



# Measuring Disaster Resilience and Challenges

Chaminda Pathirage

Centre for Disaster Resilience, University of Salford, UK



# Concept of Disaster Resilience

“Ability of a community to **“bounce back”** and **recover** using its own resources’ and also the **ability** of groups or communities to **cope** with external shocks and stresses as a result of social, environmental and political change” DMC SL

Ability of a CI system to **prevent, withstand, recover** and **adapt** from the effects of climate hazards and climate change EU CIRCLE

Over 300 Resilience definitions

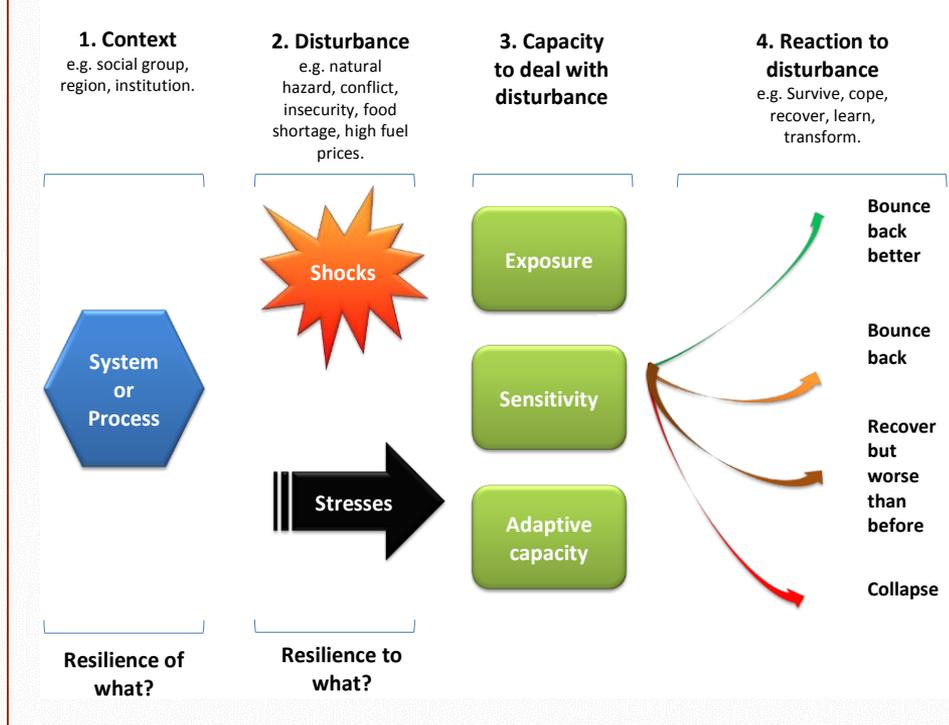
# Concept of Disaster Resilience

## ❖ **Common elements** of resilience definitions:

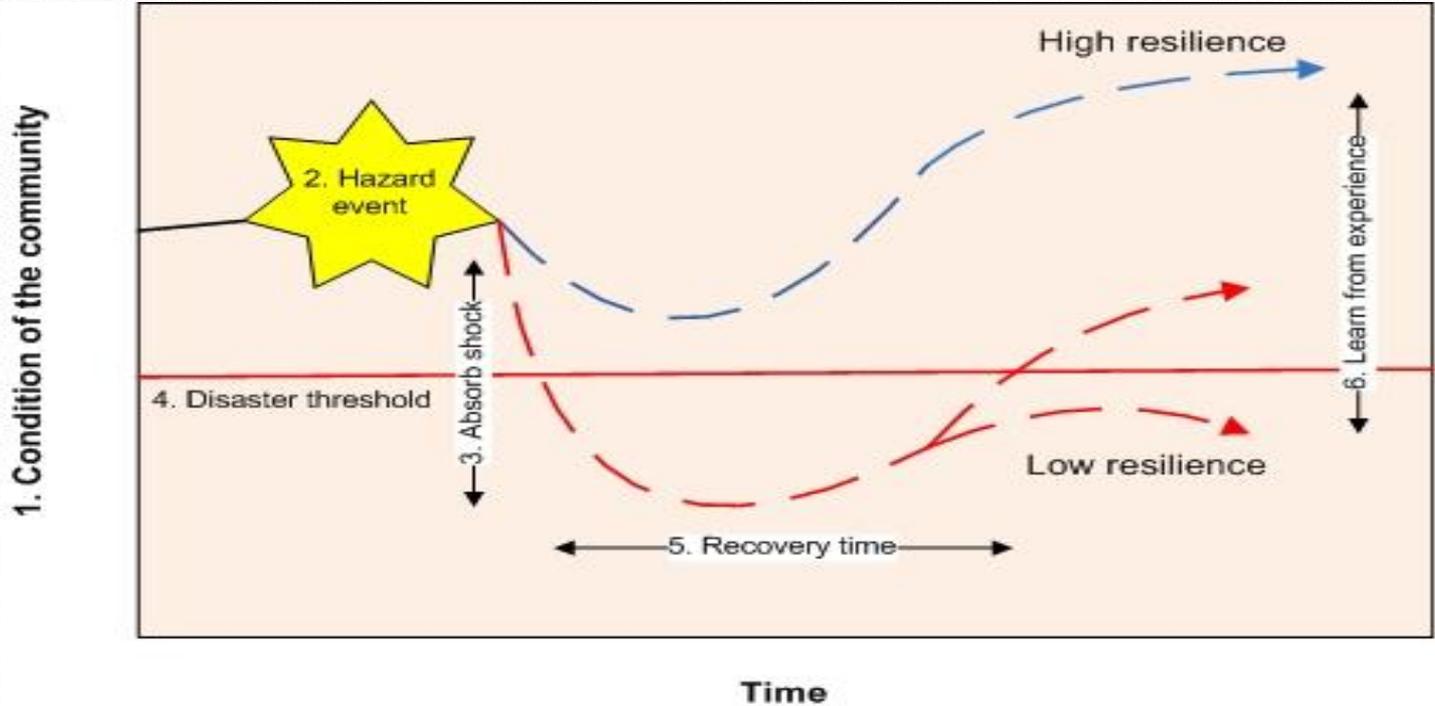
- Context (C )
- Disturbance (D)
- Capacity to deal with disturbance (CD)
- Reaction to disturbance (R)

# Concept of Disaster Resilience

## The four elements of a resilience framework



# Concept of Disaster Resilience





# EU-CIRCLE

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

[HOME](#)

[ABOUT](#) ▾

[RESEARCH](#) ▾

[RELATED PROJECTS](#) ▾

[DISSEMINATION MATERIAL](#) ▾

[NEWS & EVENTS](#)

[CONTACT](#)

[PARTNERS AREA](#)



