EU-CIRCLE Risk Assessment Approach

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1. References

1) Grant Agreement No. 653824, 2015
2) Detailed Methodological Framework, D1.5, KEMEA, 2017
3) Holistic CI Climate Hazard Risk Assessment Framework, D3.4, Fraunhofer, 2016
4) Dubrovnik Meeting, 2017

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2. Background Information

1) **Project Title:** EU-CIRCLE - A panEuropean framework for strengthening Critical Infrastructure Resilience to Climate Change
2) **Duration:** 36 months (May 2015 – May 2018)
3) **Engagement:** 1.123 PMs (Person-Months)
4) **No. of Partners:** 20
5) **Grant Amount:** 7,3 m€

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3. Motivation

Climate stressors
- Temperature
- Rain
- Snow
- Fog
- Wind

CHEs – Climate Hazardous Events
CIs – Critical Infrastructures
BCP – Business Continuity Plan
OSP – Operating Security Plan

Climate Hazards
- Flood
- Fire
- Storm
- Blizzard
- Sliding

1) We are witness to Climate Changes
2) CHEs affect CIs (BCP & OSP)
3) River floods (44%) and windstorms (27%) are the major CHEs presently
4) CHEs may rise significantly in Europe in the future
5) Heat waves are foreseen as the most damaging CHE
6) Overall damages on CIs caused by CHEs are foreseen to be as follows:
   - Tripled by the 2020; 6-fold by mid-century; More than 10-fold by the end of the century
   - Energy & Transport will be threatened uppermost

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4. Project Description

WP	Title	Lead Beneficiary	Country
WP1	Setting the Operational Environment	KEMEA	Greece
WP2	Climatic Data Capture and Processing	NCSRD	Greece
WP3	CI Risk Model for Climate Hazard	Fraunhofer	Germany
WP4	CI Resilience and Adaptation to Climate Change	ARTELIA	France
WP5	CI Resilience Platform	STWS	Greece
WP6	Case Studies and EU-CIRCLE Assessment	GMU	Poland
WP7	SimICI: Reference Simulated Network of Interconnected CIs	XUV	UK
WP8	Dissemination and Exploitation	EUC	Cyprus
WP9	Management	NCSRD	Greece

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5. Project Objectives

It is presently acknowledged and scientifically proven than climate related hazards have the potential to substantially affect the lifespan and effectiveness or even destroy of European Critical Infrastructures (CI), particularly the energy, transportation sectors, buildings, marine and water management infrastructure with devastating impacts in EU appraising the social and economic losses. The main strategic objective of EU-CIRCLE is to move towards infrastructure network(s) that is resilient to today's natural hazards and prepared for the future changing climate. Furthermore, modern infrastructures are inherently interconnected and interdependent systems ; thus extreme events are liable to lead to 'cascade failures'. EU-CIRCLE's scope is to derive an innovative framework for supporting the interconnected European Infrastructure's resilience to climate pressures, supported by an end-to-end modelling environment where new analyses can be added anywhere along the analysis workflow and multiple scientific disciplines can work together to understand interdependencies, validate results, and present findings in a unified manner providing an efficient "Best of Breeds" solution of integrating into a holistic resilience model existing modelling tools and data in a standardised fashion. It, will be open & accessible to all interested parties in the infrastructure resilience business and having a confirmed interest in creating customized and innovative solutions. It will be complemented with a webbased portal.The design principles, offering transparency and greater flexibility, will allow potential users to introduce fully tailored solutions and infrastructure data, by defining and implementing customised impact assessment models, and use climate / weather data on demand.

