

Measuring and Managing Urban Disaster Resilience

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Photo: John Claude White

1883/84



Photo: Marcus Nüsser

11. Oct. 2011

What is at stake?

- *Unprecedented losses*
- *Compounding effect on the poor and vulnerable*
- *Threat to development and social progress*



Tehran

120,000 to 380,000
projected death toll



Istanbul

40,000 fatalities
200,000 injured

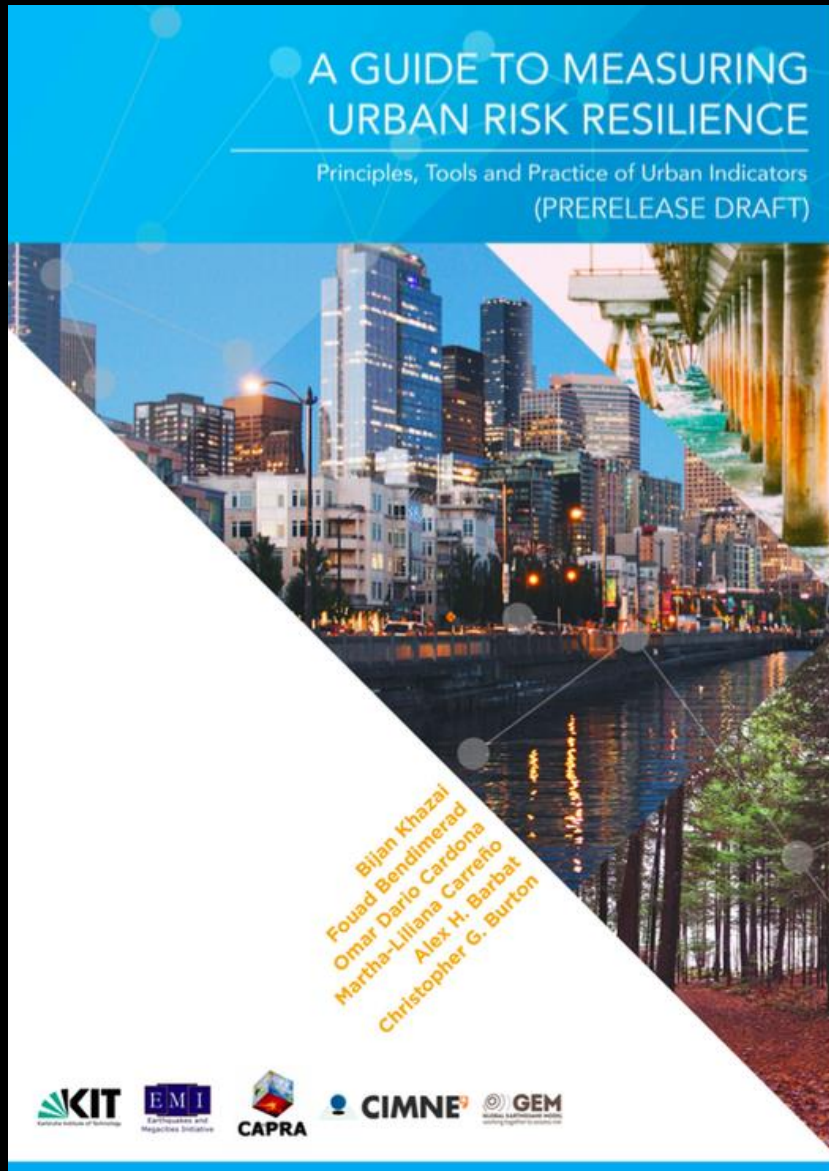


Kathmandu

22,000 – 40,000 death toll
60% heavily damaged bldgs

What gets measured gets managed! What gets monitored gets done!





- Manizales
- Bogota
- Istanbul
- Amman
- Mumbai
- Metro Manila
- Pasig
- Quezon City
- Dhaka
- Lalitpur
- Addis Ababa
- Algiers (new)
- Dar es Salam (new)

Measuring Risk and Resilience: Indicators

Indicators

Quantitative variables intended to represent a characteristic of a system of interest

Indices




Multiple indicators combined to construct composite indicators, or indices

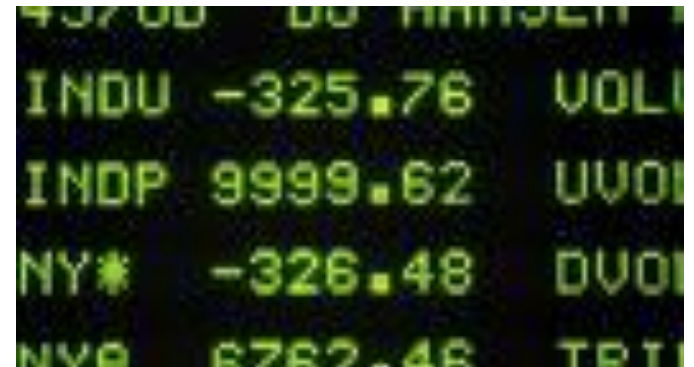
Uses

Inform decision making, build consensus, improve stakeholder participation, explore underlying processes, advocacy, measure progress over time
Simplify complexity to a single metric



FIFA/Coca-Cola World Ranking

| Rank | Team | Total Points |
|------|---|----------------|
| 1 |  Germany | 1558 (1558.49) |
| 2 |  Brazil | 1431 (1430.57) |
| 3 |  Belgium | 1298 (1298.32) |
| 4 |  Portugal | 1274 (1273.69) |
| 5 |  Argentina | 1241 (1241.45) |

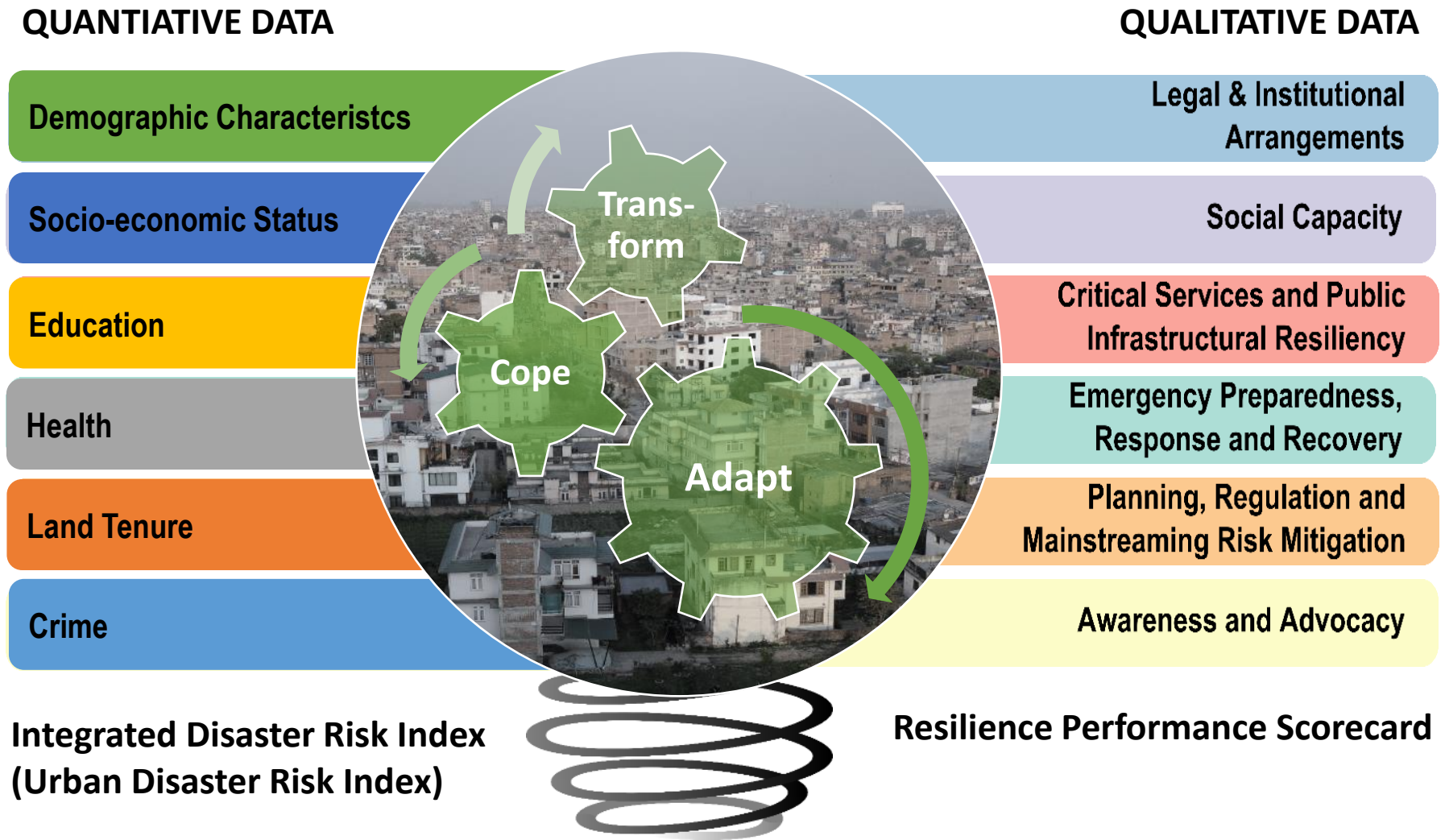


The City System ...