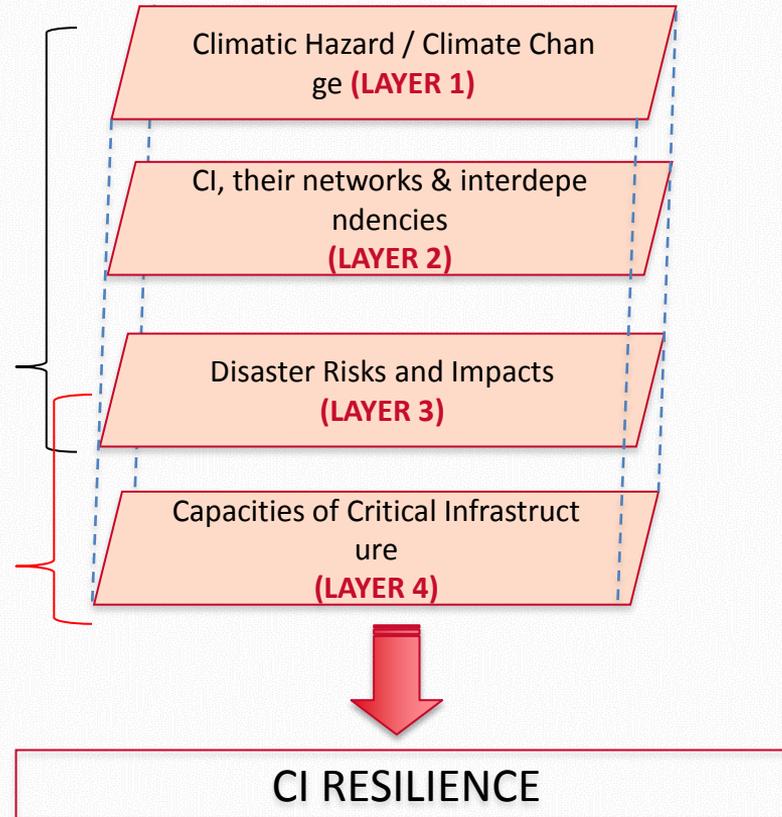
# Layered Approach

Resilience of What?

Resilience for What?

Asset Properties

Resilience Parameters  
and Indicators



# AARCA Capacities – Index of Indicators

Anticipative



The ability of the CI system to anticipate and reduce the impact

Absorptive



The ability of CI system to buffer, bear and endure the impacts

Restorative



The ability of a CI system to be repaired easily and efficiently

Coping



The ability of CI system to face and manage adverse conditions using available skills and resources

Adaptive



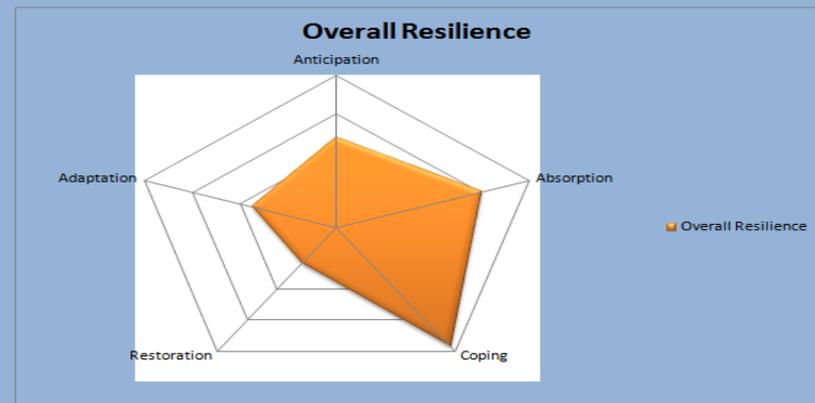
The ability of a CI system to adjust and to take advantage of opportunities against potential impacts

# RAMT Tool

## ❖ Capacity Index

Overall resilience index = 6.09

Resilience Indicators	Resilience index R	Capacity index C	Weight C	Real C
<b>Anticipation</b>				
1.1. Awareness of potential hazards	0.42	5.90	3	1.18
1.2. Quality/extent of mitigating features	0.63			
1.3. Quality of disturbance planing/response	0.00			
1.4. Communication Systems / Information sharing	2.70			
1.5. Learnability / Training	2.16			
<b>Absorption</b>				
2.1. System failure (integrity of CI affected)	3.34	5.61	2	1.51
2.2. Severity of failure (services of the CI affected)	0.60			
2.3. Resistance	0.75			
2.4. Robustnes and redundancy	0.92			
<b>Coping</b>				
3.1. Response	0.85	5.85	1	1.93
3.2. Economics of response	0.00			
3.3. Interoperability with public sector	5.00			
<b>Restoration</b>				
4.1. Post-event damage assessment	1.19	8.32	5	0.58
4.2. Recovery time	2.21			
4.3. Economics of restoration	4.92			
<b>Adaptation</b>				
5.1. Adaptability and flexibility	1.93	6.76	4	0.88
5.2. Impact / consequences reducing availability	3.30			
5.3. Economics of adaptation	1.53			



# Operationalizing Resilience

The ability of the critical infrastructure system:

- to **prevent** the impacts by minimising the exposure of critical infrastructure to hazards;
- to **withstand** the impacts from climatic hazards and climate change by reducing the magnitude and number of impacts;
- to **recover** from the effects of climate hazard: through the rapid restoration of services; and
- to **adapt** through modification and improvements to the CI system.