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6. Methodological Framework

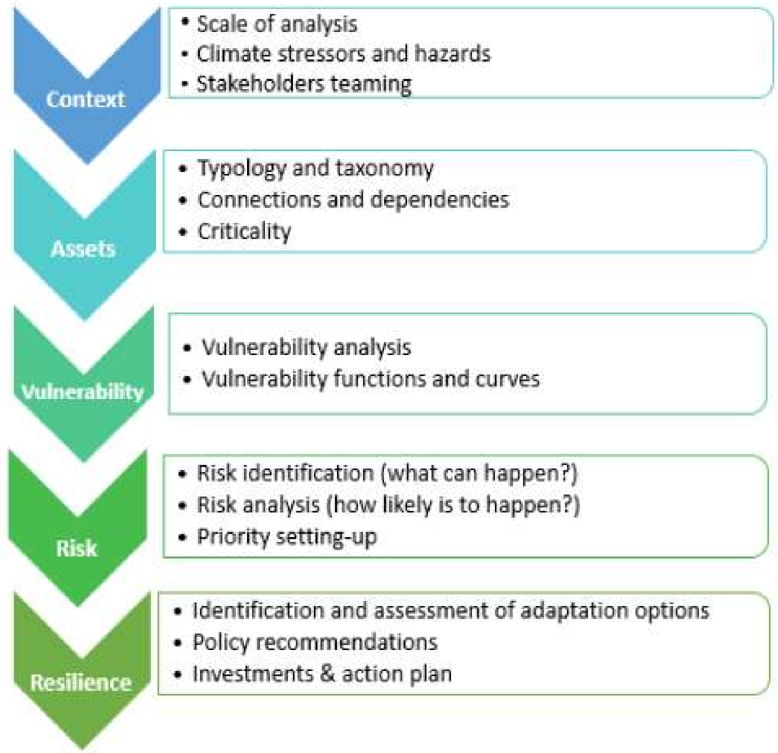

Figure 15. Procedural steps of EU-CIRCLE methodological framework

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6. Risk Assessment Approach (1)

WP3 Tasks

- CI Risk Model for Climate Hazards -

Task 3.1 Definition of CI assets and networks
Task 3.2 Definition of climate related CI critical event parameters and CI exposure
Task 3.3 CI interconnections
Task 3.4 Impact Assessment Models
Task 3.5 Holistic Risk Assessment Propagation model
Task 3.6 Definition of CI Risk Model Metadata

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6. Risk Assessment Approach (2)

Damage & Impact Assessment

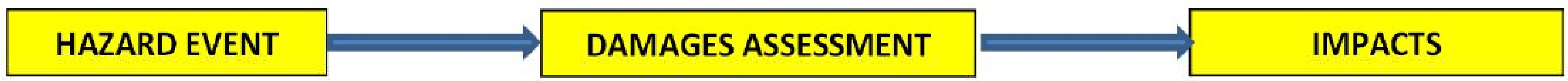

Figure 6. Damage and Impact process

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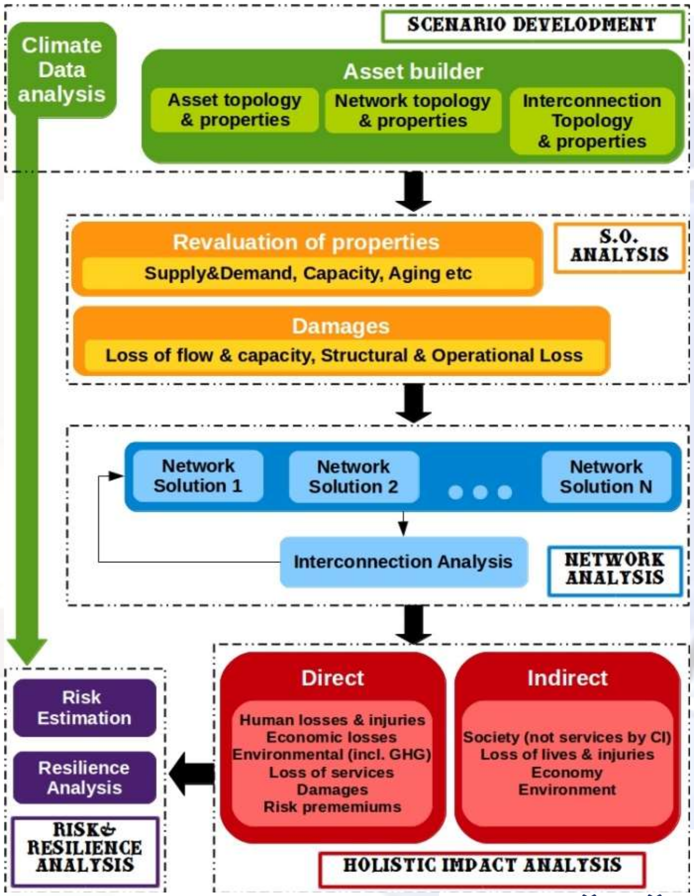
6. Risk Assessment Approach (3)