... and its Resilience Dimensions

Resilience: ability of an urban systems to adapt to, cope with and transform in view of potential adverse impacts.



An aerial photograph of a city street intersection, likely in Japan, showing various buildings, roads, and a crosswalk. A large, semi-transparent green circle is centered over the image, containing the text 'Integrated Disaster Risk Index'.

Integrated Disaster Risk Index

Quantitative

Integrated Seismic Risk

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graph TD; A[Integrated Seismic Risk] --- B[Physical Seismic Risk]; A --- C[Socio-Economic Vulnerability and Resilience]; B --- D[Seismic Hazard]; B --- E[Exposure]; B --- F[Physical Vulnerability]; C --- D; C --- E; C --- F;
```

Physical Seismic Risk

Probability of damage and loss to people and structures due to earthquakes

Socio-Economic Vulnerability and Resilience

Vulnerability of society and economy and their capacity to cope with earthquake events

Seismic Hazard

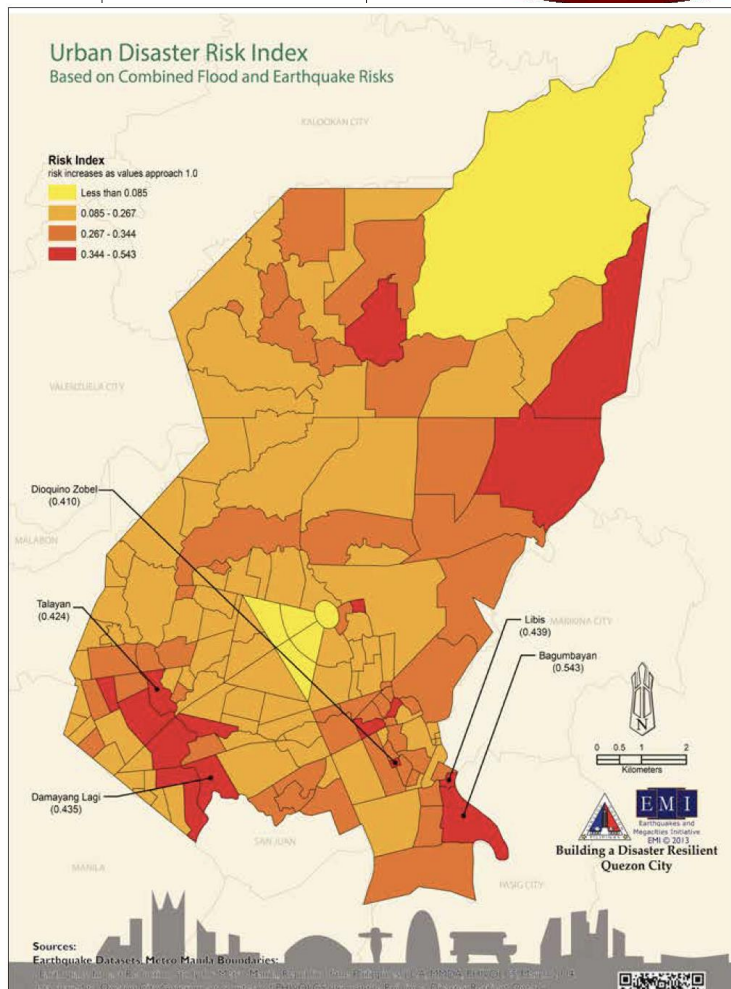
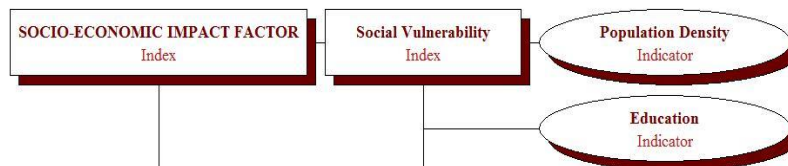
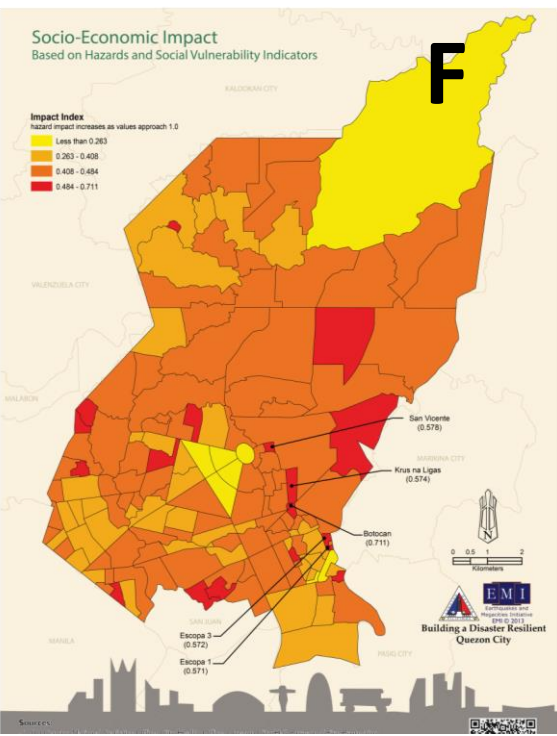
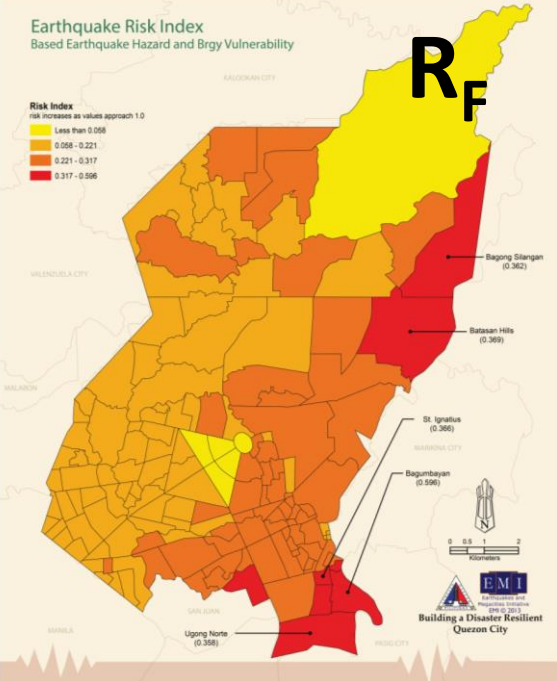
Probability of ground shaking due to earthquakes