- ❖ Using system dynamics simulation modelling to develop a “business simulator” for the RAMTs

# CI Resilience Model

**EU CIRCLE CI resilience prototype model**  
June 2017

[Instructions](#)

Shock to performance?

Include growth assumption?

Implement resilience plan?



**University of Salford**  
MANCHESTER

Implementation start for resilience plan

0    13    26    39    52

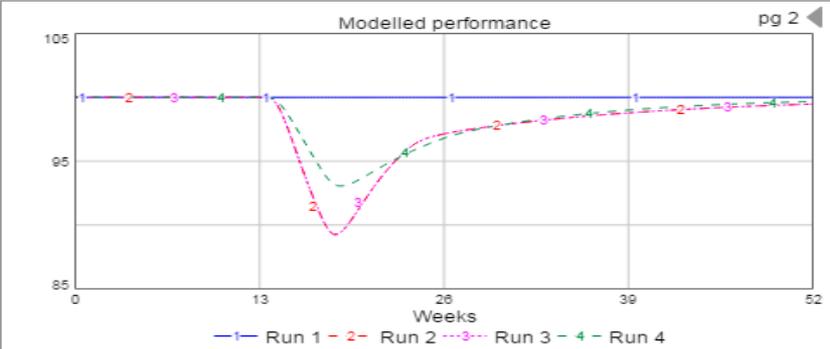
Weights inputs page

2: Profile of Shock

--	--	--	--	--

Capacities Explained

**Modelled performance** pg 2



— Run 1 — - - Run 2 - · · · Run 3 - · - - Run 4

**Table 1: AARCA Resilience Capacities**

	Absorptive	Anticipative	Restorative	Coping	Adaptive
Production	3	3	3	3	3
Distribution	1	1	2	2	1
Management and decn making	3	3	3	3	1
Physical infrastructure	1	1	1	1	1