5 steps RA methodology

1. Scenario development
2. Structural & Operational Analysis
3. Network Analysis
4. Holistic Impact Analysis
5. Risk & Resilience Analysis

Case Studies

1. French – Heat wave and forest fire
2. Poland – Sea surge and extreme winds
3. UK – Storm and Flood
4. Bangladesh - Hurricane
5. German - Flood

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6. Risk Assessment Approach (4)

Risk definition

$$R = L \times I$$

R – Risk
L - Likelihood of the extreme disruption event
I - Direct and indirect Impacts

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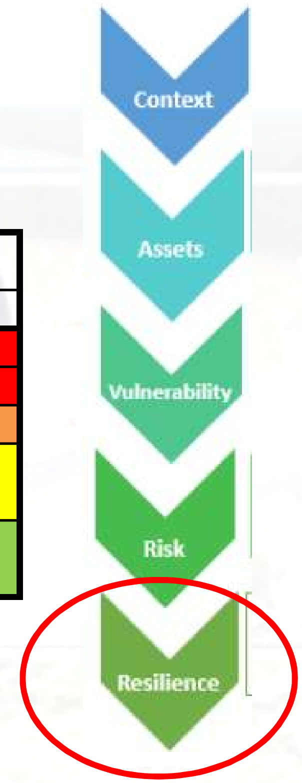
6. Risk Assessment Approach (5)

Risk Matrix

LIKELIHOOD	IMPACT				
	NEGLIGIBLE	SMALL	MEDIUM	HIGH	SEVERE
VERY HIGH	LOW	MEDIUM	HIGH	CRITICAL	CRITICAL
HIGH	VERY LOW	MEDIUM	MEDIUM	HIGH	CRITICAL
MEDIUM	VERY LOW	LOW	MEDIUM	MEDIUM	HIGH
LOW	VERY LOW	VERY LOW	LOW	LOW	MEDIUM
VERY LOW	VERY LOW	VERY LOW	VERY LOW	VERY LOW	LOW



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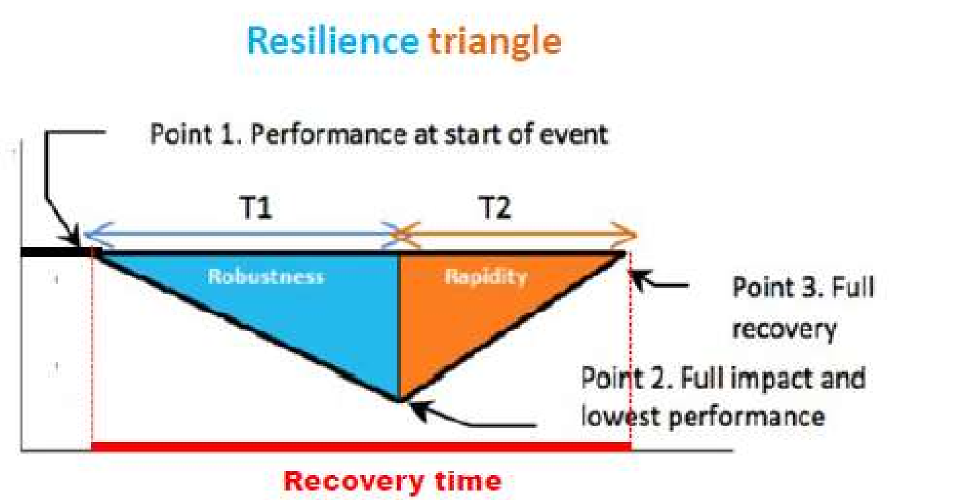
6. Risk Assessment Approach (6)

Resilience as we learn (1)

Resilience = Robustness + Rapidity

Resilience and Vulnerability may be seen as the Antonyms



The smaller triangle area, the greater the system resilience.

