Risk-based assessment of the vulnerability of cities and infrastructures to climate change

DRMKC event – Brussels, March 17, 2017

Erich Rome, Fraunhofer IAIS + RESIN team

www.resin-cities.eu

This project is co-funded by the Horizon 2020 Framework Programme of the European Union.
How important are cities for Europe?

- “Built-up areas — defined as cities, towns and suburbs — provide a home to almost three quarters (72.4 %) of the EU-28’s population.” (EUROSTAT)

- By 2050 it is expected that 82% of the population in Europe will live in urban areas

- “Cities generate up to 80% of a country’s GDP” (BMZ, Germany)

- Cities are central to a well-functioning European economy and society
Effects of Climate Change and extreme weather ...

... threaten Cities and Infrastructures in Europe

- The concentration of people and assets in cities also renders them extremely vulnerable to the effects of extreme weather events and climate change.
- Disasters threaten people’s lives, critical infrastructure systems, and value chains.

How well are cities prepared for this?

- The development of urban climate change adaptation strategies has been slow.
- A report of the EEA notes the poor integration of different domains, such as housing, sanitation, water management, and traffic management, within urban adaptation strategies.
- Urban adaptation strategies are imbalanced in how they address vulnerable sectors.
Project RESIN

Climate Resilient Cities and Infrastructures

- Co-funded by: EU H2020 research framework programme
- Type: Research and Innovation Action (RIA)
- Start date: May 1, 2015
- Duration: 42 months
- Planned effort: 866.75 PM
- Partners: 17
- Coordinator: Peter Bosch, TNO
- Website: http://www.resin-cities.eu
Resilience: For whom?

Bilbao

Paris

Bratislava

Manchester
RESIN partners and tier-2 cities

**Tier-1 Cities:**
- Bilbao
- Bratislava
- Greater Manchester
- Paris

**Tier-2 Cities:**
- Padova
- Alba
- Almada
- Zadar
- Burgas
- Vilnius
- Radom
- Sfantu Gheorghe
- Lahti
- Newcastle
- Reykjavik
- Ghent
- Nijmegen
- London
- Athens
- Warsaw
- Strasbourg

**Research & Development Partners:**
- TNO
- Fraunhofer
- ITTI
- Siemens

**Academic & Research Partners:**
- Tecnalia BC3
- University of Bratislava
- University of Manchester
- Engineering School Paris

**Dissemination & Standardisation Partners:**
- NEN
- Uniresearch
- Arcadis
- ICLEI

17.03.2017
The latest report of the IPCC (AR5, 2014) brought a change of paradigm.

Vulnerability assessment is now risk-oriented.

This harmonises Climate Change related vulnerability assessment with risk assessment in other areas, including:
- disaster risk reduction
- critical infrastructure protection

Lacking: suitable methods

Vulnerability is the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts including sensitivity or susceptibility to harm and lack of capacity to cope and adapt’ (IPCC 2014).
Vulnerability Assessment (VA) in RESIN

Risk-based VA for complying with concepts in IPCC AR5

• Novelty:
  Integrated Vulnerability Assessment for Vital Infrastructures and built-up Areas (IVAVIA)

• Modified Vulnerability Sourcebook method
  – modular approach
  – originally developed by German society for international collaboration GIZ
  – BUT risk-based (complies to newer IPCC AR5 concepts)

• Collaboration and exchange with authors GIZ and EURAC
Elements of risk-based vulnerability assessment

RESIN approach

\[ \text{Risk} = \text{<probability of adverse event>} \times \text{<consequences>} \]
The IVA VIA Modules

- **M0**: Selecting hazards and drivers
- **M1**: Preparing the Vulnerability Assessment (VA)
- **M2**: Developing Impact Chains
- **M3**: Identifying and Selecting Indicators
- **M4**: Data Acquisition and Management
- **M5**: Normalisation of Indicator Data
- **M6**: Weighting and Aggregating of Indicators
- **M7**: Aggregating Vulnerability Components to Vulnerability / Risk
- **M8**: Presenting the Outcomes of your Vulnerability Assessment

---

**Implementation Status**
- Implemented, tested, and in use for city case studies
- Under development
- Planned
What is an Impact Chain Diagram (ICD)?

