

August Hazardous Webinar: Natural hazards and resilience in complex urban systems

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The project

Natural hazards and resilience in complex urban systems

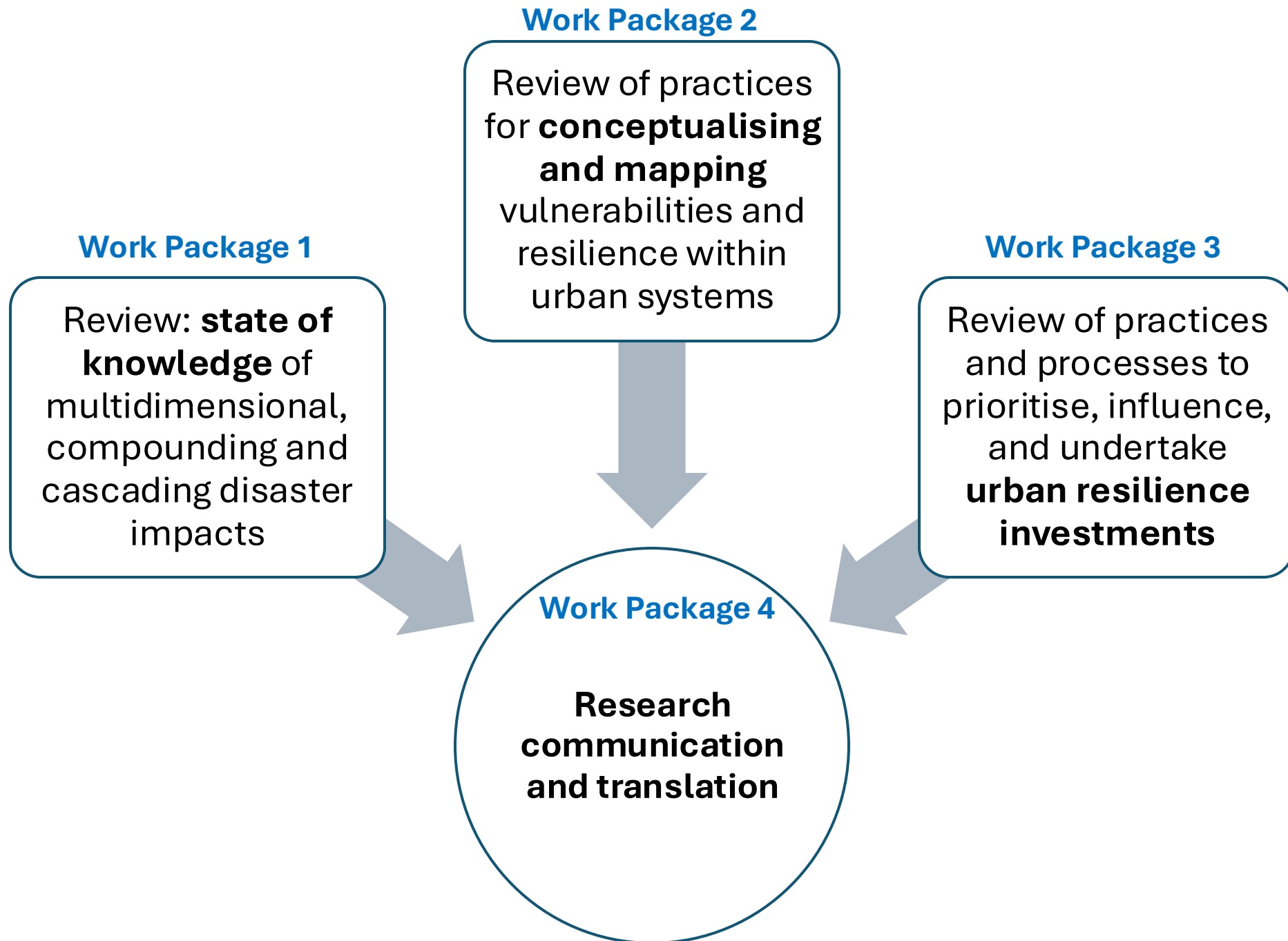
- Understanding of vulnerabilities to multi-dimensional, compounding and cascading disaster impacts within complex urban systems
- Better understanding of how to build urban resilience and reduce disaster risk
- Resilience strategies and investments
- Communicate and disseminate insights



