									
4b	Introduction/ update meeting									
4c	Progress meetings									
4d	City perspectives interviews									
5a	City profile preparation									
5b	Workshop delivery									
6a	City close-out meeting									
6b	City assessor close-out									
6c	Local partner close-out meeting									

**KEY**

 Task delivery

 Arup fieldwork period

## Concepción

TASK		WEEK BEGINNING											
		10-Aug	17-Aug	24-Aug	31-Aug	07-Sep	14-Sep	21-Sep	28-Sep	05-Oct	12-Oct	19-Oct	26-Oct
1a	Engage city and local partner(s)												
1b	City context desktop review												
2a	Review questionnaires												
2b	Stakeholder selection												
2c	City inception meeting												
2d	Workshop preparation												
3a	Stakeholder engagement												
3b	City launch meeting												
3c	Questionnaire distribution												
4a	Data collection and assessment - qualitative												
	Data collection and assessment - quantitative												
4b	Introduction/ update meeting												
4c	Progress meetings												
4d	City perspectives interviews												
5a	City profile preparation												
5b	Workshop delivery												
6a	City close-out meeting												
6b	City assessor close-out												
6c	Local partner close-out meeting												

**KEY**

 Task delivery


 Arup fieldwork period

## Shimla

TASK		WEEK BEGINNING													
		24-Aug	31-Aug	07-Sep	14-Sep	21-Sep	28-Sep	05-Oct	12-Oct	19-Oct	26-Oct	02-Nov	09-Nov	16-Nov	
1a	Engage city and local partner(s)														
1b	City context desktop review														
2a	Review questionnaires														
2b	Stakeholder selection														
2c	City inception meeting														
2d	Workshop preparation														
3a	Stakeholder engagement														
3b	City launch meeting														
3c	Questionnaire distribution														
4a	Data collection and assessment - qualitative														
	Data collection and assessment - quantitative														
4b	Introduction/ update meeting														
4c	Progress meetings														
4d	City perspectives interviews														
5a	City profile preparation														
5b	Workshop delivery														
6a	City close-out meeting														
6b	City assessor close-out														
6c	Local partner close-out meeting														

**KEY**

 Task delivery

 Arup fieldwork period





City Resilience Index

# Appendix C

---

## Pilot outputs

---



# C1. Quantitative Data quality

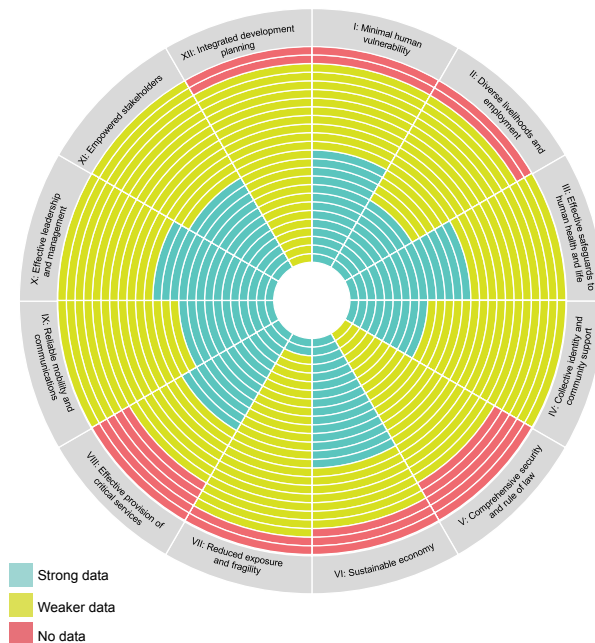
Quantitative Data quality varied significantly across each Pilot City. An analysis of data quality for each Pilot City is provided below.

## Liverpool



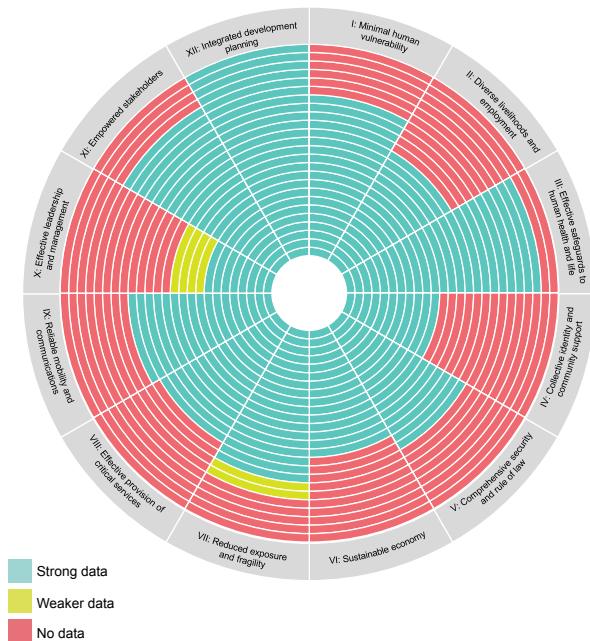
The quality of Quantitative Data gathered in Liverpool is very high. Due to restrictions on data quality relating to Phase 1 Cities, all data is from city-specific, well referenced sources.