Include resilience in production

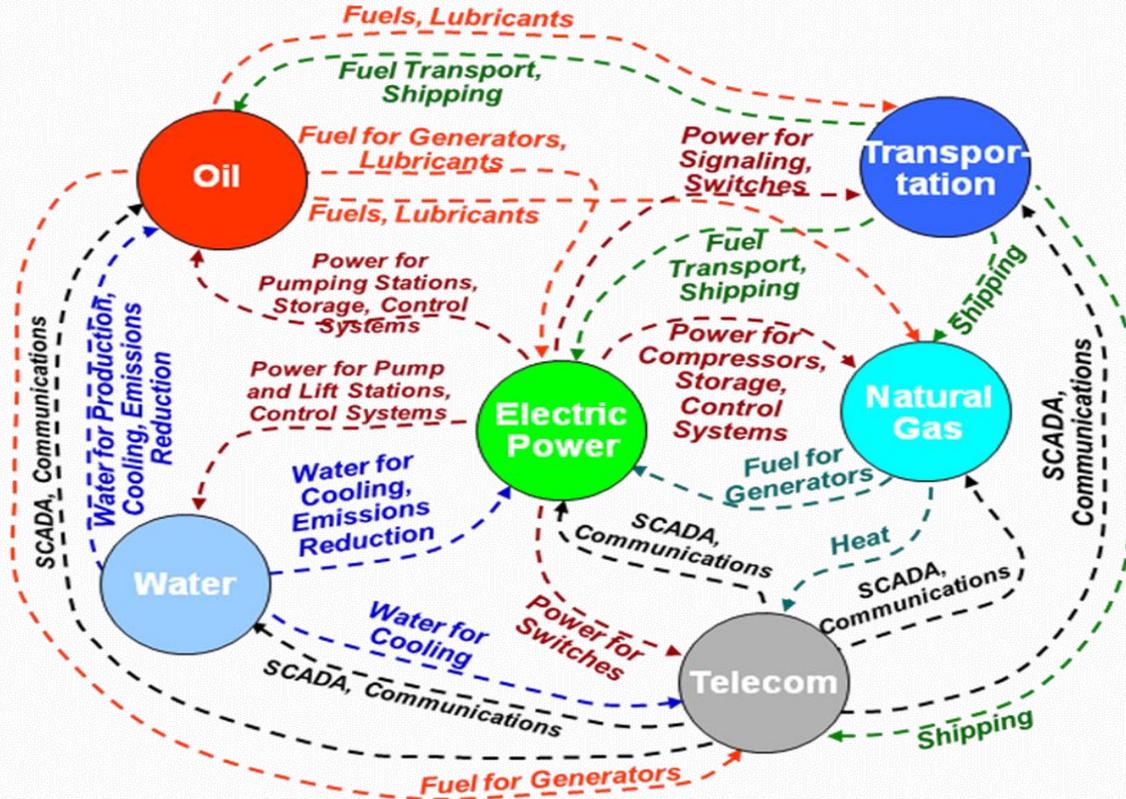
Include resilience in distribution

Include resilience in Mgt and Decision making

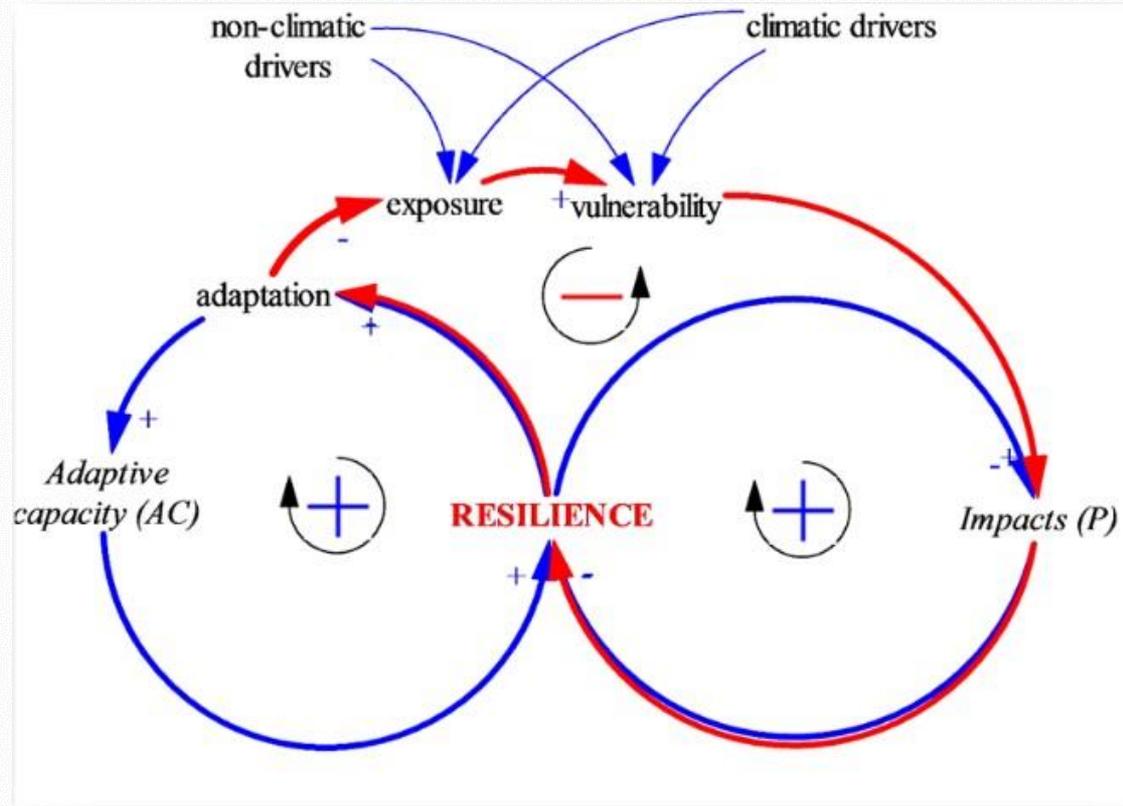
# Stakeholder Workshops



# Challenge: Interdependencies



# Challenge: Static vs Dynamic



# Challenge: Responsibility



Thank You !