A pan-European framework for strengthening Critical Infrastructure resilience to climate change
EU-CIRCLE

ATHANASIOS SFETSOS
on behalf of the EU-CIRCLE consortium
EU-CIRCLE Consortium

20 partners

9 EU countries

13 International members of Stakeholder’s Advisory Group
EU-CIRCLE in a nutshell

- Making the interconnected and interdependent Critical Infrastructures more resilient to climate change

- Development of a validated Climate Infrastructure Resilience Platform **(CIRP)** that will:
  - assess potential impacts due to climate hazards,
  - provide monitoring through new resilience indicators and
  - support cost-efficient adaptation measures.

- Addressing community requirements, either in responding to **short-term hazards and extreme weather** events or in **deriving the most effective long term adaptation measures**.

- Move from CI specific resilience to holistic one
EU-CIRCLE analysis

- Identify, assess and quantify the risks that CI are exposed to, and how these will evolve under no-adaptation policy options.

- Identify new risks that may appear under future climate conditions, or due to new CI being planned (or expanded) in the future.

- Assessing risks in the future under the application of different adaptation options policies and measures.
How far into the future would you consider climate change analysis

- CS1: heatwaves and dryness on electricity networks
- CS2: maritime scenario
- CS3: coastal flooding
- CS4: urban flooding
The role of climate change

- Examine how the frequency and magnitude of extremes will change in the future
- Multiple hazards
Linkage of risk management, resilience and modelling
How to measure impacts

- Direct to the Network
  - Loss of lives
  - Damages to assets
  - Degraded performance
  - Economics-Financial
  - Safety – Reliability Levels
  - Reputation

- Indirect - Societal
  - Loss of lives
  - Economy – sectoral IO
  - Provision of services
  - Also to specific society groups
  - Environmental
Definition of resilience

Consolidation Workshop
Main Outcomes from Roundtables

KEYWORDS FOR RESILIENCE

<table>
<thead>
<tr>
<th>Case Study</th>
<th>Description</th>
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<tbody>
<tr>
<td>Study 1</td>
<td>Safe life, safe valuables, return to service</td>
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<tr>
<td>Study 2</td>
<td>Strength, elasticity, insight (awareness)</td>
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<tr>
<td>Study 3</td>
<td>Interruption of all sources of flooding, risk acceptance, capacity building</td>
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<tr>
<td>Study 4</td>
<td>Adaptation, how to absorb the impact, recover</td>
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</tbody>
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May 18th, 2016
Milan, Italy
1st CONSOLIDATION WORKSHOP

DRMKC workshop with FP7 and H2020 projects
16-17th March 2017
## Resilience Framework

<table>
<thead>
<tr>
<th>Resilience Capacities</th>
<th>Anticipatory</th>
<th>Absorptive</th>
<th>Coping</th>
<th>Restorative</th>
<th>Adaptive</th>
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</thead>
<tbody>
<tr>
<td>Reduce Likelihood</td>
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<tr>
<td>Reduce Consequences</td>
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<td>Transfer Risk</td>
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<td>Avoid Risk</td>
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### Indicators

- Probability of failure
- Pre-event functionality
- Quality/extent of mitigating
- Disturbance planning/response
- Crisis communication
- Learnability

- Systems failure
- Severity of failure
- Just in time delivery
- Reliability
- Post-event functionality
- Resistance
- Robustness

- Withstanding
- Redundancy
- Resourcefulness
- Response
- Economic Costs
- Interoperability

- Post-event damage assessment
- Recovery time post-event
- Recovery/loss ratio
- Cost of reinstating functionality post-event

- Substitutability (replacement of service)
- Adaptability / flexibility
- Impact reducing availability
- Consequences reducing availability
CIRP – in a nutshell

- **Inputs** - Hazards, Inventory, Fragility Models
- **Output** - Damage Prediction, Reporting, Decision Support

- Climate Change
- Hazard Definition
- **Inventory Selection**
- **Consequence Estimation**
- **Damage Prediction**
- Decision Support
SimICI

- Reference environment for development and testing
  - Sample data set resembling the real world
  - Accessible to the community
- Participation of EU-CIRCLE to the Open Research Data Initiative
Case Study 1: Heat Wave and Forest fire impacts on electric and road transport networks
Provence-Alpes-Côte d’Azur Region (France)
Case Study 1 in a nutshell

**Impact on:**
- Individual assets of each CI
- CI internal cascading effects
- Interactions between CIs
- Cascading effects across CIs

**Energy:**
- **Electricity**
  - Production (mostly EDF)
  - Transmission (RTE)
  - Distribution (ENEDIS)

**Public Authorities (Fire Fighters)**

**CI Ecosystem**

**Scenario for the French case study (N°1)**
- Heat Wave
- Forest fires
- Climate change
Case Study 2: Sea Surge and Extreme Winds at Baltic Sea Area

Gdynia Maritime University - GMU

GMU TEAM

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Description of Case Study
Scenario 1: Oil Transport in Port

- Experiment Description

The port oil piping transportation system is operating at one of the Baltic Oil Terminals that is designated for the reception from ships, the storage and sending by carriages or cars the oil products.

Figure 1. Piping at the pier of Gdynia Port
Description of Case Study
Scenario 1: Oil Transport in Port

- Experiment area dimension and time of execution

Maps of Case Study Scenario 1 Location

Figure 2. The port oil piping transportation system operating between the Port of Gdynia and the Terminal in Dębogórze
International Case Study: Effects of Cyclonic pressures, consequent flooding & effects on critical infrastructure / adaptation policies in Bangladesh

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The effect on the embankment infrastructure after Cyclone Aila

Six months after the cyclone, many embankments remained broken and land was still flooded. There was limited return, and 200,000 people still lived on the roads and embankments. Some returned to their land by night and returned to the embankments at night or during high tides.

Embarkments were not rapidly repaired, and land remained flooded. Families remained displaced on embankments.
Case Study: Rapid Winter Flooding
Dresden Region

RALF HEDEL, STEFAN HAHMANN
PATRICK BRAUSEWETTER

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Description

- Case study area
  - Densely populated area in the triangle of DE/CZ/PL
  - Center of industry, science, culture, settlements
  - City of Dresden as the center, population >500,000
  - many smaller cities and towns nearby in the main development area along the valley of the river Elbe
  - Hilly topography (up to 1,200 m), smaller water bodies from the mountains are directed to the valley of the river Elbe

- Historical floods of river Elbe:
  - 1845 (Mar/Apr)
  - 2002 (Aug)
  - 2006 (Mar/Apr)
  - 2011 (Jan)
  - 2013 (Jun),
Case Study 3

Urban Coastal Flooding, Torbay, UK

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Flooding from different sources
- surface water runoff
- highway flooding
- sewer flooding
- main river and ordinary watercourse flooding

Coastal flooding due to overtopping of sea defences during high tides + easterly winds.

All sources of flooding are exacerbated during high tides and heavy rainfall when capacity of the outfall is reduced.
This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 653824

Thank You For Your Attention

http://www.eu-circle.eu