Enhancing resilience: from city to asset scale

Understanding Risk Balkans, Belgrade
19 September 2018
Welcome to our session
Outline

14:00 Welcome and introduction

Presentations

1) City Resilience Index – Sachin Bhoite
2) Resilience of an infrastructure system – Áine Ní Bhreasail
3) Corridor X – Aleksandar Bajovic
4) The Resilience Shift – Savina Carluccio

Live polling – www.sli.do

Open Q&A and panel discussion

Interactive feedback session

15:30 Close
Informative
A shift from theory to practice
Reflective
short term
known
asset scale
prepare
static equilibrium

long term
unknown
whole system
recover/adapt
dynamic equilibrium

Risk
Resilience
Resilience value
CITY RESILIENCE INDEX

Sachin Bhoite, Arup

Understanding Risk Balkans
Belgrade, 19 September 2018
Cities rely on a complex web of institutions, infrastructure and information
Cascading failure & mutual support within systems

Haiti

New Orleans
The Challenge for CRI

Making city resilience

• Tangible
• Practical
• Globally applicable
Research

27 Cities; 150 Sources of Literature
Research
27 Cities; 150 Sources of Literature

Although profile of shocks and stresses was very different…

1500+ factors
Research

27 Cities; 150 Sources of Literature

Similar themes emerged across cities

1500+ factors
City Resilience Index
How and what to measure

Health & Wellbeing

People: the health and well-being of everyone living and working in the city.

Economy & Society

Organisation: the systems within the society and economy that enable urban populations to live peacefully and act collectively.

Infrastructure & Environment

Place: the quality of physical infrastructure and ecosystems that protect, provide and connect us.

Leadership & Strategy

Knowledge: appropriate leadership and strategy, enabling the city to learn from the past and take timely action.
Research

27 Cities; 150 Sources of Literature

Understanding Resilience at a City Scale (100RC Santa Fe)
Applications

- 4 Dimensions
- 12 Goals
- 52 Indicators
- 156 Variables

156 Qualitative Questions
156 Quantitative Metrics

Basis and tools for measurement

Child-centred Urban Resilience Framework

Water systems resilience framework

Vietnam CRI

Tools and processes

Communication and capacity
Sustainable Development Goals

Thematic overlap with goals

- Substantial thematic overlap
- Some thematic overlap
Value

Feedback from cities:

• Informs / supports integrated planning and investment decisions
• Communicates knowledge about resilience concepts and actions
• Enables monitoring / measurement
• Builds credibility
• Empowers stakeholder engagement
www.cityresilienceindex.org
Resilience of an infrastructure system

Áine Ní Bhreasail
Senior Engineer
Arup

Understanding Risk Balkans
19th September 2018
Acknowledgements

- **Urban Rail Development Handbook**
- World Bank Team: particularly the main Handbook authors Joanna Moody, Daniel Pulido, Georges Darido, Ramon Munoz-Raskin
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Resilient infrastructure is essential for the safety, well-being, sustainability, and economic prosperity of cities
(Transformation through infrastructure, World Bank 2012)
Resilience between systems

Each infrastructure system has interdependencies on other systems

from Urban Rail Development Handbook, World Bank
Resilience within systems

Each system also needs to consider its own resilience

from Urban Rail Development Handbook, World Bank
Resilience of a railway system
Hazards

© Arup, Adapted from Urban Rail Development Handbook, World Bank
Case study – New York

• Super Storm Sandy in 2012
• Adaptations for climate change had been undertaken
• Current plans may not be sufficient
• The Metropolitan Transportation Authority created a Climate Adaptation Task Force

Temporary Flood Mitigation Measures at a New York Subway Station in 2012

Removable Subway Stairs Flood Control Cover in New York in 2013
In 2011, Thailand experienced severe monsoons with 14 million people affected and more than 800 deaths.

- Bangkok’s urban subway and aboveground Skytrain services remained operational.
- Station entrance design credited with this resilience.
- But resilience must be considered within the wider urban context.
Case study – Istanbul, Turkey

- Turkey is subject to devastating earthquakes
- Istanbul Metro Marmaray Tunnel only 16 km from an active fault
- The design of the tunnel includes
  - Grout injection to minimize liquefaction effects
  - A flexible tunnel that would not fracture under powerful ground shaking
  - Installation of flood wall gates

Workers in the Marmaray Tunnel, designed to be resistant to the large earthquakes expected in Istanbul, Turkey
Mitigation measures

- Place rolling stock on higher ground
- Install fire resistant materials, lightening rod installation, surge protection
- Maintain vegetation
- Coastal wetlands
- Sea wall
- Independent power supply
- Slope stabilisation measures
- Install cooling system
- Speed restrictions
- Raise signalling equipment
- Raise station entrances