Exposure

Elements at risk

Physical Vulnerability

Vulnerability of structures and their occupants to seismic hazard



Disabled
Indicator

Urban Poor
Indicator

Elderly
Indicator

Children
Indicator

Hospital Beds
Indicator

Hospital Distance
Indicator

Malls and Markets (eq)
Indicator

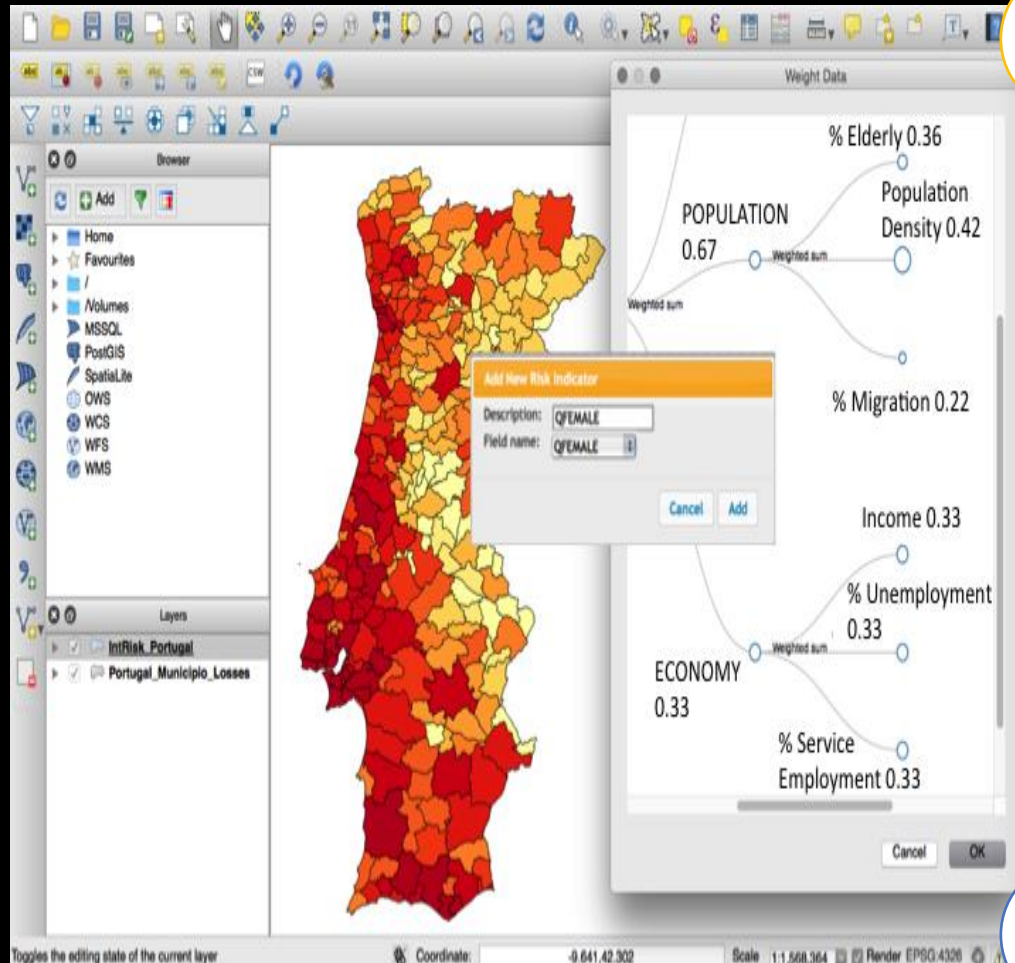
Strong (eq)
Indicator

Affected Roads (eq)
Indicator

Roads and Bridges (eq)
Index

$$UDRI = \sum_{i=1}^n R_{Fi} \times (1 + F_i)$$

Integrated Risk Modelling in OpenQuake



Selection of Indicators

Normalization

Multi-variate Analysis

Weighting/Aggregation

Link to Physical Risk

Visualization

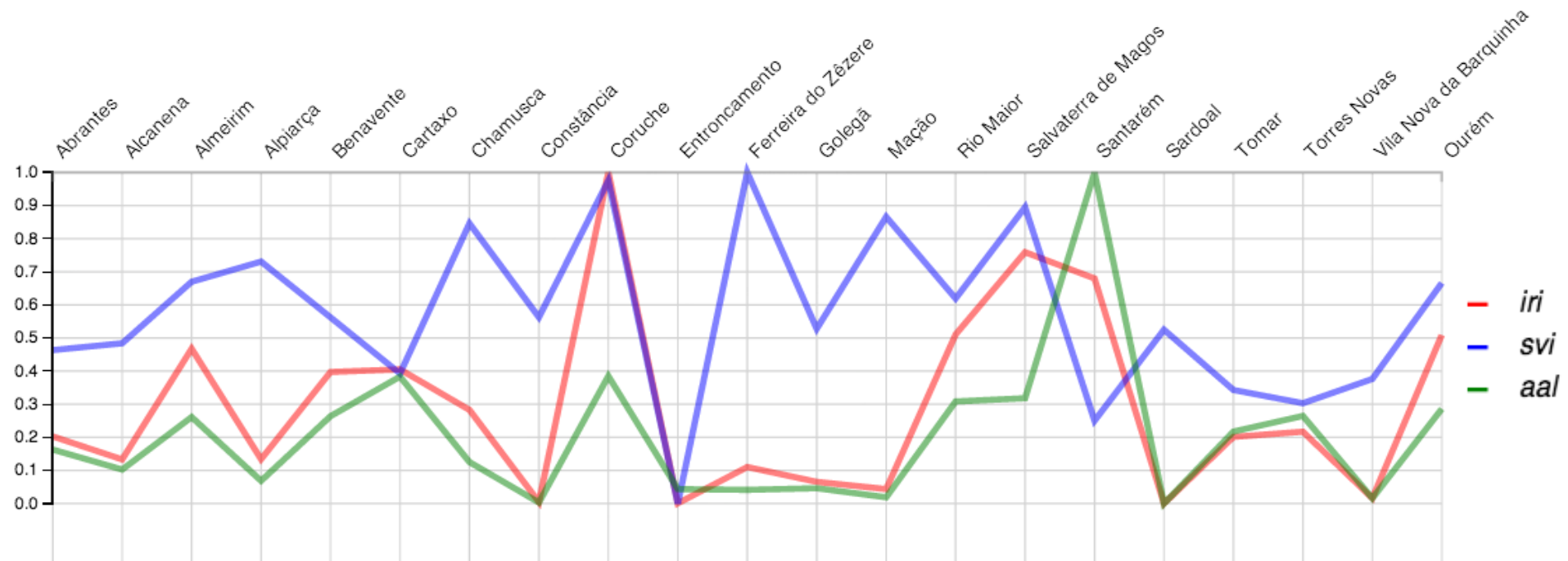


MapQuest Openstreet

Load Project



Project Def IRI Chart Category Chart Primary Chart



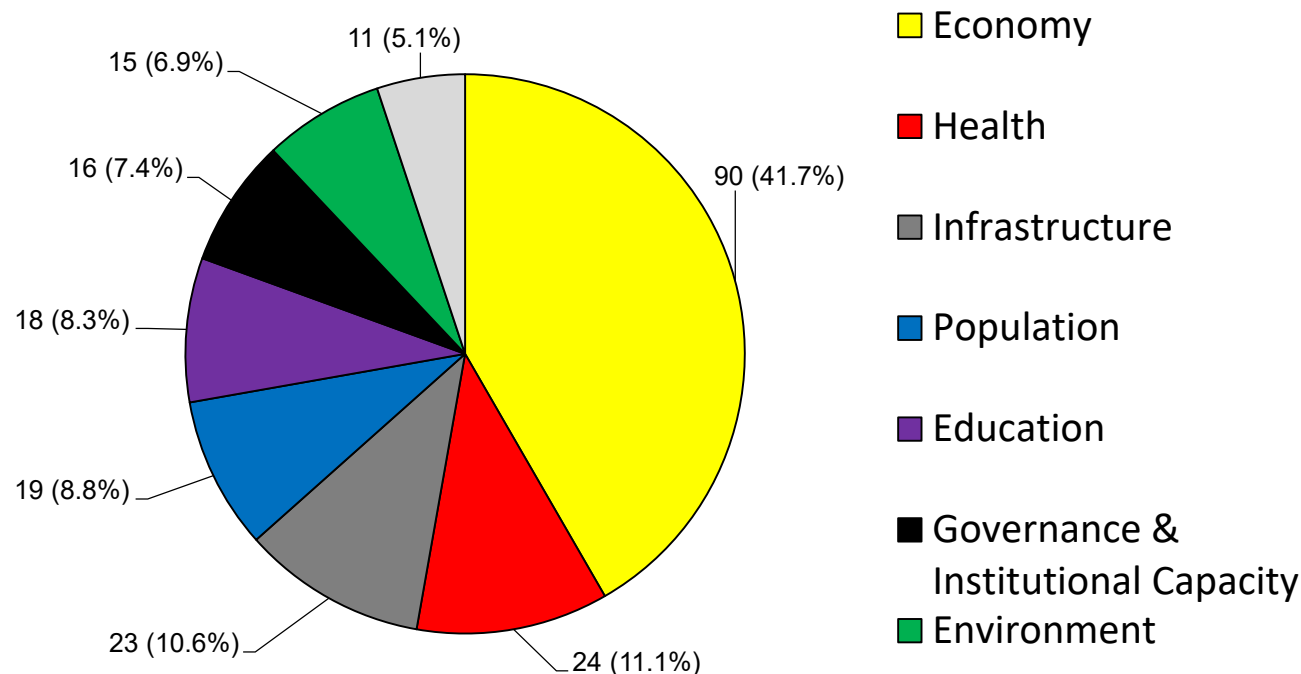
Global Socio-economic Vulnerability Database

■ **317**

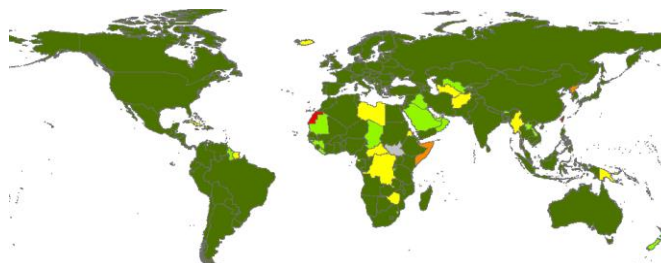
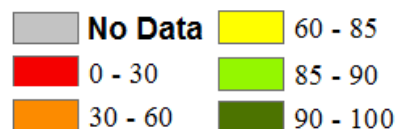
socio-economic
vulnerability
indicators

■ **44**

publically
available
sources



Data Completeness
by Country (%)

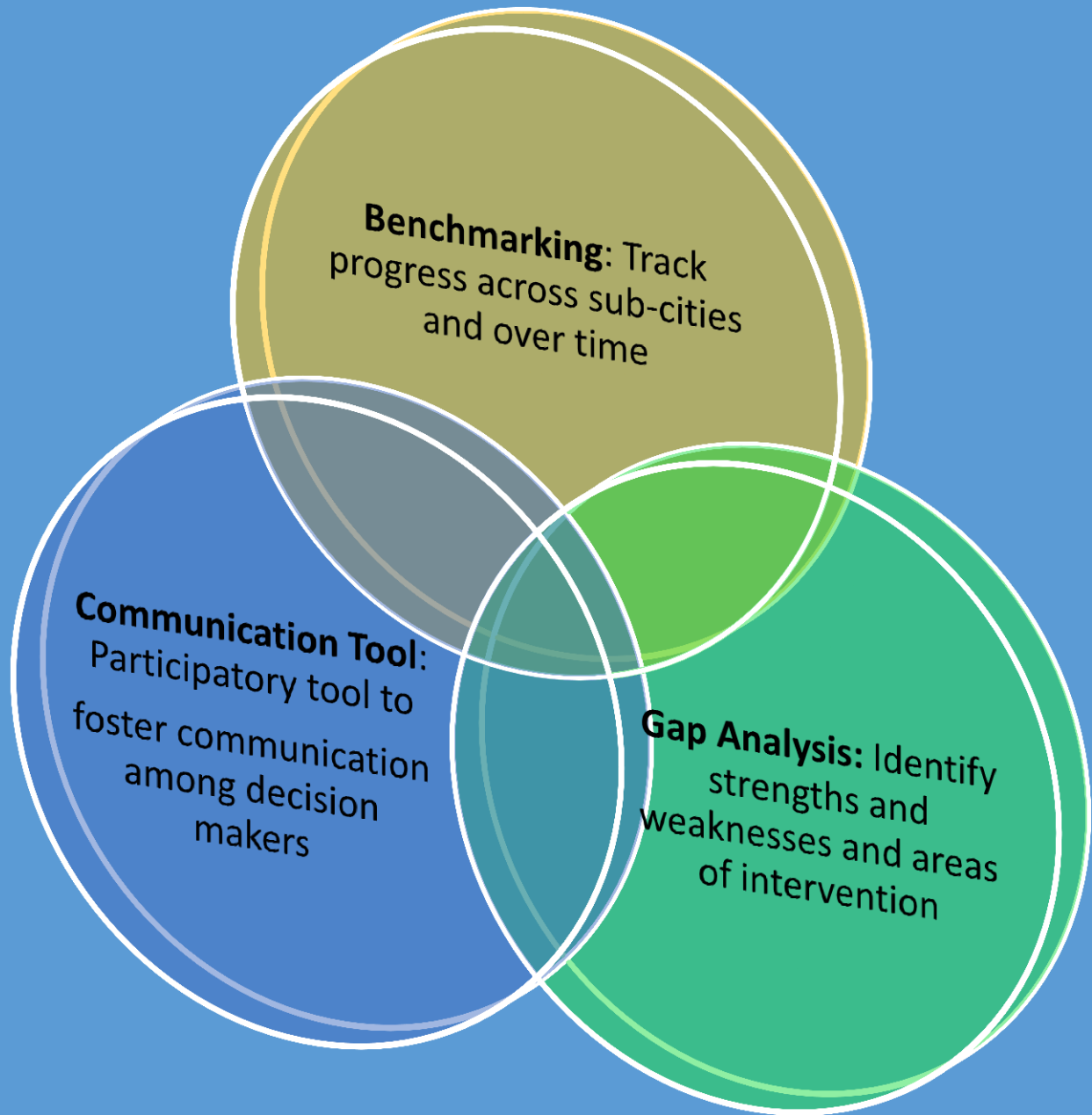
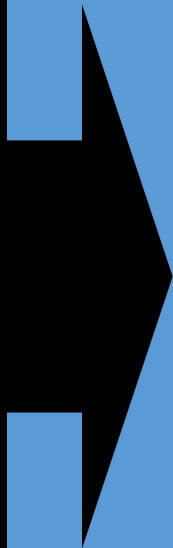