## Arusha



Quantitative Data quality in Arusha is low. While a large proportion of Indicators were completed, over half of these (54%) were completed based on estimates provided by relevant government or external experts. Indicators where data quality was particularly poor include **reduced exposure and fragility**, and **integrated development planning**. Stronger areas include **minimal human vulnerability**, **effective safeguards to human health and life**, **sustainable economy**, and **effective provision of critical services**.

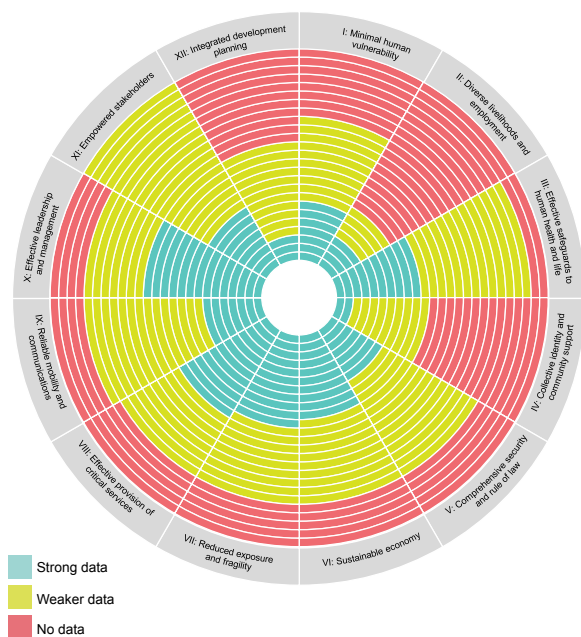
## Concepción



Data quality in Concepción is very strong in comparison to other cities, and represents the strongest quality profile of the CRI Pilots. Almost all data comes from formal sources, as opposed to being sourced from expert estimates or derived from multiple sources.

Some level of strong measured Quantitative Data is available across every Indicator, however particularly strong areas include **integrated development planning, effective safeguards to human health and life, and empowered stakeholders**

## Shimla



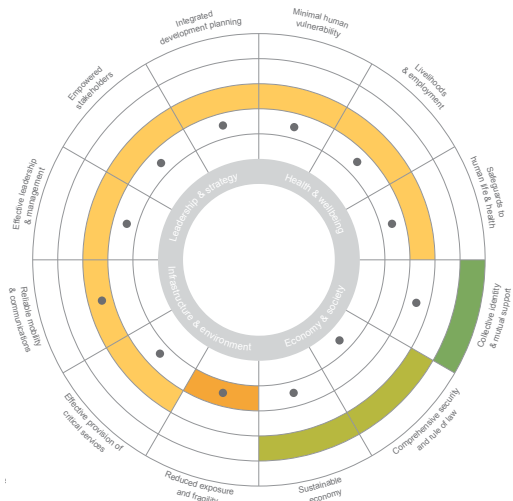
While overall data availability in Shimla is relatively high, much data was obtained from 'weaker' sources. In Shimla 32% of data obtained was based on expert estimates, largely due to a lack of formal record keeping and data collection within government departments. A further 23% was derived from data sources which are not considered to be fully compatible, mainly because calculations were undertaken with census population figures which were not up-to-date (2011).