Source: Adobe Stock



Project approach

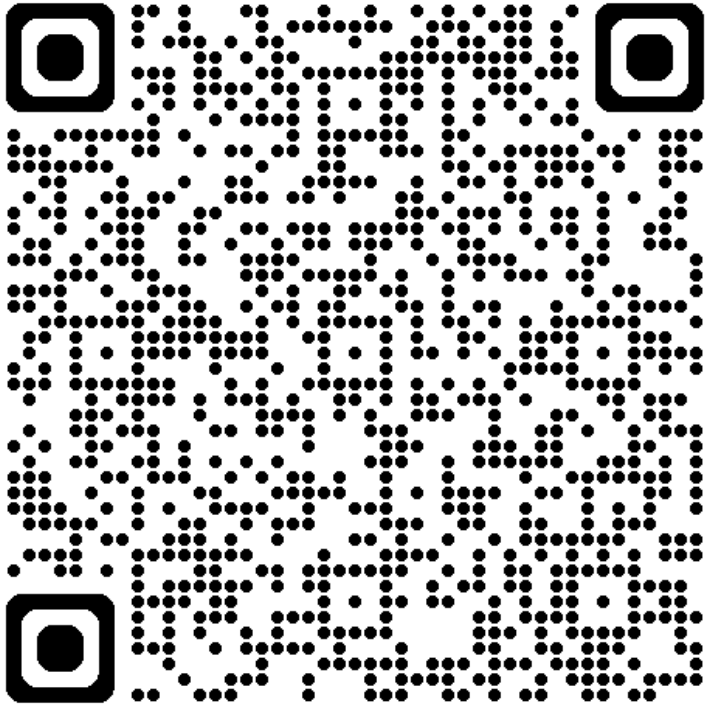


Research translation / Outcomes

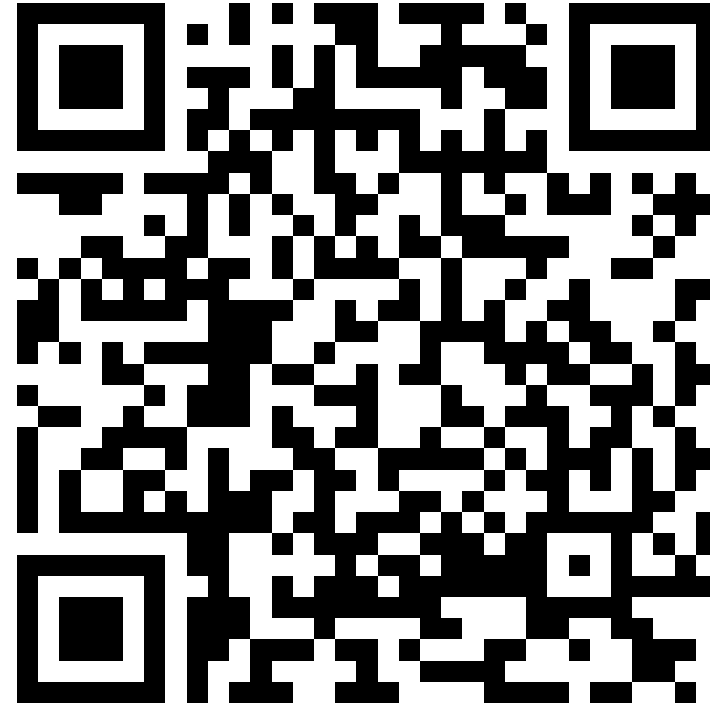
- **Practical guidance tool:** Considerations for conceptual mapping of vulnerabilities and resilience at local scales
- **Proof of concept case study** for practical guidance tool
- **Draft process principles and standards** for prioritising and influencing urban resilience investments
- **Draft guidance on monitoring and evaluation** of urban resilience investments – work in progress
- **Capability resources** – work in progress



Where can I find out more?