An aerial photograph of a city, likely Manila, showing a dense urban landscape with numerous buildings, including a prominent white domed structure in the lower right. A large, semi-transparent blue circle is centered over the image, containing the title text.

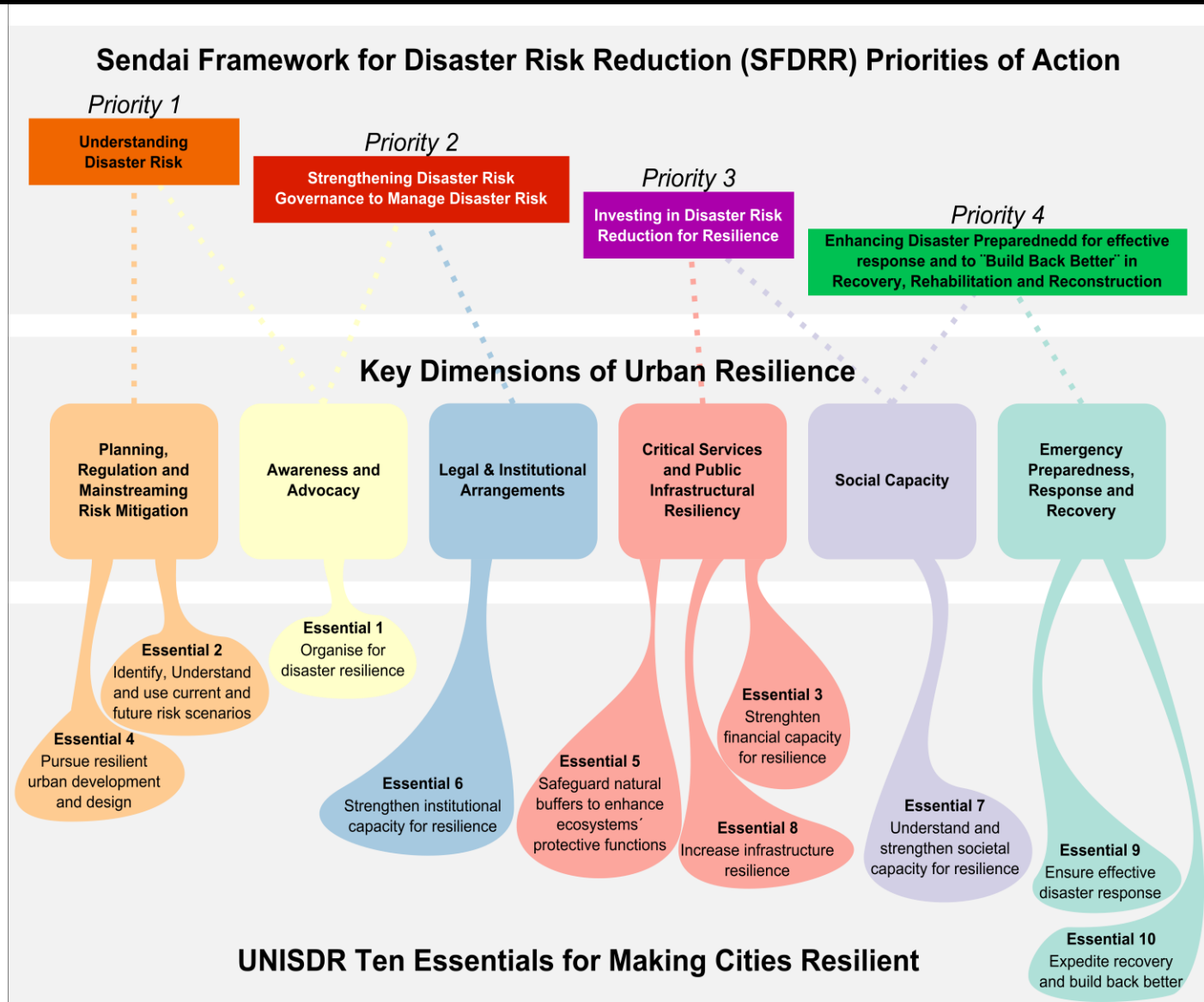
Resilience Performance Scorecard

Qualitative

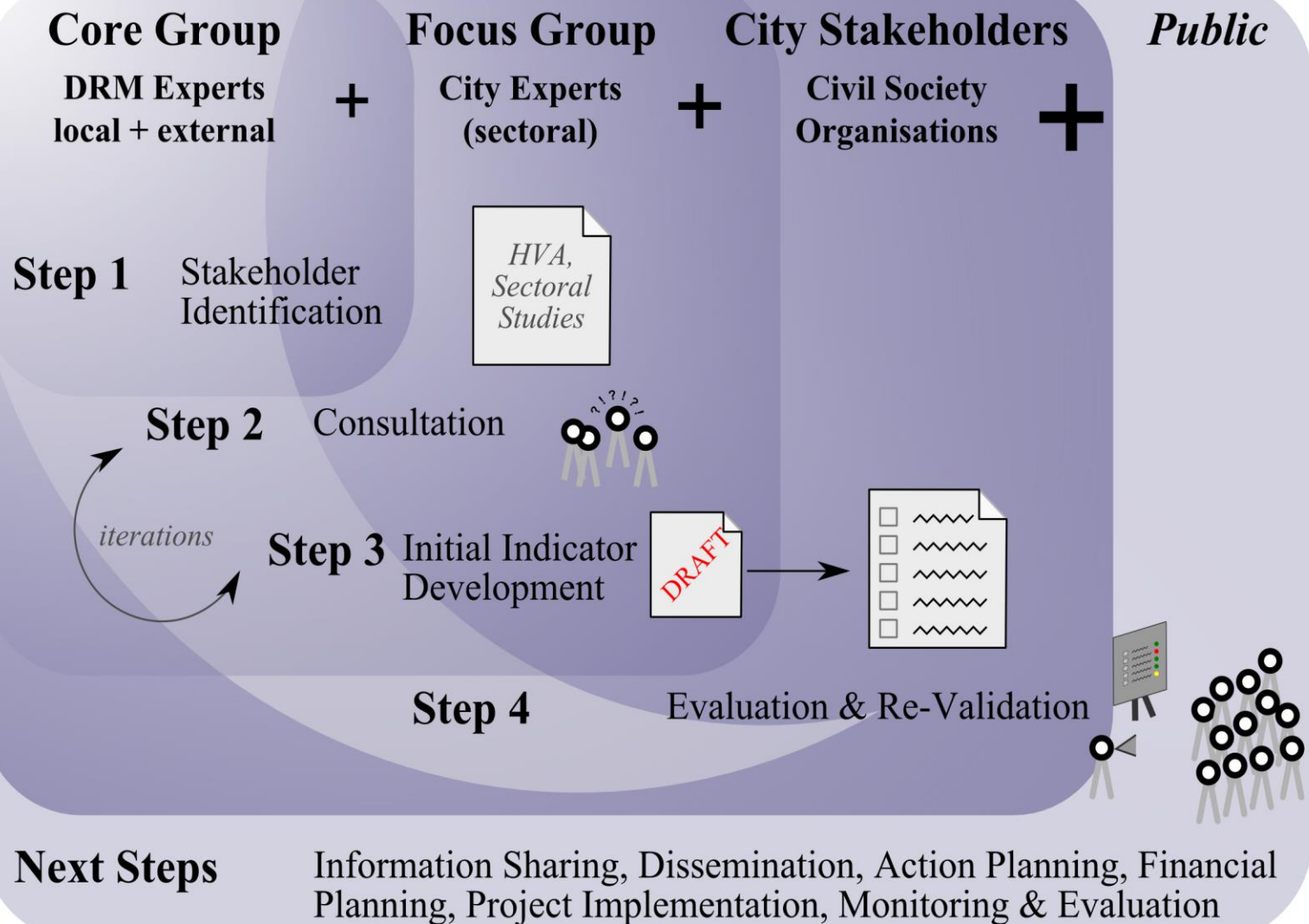
3 Key Aims of Resilience Performance Scorecard



Dimensions of the Resilience Performance Scorecard



Participatory Development Approach



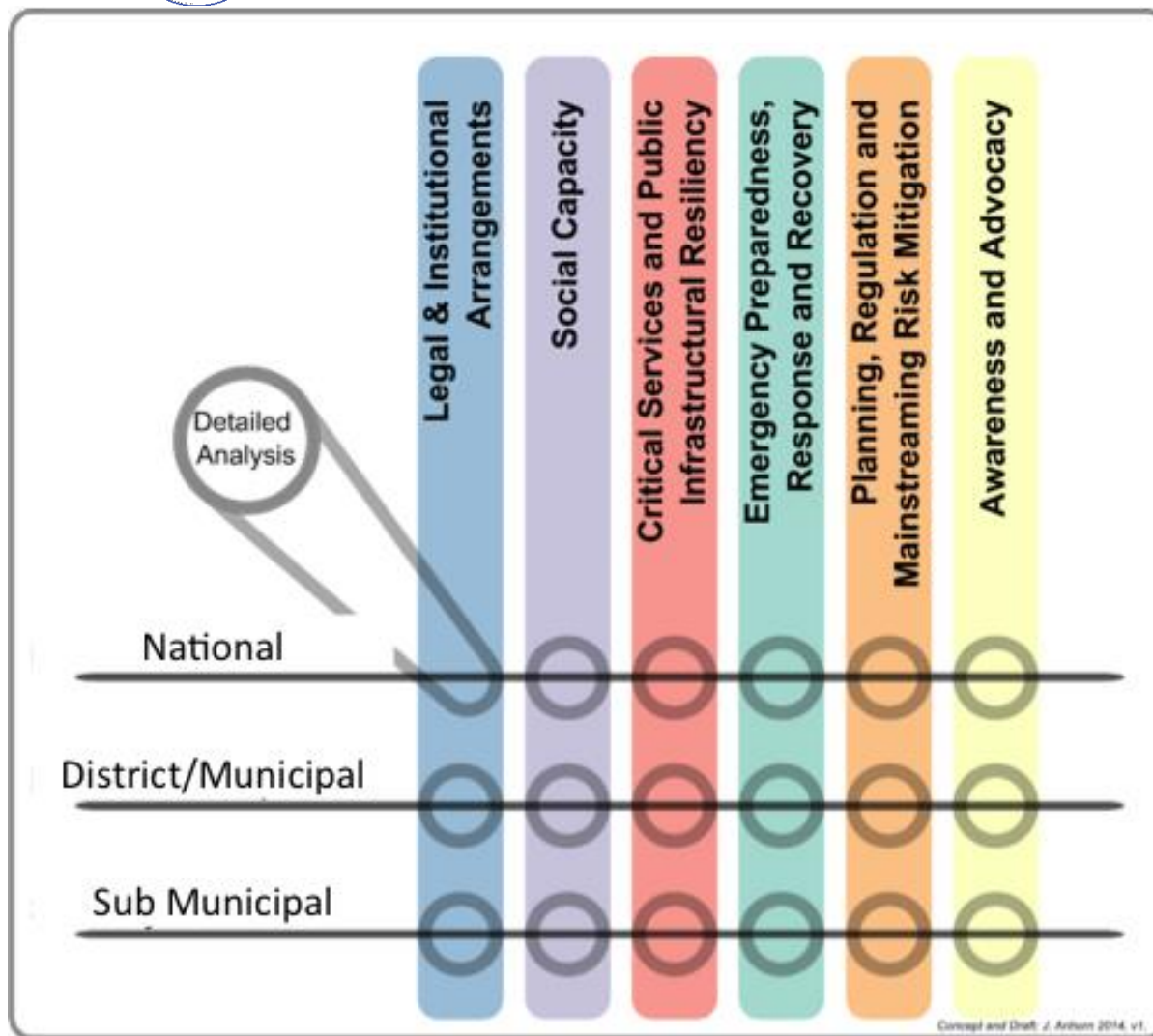
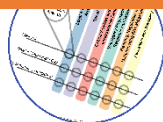
Identify
Stakeholders

Analysis

Indicator
Development

Benchmark

Assess



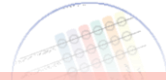
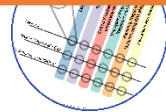
Identify
Stakeholders

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Benchmark

Assess



Legal & Institutional Arrangements

are legal regulations and directives effective

do clearly defined roles and responsibilities exist for DRR

how much confidence exists in governmental and non-governmental institutions

is there coordination and cooperation among relevant groups

Social Capacity

how strong are social networks

are special programs to protect cultural heritage in place