**Tool from the original Vulnerability Sourcebook**

- Tool for **capturing** and **structuring** the “ingredients” (or components) of a particular impact chain
- **Describes** the basic connections between the elements
- **Prepares** the selection of indicators for many of the components

**Experiences so far (Co-creation process with Bilbao, Manchester, Paris):**

- ICDs are easy to grasp and apply
- The structured approach is much appreciated by stakeholders
- ICDs give first clues on adaptation possibilities
Impact chain: Heat wave on public health

Driver
- Increasing average temperature

Hazards
- Water scarcity / quality
- New types of illness-spreading insects
- Heat wave

Impacts
- Loss of human lives
- Morbidity
- Loss of work capacity
- Economic losses
- Loss of GDP

Indicators
- Number of hot days and tropical nights
- Average temp. on a day exceeds 32 °C
- Number of consecutive hot days

Sensitivity
- Percentage of people with age > 65
- Urban Comfort Map (Tecnalia)
- Statistical data
- Technical insp. (en. efficiency classes)
- Av. number of floors of buildings

Vulnerability
- Green & blue infrastructure (river, cool and green roofs)
- Early warning system
- Availability of hospitals / contingency plans
- Social networks (neighbourhood, family, friends)
- Behaviour
- Availability of air condition in flats, offices & transport
- Education and awareness

Coping Capacity
- Yes/No
- "Accion Social" (they work on dependency)
- Use of sport centres, access to specific sites
- No data (private smart metering?)
- Informing citizens (frequency)

Indicators
- Age dependency of population
- Urban heat island
- Density of population
- Building design (insulation, windows, orientation)
- Urban form (canyons, highrise residential buildings)

Technical insp. (en. efficiency classes)

Bilbao

17.03.2017

RESIN project - DRMKC event Brussels
Hypothetical calculation: vulnerability risk values for a heatwave for all Barrios in Bilbao

Please note, that these are calculated just for testing our method in principle. This is only for showing and has in the current state of IVAVIA development no evidence!
Effect of adding/subtracting greenspace on surface temperature

Source: Gill, 2006
Standardisation work

• Employ standards where possible (like ISO/IEC 31010 (2009))

ISO/TC 207/SC 7 - Environmental management – Greenhouse gas management and related activities
• liaison request accepted – work programme:
• Fraunhofer and ICLEI joined the liaised German DIN working group NA 172-00-13 AA “Adaptation to the consequences of climate change”
• Tecnalia joined the Spanish mirror group
• RESIN input has the chance to get transferred on an international level: current NWIP Vulnerability Sourcebook method adapted to the risk-based vulnerability assessment approach of the IPCC assessment report

ISO/TC 268/WG 2 - Sustainable cities and communities – City indicators
• liaison requested
Observations & recommendations

• There is still much to be done on the policy side
• Cities do not have dedicated CCA budgets – CCA typically needs to be covered by departments’ standard budget
• Developmental goals conflict with CCA goals – green space vs office buildings

• Make policies for raising the required additional money at all governance levels
• Oblige cities to allocate specific budgets for CCA measures
• 'Mainstreaming' adaptation/resilience across policy themes is a potentially useful approach
• Improve the mindset of city developers towards a ‘systems perspective’ – make them go for green & blue
• Consider green & blue infrastructures to be also critical infrastructures
Towards the liveable city

“In more than 2000 years of city planning, those who have written about cities have agreed on three points:

1. cities are centres of innovation and creativity in civilisation;
2. the more pleasant a city is the more likely it is that residents will be innovative and creative;
3. vegetation is the key to making cities pleasant.”

Botkin and Beveridge (1997)

Disclaimer
This presentation was derived from the H2020 project RESIN, which has received funding from Horizon 2020, the European Union’s Framework Programme for research and innovation, under grant agreement no 653522. The content of this presentation does not reflect the official opinion of the European Union. Responsibility for the information and views expressed herein lies entirely with the presenter.