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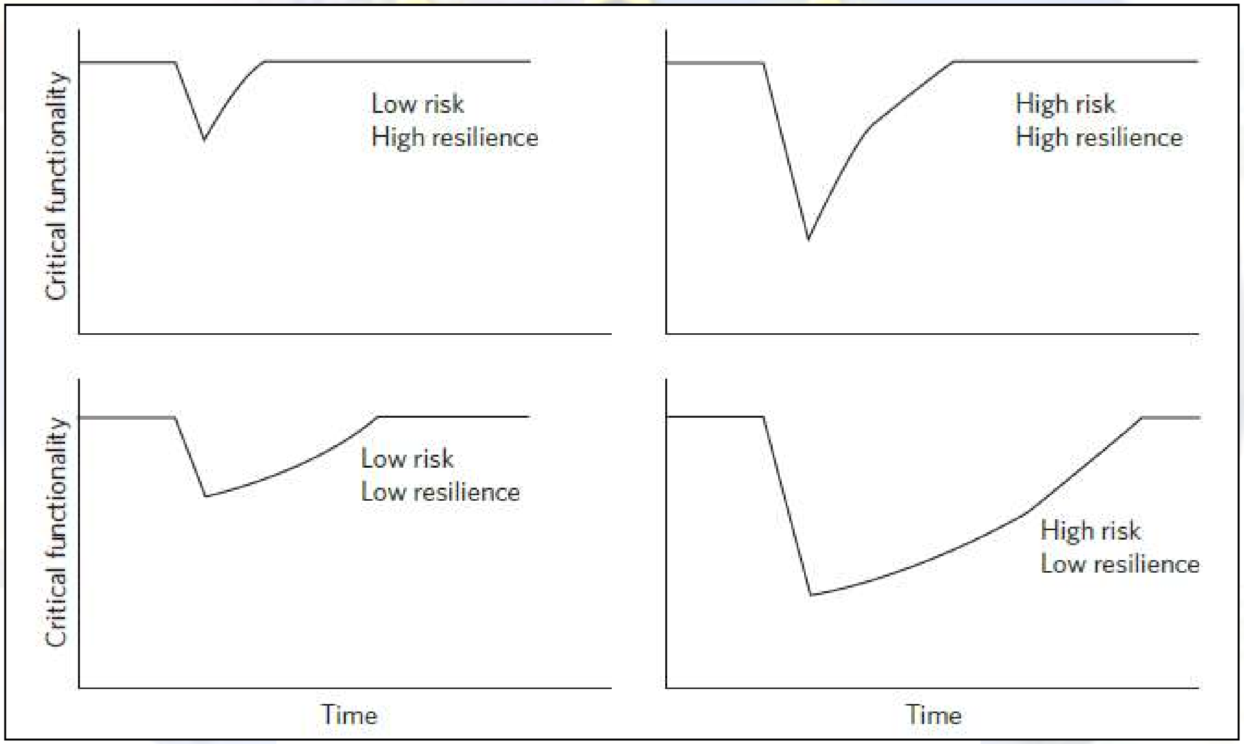
6. Risk Assessment Approach (7)

Resilience as we learn in VVG (2)



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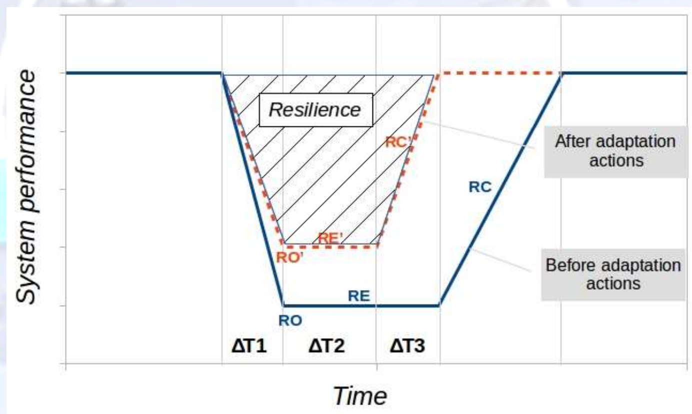
6. Risk Assessment Approach (8)

Resilience as EU-CIRCLE teaches

Resilience is composed of five CI capacities.
These are:

1) **Adsorptive capacity**
2) **Adoptive capacity**
3) **Anticipatory capacity**
4) **Coping capacity**
5) **Restorative capacity**



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