do social assistance programs exist

how integrative are social networks

are healthcare services available

are people heard in decision making

Critical Services and Public Infrastructural Resiliency

are hospitals and schools resilient

are transportation systems resilient

is water and sanitation infrastructure resilient

are electric and gas networks resilient?

are private dwellings resilient

do business continuity plans exist

Emergency Preparedness, Response and Recovery

do people stockpile emergency supplies

are contingency plans and personnel with clear responsibilities for emergency services available

do you have a local emergency center

are funds for emergency preparedness, response and recovery available

Planning, Regulation and Mainstreaming Risk Mitigation

is DRR incorporated into development planning

is reinforcement and retrofitting of private infrastructure carried out

are risk sensitive construction codes and standards in place

are insurances and disaster funds utilized

Awareness and Advocacy

are people aware of the risk

are trainings and capacity building programs for professionals in place

do public outreach activities exist

what kind of information mechanisms exist

Issues / Categories / Indicators

Identify
Stakeholders

Analysis

Indicator
Development

Benchmark

Assess

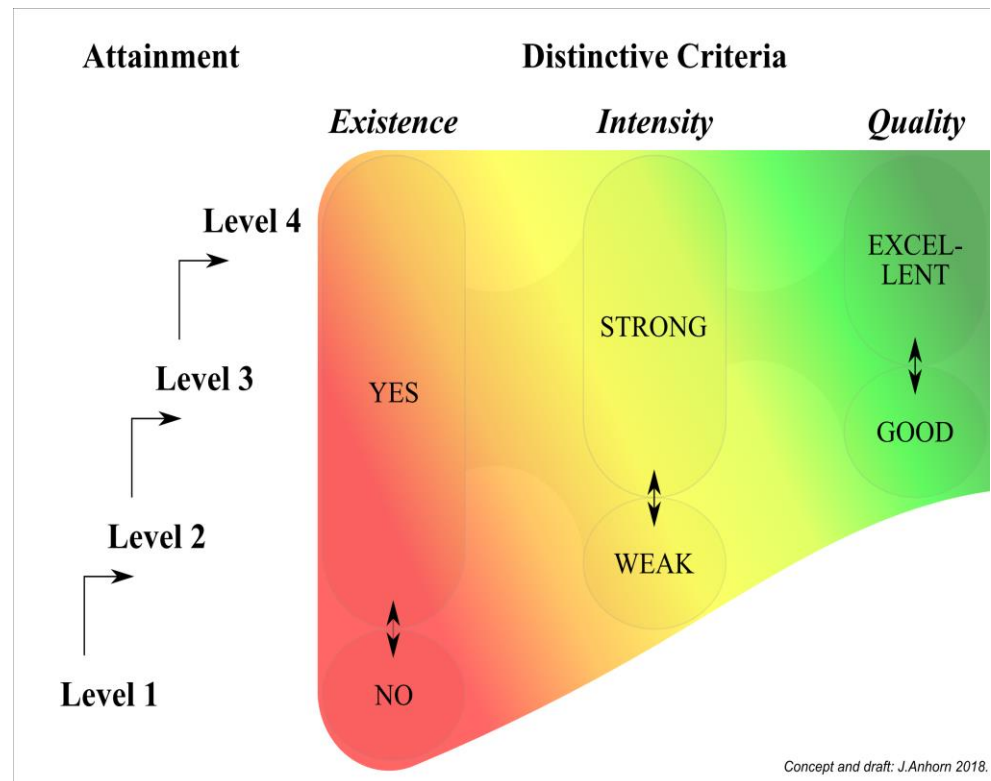
■ Questions are **multiple choice** and measure level of achievement

1 = Highest level of Achievement

2 = Engagement and Solution Development

3 = Awareness of Needs

4 = Little or No Awareness



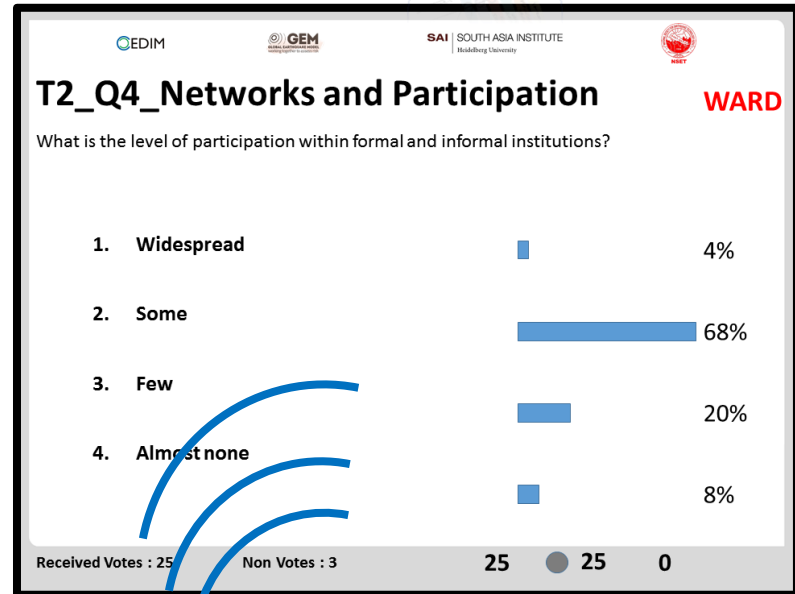
Identify
Stakeholders

Analysis

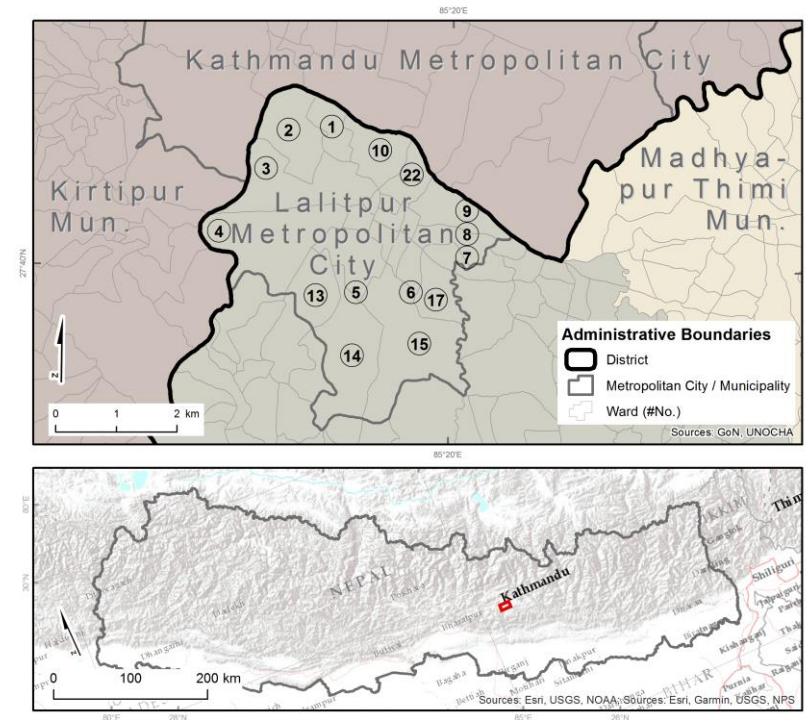
Indicator
Development

Benchmark

Assess



Case Study: Lalitpur, Nepal (2014-2015)



Draft & Cartography: J.Anhorn 2018

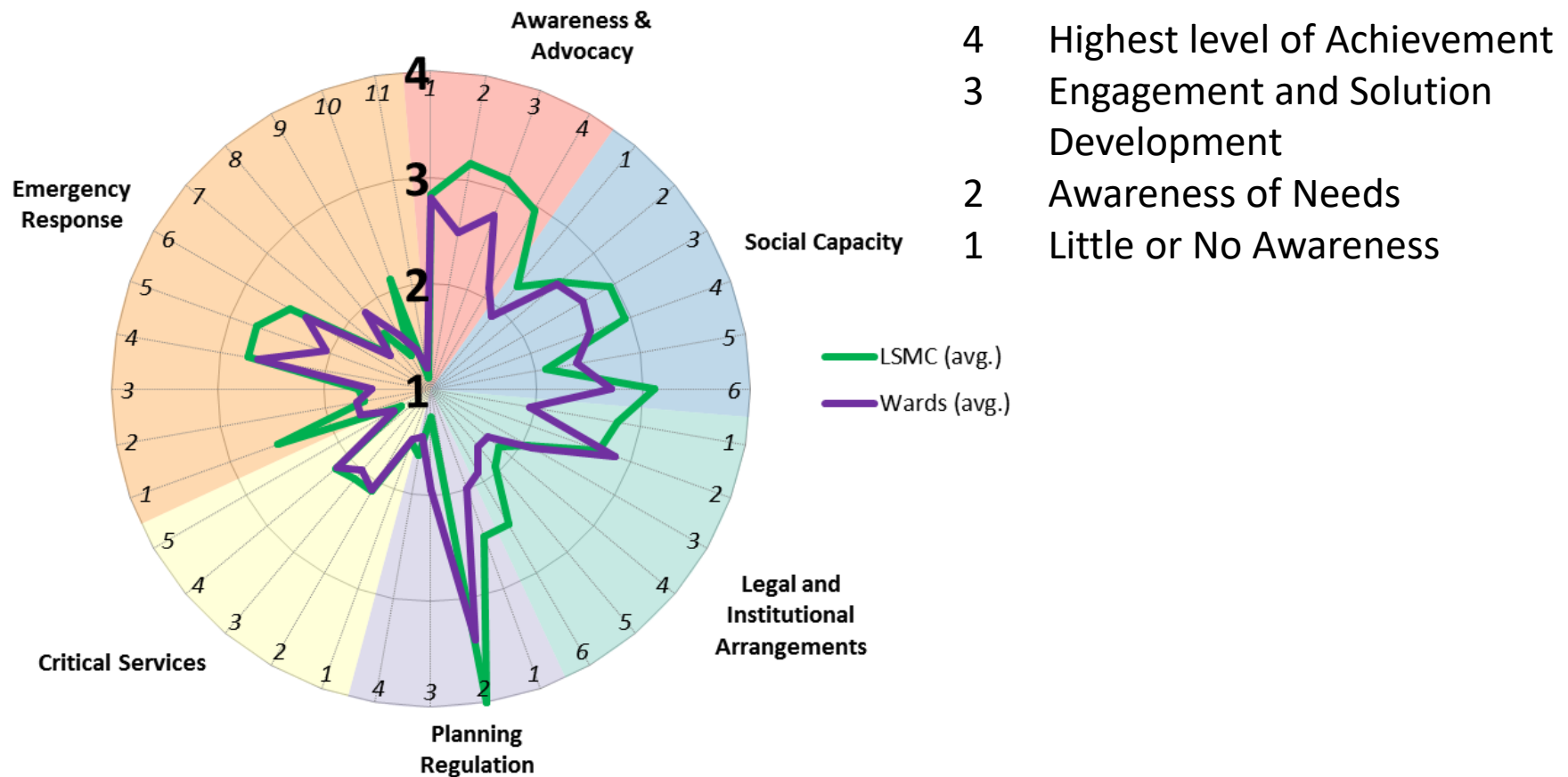
Focus Group

25 Ward representatives

20 Municipal Representatives

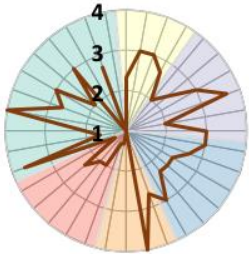
Administration, Community Development, Conservation, Accounting, Law, Public Works, Revenue, City Police, Urban Development

Municipal vs. Sub-Municipal Stakeholders

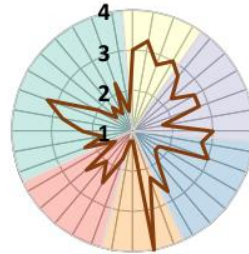


Scoring by Focus Group

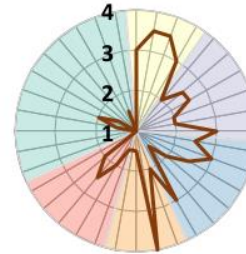
Urban Development



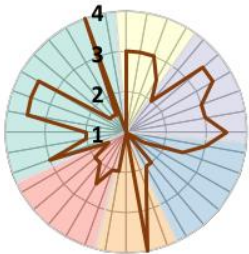
City Police



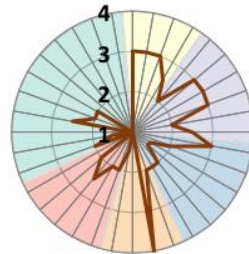
Legal Dept.



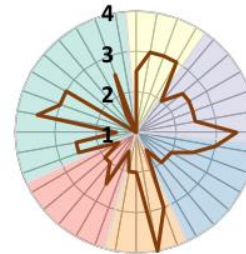