© Arup, Adapted from Urban Rail Development Handbook, World Bank
Non-structural measures

- Early warning systems
- Response plans including evacuation
- Monitoring of hazards
- Communication and coordination with disaster management teams
- Capacity building

Participants in a drill testing the emergency shelter capabilities of train stations following an earthquake: Tokyo, Japan
Thank you

Áine Ní Bhreasail
Senior Engineer
Arup

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Resilience value aspect for Corridor 10 Highway Project, Serbia
About the Project
Corridor X Highway Project

- Key axis in the Serbian road network
- Important part of the European road network (Pan-European Corridor)
- World Bank category A project
### Key numbers and facts

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Equivalent</th>
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<tbody>
<tr>
<td>17 Million m³ of excavated material</td>
<td>7,000 Olympic Swimming Pools</td>
</tr>
<tr>
<td>1.5 Million m³ of concrete</td>
<td>300 Avala Towers</td>
</tr>
<tr>
<td>82,500 t of steel</td>
<td>12 Eiffel Towers</td>
</tr>
<tr>
<td>13.5 Million m² of laid asphalt</td>
<td>45 Runways of Belgrade Airport</td>
</tr>
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- >1,300 M EUR investment
- 160 km of new highway
Our Role

• We are Environmental Management Plan Supervision Consultant (EMPSC) to the Client - Koridori Srbije

• Addressing Social Impacts of the Project and the implementation of Social Safeguards

• Environment, Health and Safety Management of the Project

• We advise/suggest the Client, the Engineer and the Contractor about actions and measures to be taken
Why we do it?

• The need to preserve ecosystems and ecosystem services to enhance the ability to adapt.

• Additionally, the synergy of ecosystem preservation with socio-ecological resilience and sustainability.

• The maintenance of ecosystems and ecosystem health is imperative for the resilience of human societies.
Challenges and obstacles
As the climate changes and countries suffer more frequent extreme weather events, that resilience of infrastructure even during construction becomes crucial.

Flooding in May 2014 and December 2017 occurred on site, interrupting the works and services and affecting the local communities. It took a lot of time for the works to be fully restored.
Thank you for your attention!
The Resilience Shift
Making resilience tangible, practical and relevant

Savina Carluccio, Arup | The Resilience Shift Project Lead
Understanding Risk Balkans,
Belgrade, 19 September 2018
What is the Resilience Shift?

A global initiative to catalyse resilience within and between key critical infrastructure sectors. We want to re-orient professional decision-making practice from a focus on physical infrastructure as an asset to infrastructure as part of a system that provide services under both ordinary and extraordinary circumstances.
Our vision

Engineered structures and infrastructure will be not only safer but better.

Morandi Bridge Collapse, Genoa (Italy).
Decisions made along the value chain will account for how critical infrastructure contributes to the resilience of the larger socio-technical-ecological system.
Critical infrastructure will be planned, designed, delivered and operated to serve communities (protect, connect, provide) under ordinary and extraordinary circumstances.
Making resilience tangible, relevant and practical

The value is created by equipping professionals and decision makers with the tools, approaches, technology, and educational practices needed to put resilience into practice.

What to do differently on Monday morning?

One of our projects is about identifying frameworks, tools and approaches that enhance the resilience of critical infrastructure and assessing them from the perspective of the value they deliver.
A value chain approach to resilience of critical infrastructure

https://media.arup.com/media/Screen+Capture+-+2018+Sep+19+07A53A46/1_0lh13id1
Diagnose & Conceive  Design & Deliver  Operate & Maintain

Value Identification

Diagnose  Options  Procure  Design/Plan  Finance  Implement  Operate  Maintain  Dispose/Reuse

↑  ↑  ↑  ↑  ↑  ↑  ↑  ↑  ↑

Continuous Learning & Improvement

Value Delivery

THE RESILIENCE SHIFT
Thank you

Find out more and subscribe to our **newsletter** at [resilienceshift.org](http://resilienceshift.org)

**Twitter** @resilienceshift and **Linkedin** The Resilience Shift
Live polling
Instructions

You will need a device connected to the internet

1. Type www.sli.do in your browser
2. Enter event code R518
3. Join the survey!
Q & A and panel discussion
Interactive feedback session
Feedback card session - Instructions

- What are your challenges in enhancing resilience in your day job?
- What is needed to move the resilience needle from theory to practice?
- What tools and approaches do you currently use/would you need to enhance resilience?

1. Answer feedback card (2-3 mins)
2. Share answers with to your neighbour (2-3 mins)
3. Key insights from the audience
“It always seems impossible until it's done”
Nelson Mandela
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Thank you!