## C2. Overview of Qualitative Resilience Profiles

### Liverpool



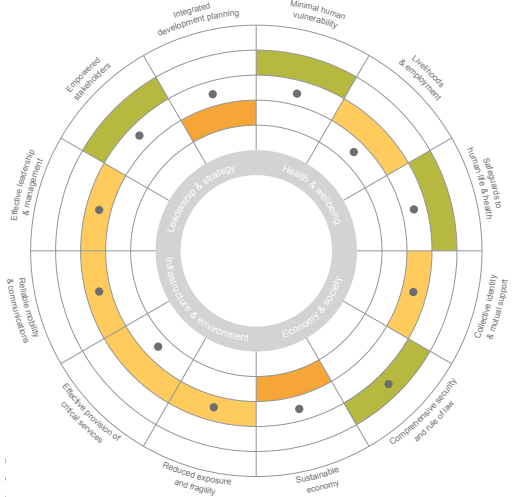
### Arusha



### Concepción



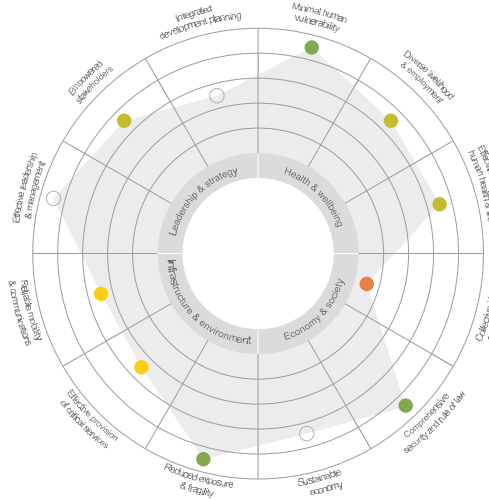
### Shimla



- Excellent outcomes ■
- Good outcomes ■
- Moderate outcomes ■
- Poor outcomes ■
- Very poor outcomes ■

# C3. Overview of Quantitative Resilience Profiles

## Hong Kong



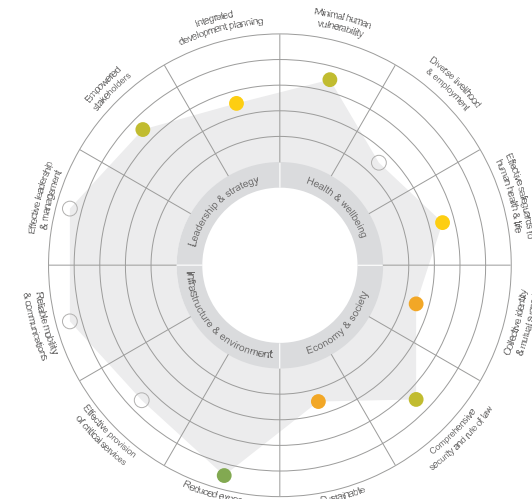
## Liverpool



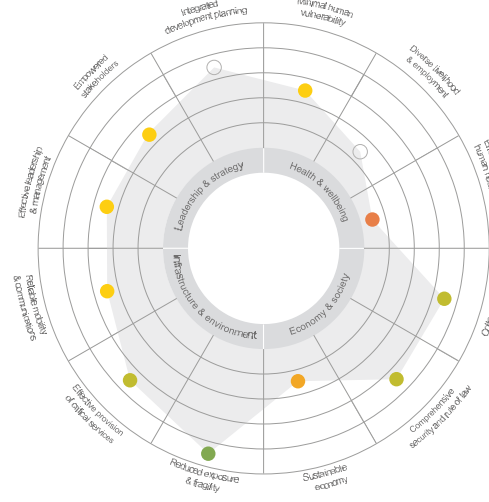
## Arusha



## Concepción



## Shimla







City Resilience Index

# Appendix D

---

## Indicator results

---



# Indicator results: Hong Kong

## Quantitative results

### Health and wellbeing

Minimum human vulnerability	
1.1 Safe and accessible 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	

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	

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	

### Infrastructure and environment

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	

Effective provision of critical services	
8.1 Effective stewardship of ecosystems	
8.2 Flexible infrastructure	
8.3 Retained spare capacity	
8.4 Diligent maintenance and continuity	
8.5 Adequate continuity for critical assets and services	

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	

### Economy and society

Collective identity and mutual support	
4.1 Local Community Support	
4.2 Cohesive communities	
4.3 Strong city-wide identity and culture	
4.4 Actively engaged citizens	

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	

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	

### Leadership and strategy

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	

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	

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	

# Indicator results: Liverpool

## Qualitative results

### Health and wellbeing

Minimum human vulnerability	
1.1 Safe and accessible 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	

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	

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	

### Infrastructure and environment

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	

Effective provision of critical services	
8.1 Effective stewardship of ecosystems	
8.2 Flexible infrastructure	
8.3. Retained spare capacity	
8.4 Diligent maintenance and continuity	
8.5 Adequate continuity for critical assets and services	

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	

### Economy and society

Collective identity and mutual support	
4.1 Local Community Support	
4.2 Cohesive communities	
4.3 Strong city-wide identity and culture	
4.4 Actively engaged citizens	

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	

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	

### Leadership and strategy















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	

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	














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	

## Quantitative results

### Health and wellbeing

Minimum human vulnerability	
1.1 Safe and accessible 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	
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	
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	

### Infrastructure and environment

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	
Effective provision of critical services	
8.1 Effective stewardship of ecosystems	
8.2 Flexible infrastructure	
8.3 Retained spare capacity	
8.4 Diligent maintenance and continuity	
8.5 Adequate continuity for critical assets and services	
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	

### Economy and society

Collective identity and mutual support	
4.1 Local Community Support	
4.2 Cohesive communities	
4.3 Strong city-wide identity and culture	
4.4 Actively engaged citizens	
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	
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	
Leadership and strategy	
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	
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	
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	