Accounting



Administration

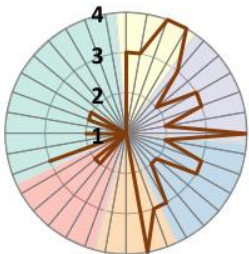


Public Works Division

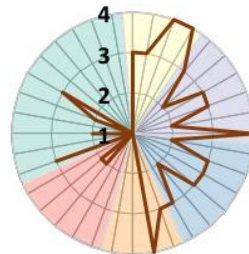


- 4 Highest level of Achievement
- 3 Engagement and Solution Development
- 2 Awareness of Needs
- 1 Little or No Awareness

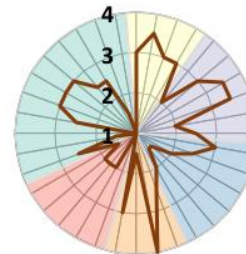
Community Development



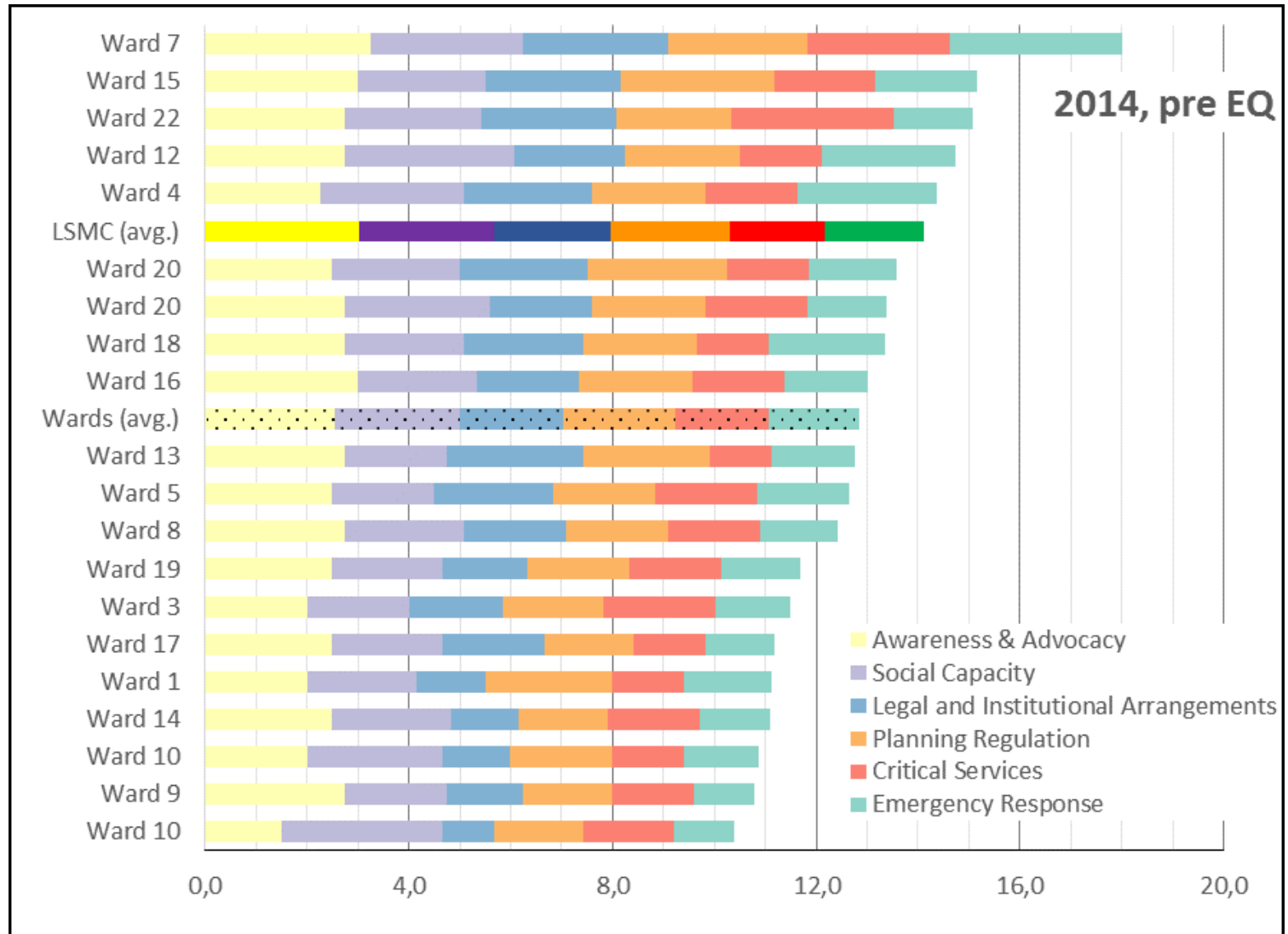
Conservation



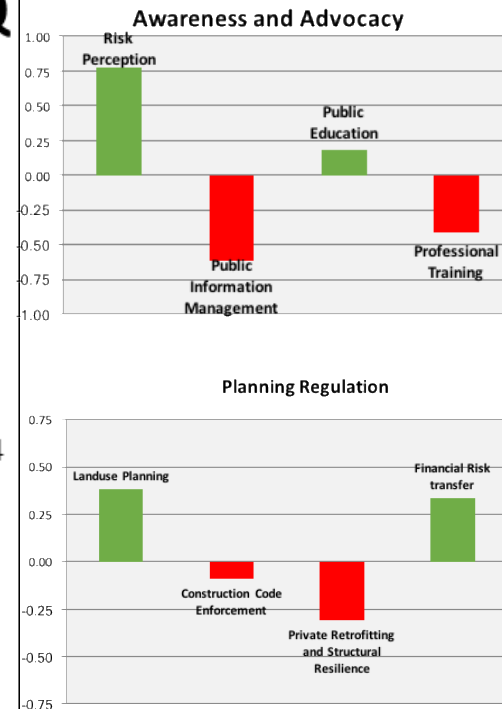
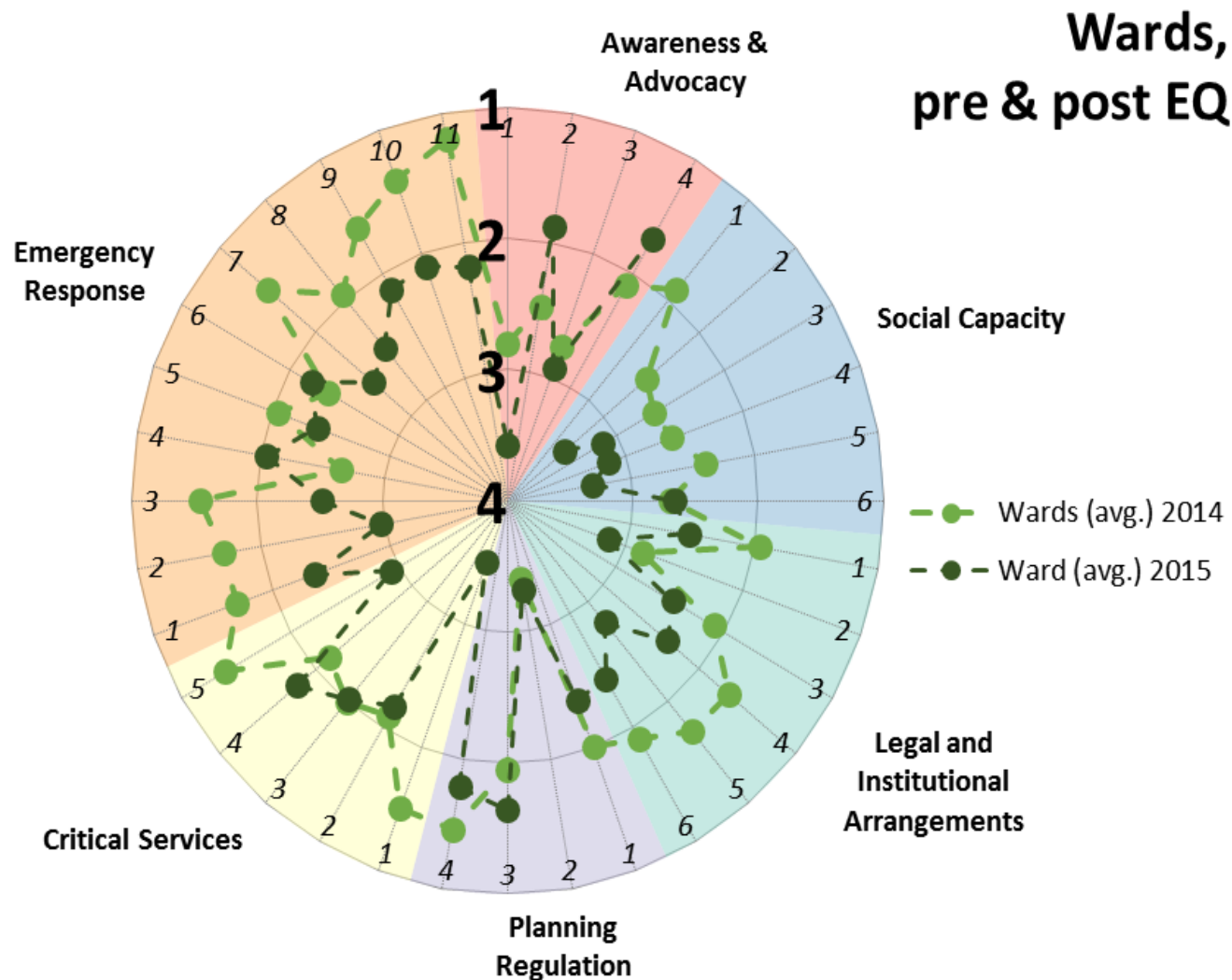
Revenue Office



2014 Scoring by Ward Representatives



Scoring before (2014) and after (2015) the 2015 Ghorka earthquake



Summary

- **Integrated Risk Index (IRI)**

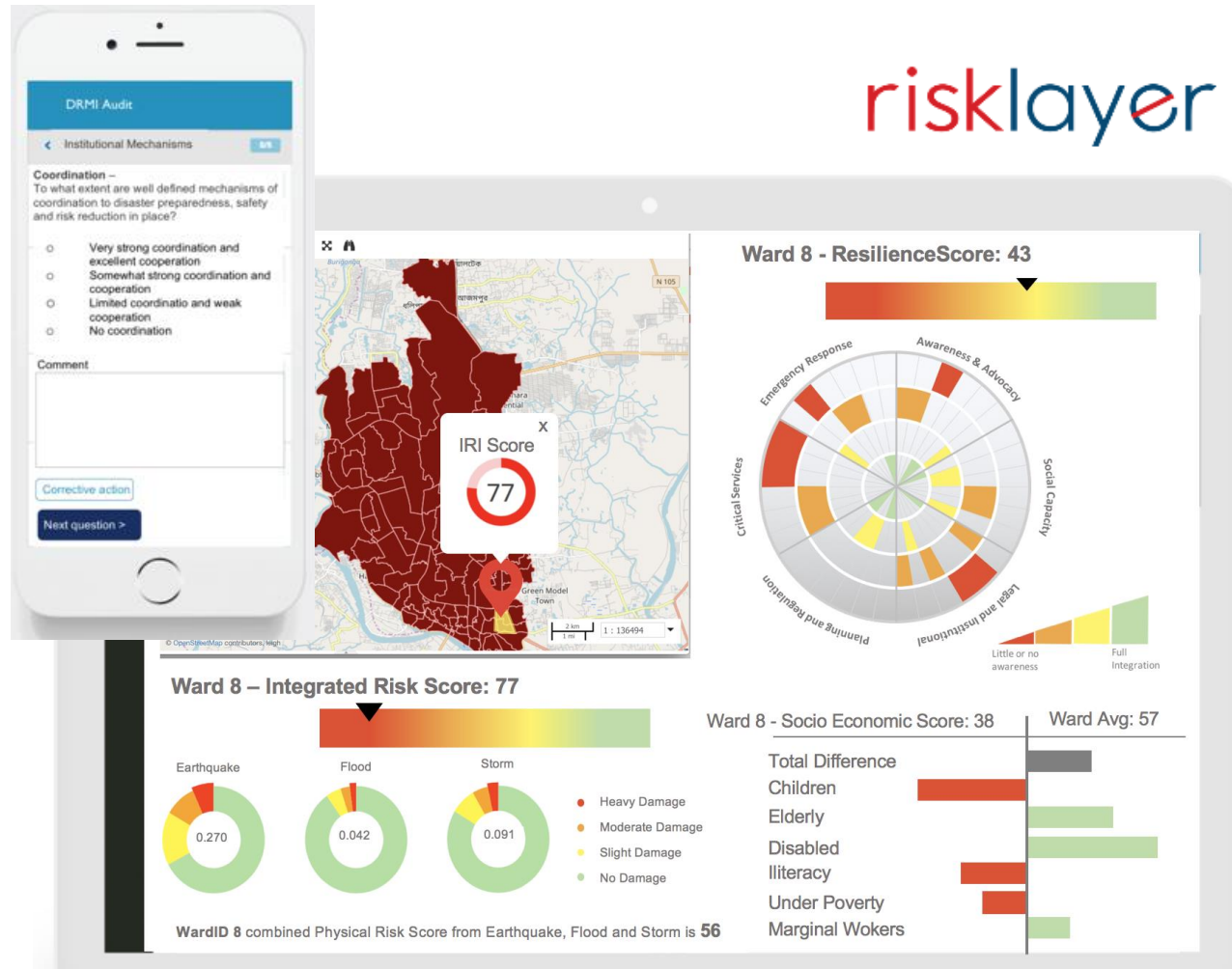
- A risk communication tool with a holistic view of urban disaster risk
- Captures direct physical damages of buildings and infrastructure and considers social vulnerability and lack of resilience that can aggravate the physical effects
- *Quantitative analysis*, requires publically available surveys

- **Resilience Performance Scorecard (RPS)**

- A monitoring and evaluation tool for benchmarking and measuring progress of city's risk management performance
- Captures multiple dimensions of resilience including organizational and operational processes
- *Qualitative analysis*, based on target surveys and a self-assessment process

Urban Disaster Risk and Resilience Performance Web-based Application

- Calculate integrated risk profiles for sub-city districts
- Measure and Compare resilience performance rating
- Track risk and resilience performance over time



Conclusions

- **Framing indicators in a participatory process** is critical to promoting the institutionalization of indicators.
- **Who defines what is important, relevant;** whose knowledge counts?
- **Participatory processes** ensure relevant indicators and targets are based on local knowledge and context are developed.
- **Leveling off Understanding:** robustness of the methodology, requires supporting evidence and key prior findings along each of the dimensions are produced and shared with the stakeholders.

Acknowledgements



Earthquake and Megacities Initiative

- Fouad Bendimerad
- Jerome Zayas



CIMNE and CAPRA

- Omar Dario Cardona
- Martha-Liliana Carreno
- Alex Barbat



GEM

- Christopher Burton
- Heidelberg Univ.**
- Johannes Anhorn

Risklayer GmbH



Thank You!

Questions

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