# Indicator results: Arusha

## Qualitative results

### Health and wellbeing

Minimum human vulnerability	
1.1 Safe and accessible 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	

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	

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	

### Infrastructure and environment

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	

Effective provision of critical services	
8.1 Effective stewardship of ecosystems	
8.2 Flexible infrastructure	
8.3 Retained spare capacity	
8.4 Diligent maintenance and continuity	
8.5 Adequate continuity for critical assets and services	

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	

### Economy and society

Collective identity and mutual support	
4.1 Local Community Support	
4.2 Cohesive communities	
4.3 Strong city-wide identity and culture	
4.4 Actively engaged citizens	

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	

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	

### Leadership and strategy

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	

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	

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	

## Quantitative results

### Health and wellbeing

Minimum human vulnerability	
1.1 Safe and accessible 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	

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	

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	

### Infrastructure and environment

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	

Effective provision of critical services	
8.1 Effective stewardship of ecosystems	
8.2 Flexible infrastructure	
8.3 Retained spare capacity	
8.4 Diligent maintenance and continuity	
8.5 Adequate continuity for critical assets and services	

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	

### Economy and society

Collective identity and mutual support	
4.1 Local Community Support	
4.2 Cohesive communities	
4.3 Strong city-wide identity and culture	
4.4 Actively engaged citizens	

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	

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	

### Leadership and strategy

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	

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	

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	

# Indicator results: Concepción

## Qualitative results

### Health and wellbeing

Minimum human vulnerability	
1.1 Safe and accessible 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	

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	

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	

### Infrastructure and environment

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	

Effective provision of critical services	
8.1 Effective stewardship of ecosystems	
8.2 Flexible infrastructure	
8.3 Retained spare capacity	
8.4 Diligent maintenance and continuity	
8.5 Adequate continuity for critical assets and services	

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	

### Economy and society

Collective identity and mutual support	
4.1 Local Community Support	
4.2 Cohesive communities	
4.3 Strong city-wide identity and culture	
4.4 Actively engaged citizens	

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	

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	

### Leadership and strategy

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	

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	

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	

## Quantitative results

### Health and wellbeing

Minimum human vulnerability	
1.1 Safe and accessible 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	

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	

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	

### Infrastructure and environment

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	

Effective provision of critical services	
8.1 Effective stewardship of ecosystems	
8.2 Flexible infrastructure	
8.3 Retained spare capacity	
8.4 Diligent maintenance and continuity	
8.5 Adequate continuity for critical assets and services	

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	

### Economy and society

Collective identity and mutual support	
4.1 Local Community Support	
4.2 Cohesive communities	
4.3 Strong city-wide identity and culture	
4.4 Actively engaged citizens	

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	

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	

### Leadership and strategy

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	

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	

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	

# Indicator results: Shimla

## Qualitative results

### Minimum human vulnerability

1.1 Safe and accessible 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	

### 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	

### 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	

### Collective identity and mutual support

4.1 Local Community Support	
4.2 Cohesive communities	
4.3 Strong city-wide identity and culture	
4.4 Actively engaged citizens	

### 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	

### 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	

## Infrastructure and environment

### 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	

### Effective provision of critical services

8.1 Effective stewardship of ecosystems	
8.2 Flexible infrastructure	
8.3 Retained spare capacity	
8.4 Diligent maintenance and continuity	
8.5 Adequate continuity for critical assets and services	

### 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	

## Leadership and strategy

### 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	

### 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	

### 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	

## Quantitative results

### Health and wellbeing

#### Minimum human vulnerability

1.1 Safe and accessible 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	

#### 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	

#### 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	

### Infrastructure and environment

#### 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	

#### Effective provision of critical services

8.1 Effective stewardship of ecosystems	
8.2 Flexible infrastructure	
8.3 Retained spare capacity	
8.4 Diligent maintenance and continuity	
8.5 Adequate continuity for critical assets and services	

#### 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	

### Economy and society

#### Collective identity and mutual support

4.1 Local Community Support	
4.2 Cohesive communities	
4.3 Strong city-wide identity and culture	
4.4 Actively engaged citizens	

#### 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	

#### 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	

### Leadership and strategy

#### 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	

#### 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	

#### 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	







**Arup**

13 Fitzroy Street  
London W1T 4BQ  
United Kingdom

**Jo da Silva**

Director

email: Jo.da-Silva@arup.com  
tel: +44 20 7755 2010

**Braulio Eduardo Morera**

Associate

email: Braulio.Morera@arup.com  
tel: +44 20 7755 4820

[www.arup.com/crj](http://www.arup.com/crj)



**ARUP**