The project website



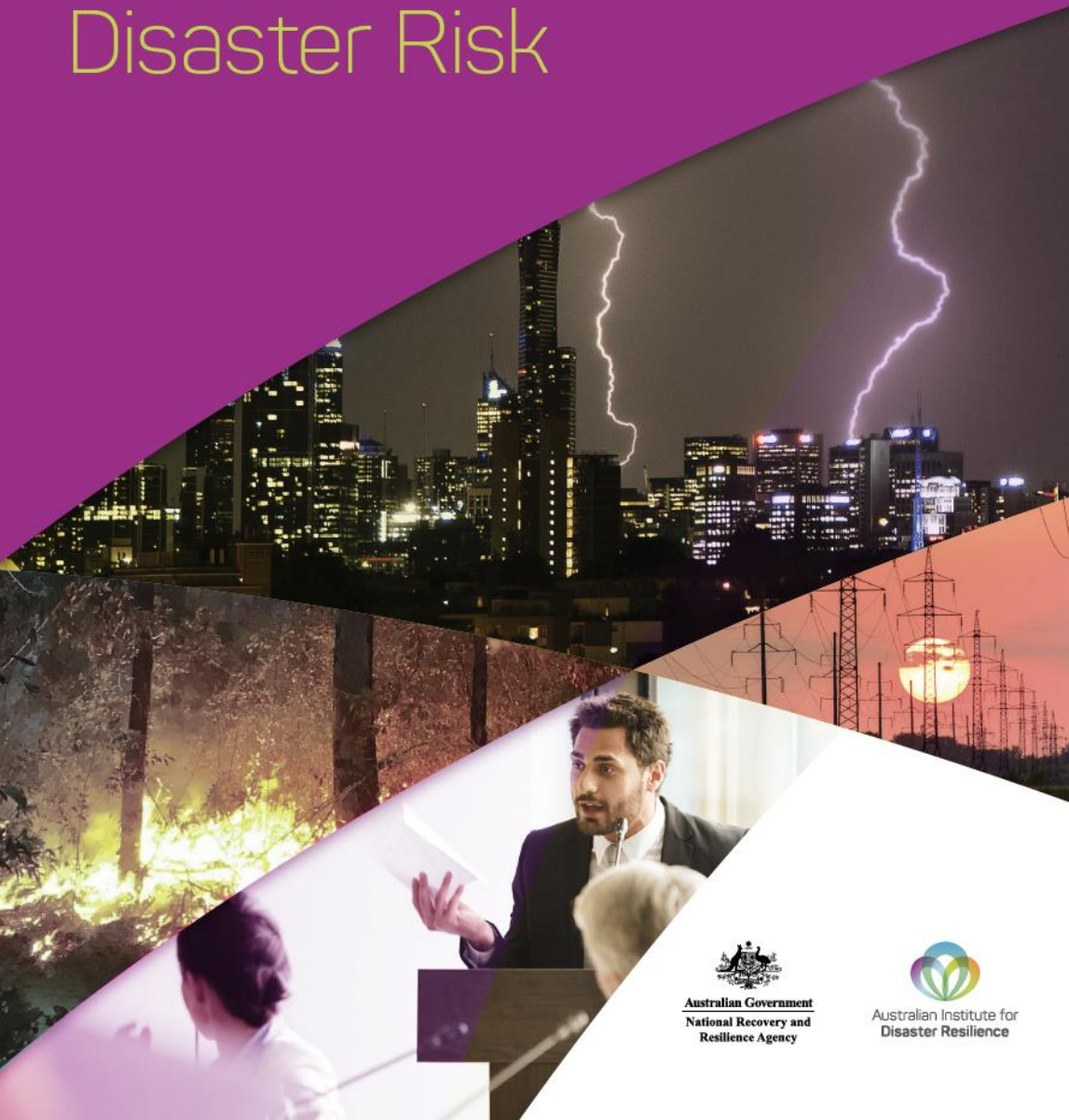
Expression of interest to be part
of the proof-of-concept study



Complex urban systems and systemic risk



Systemic Disaster Risk



2022



2021



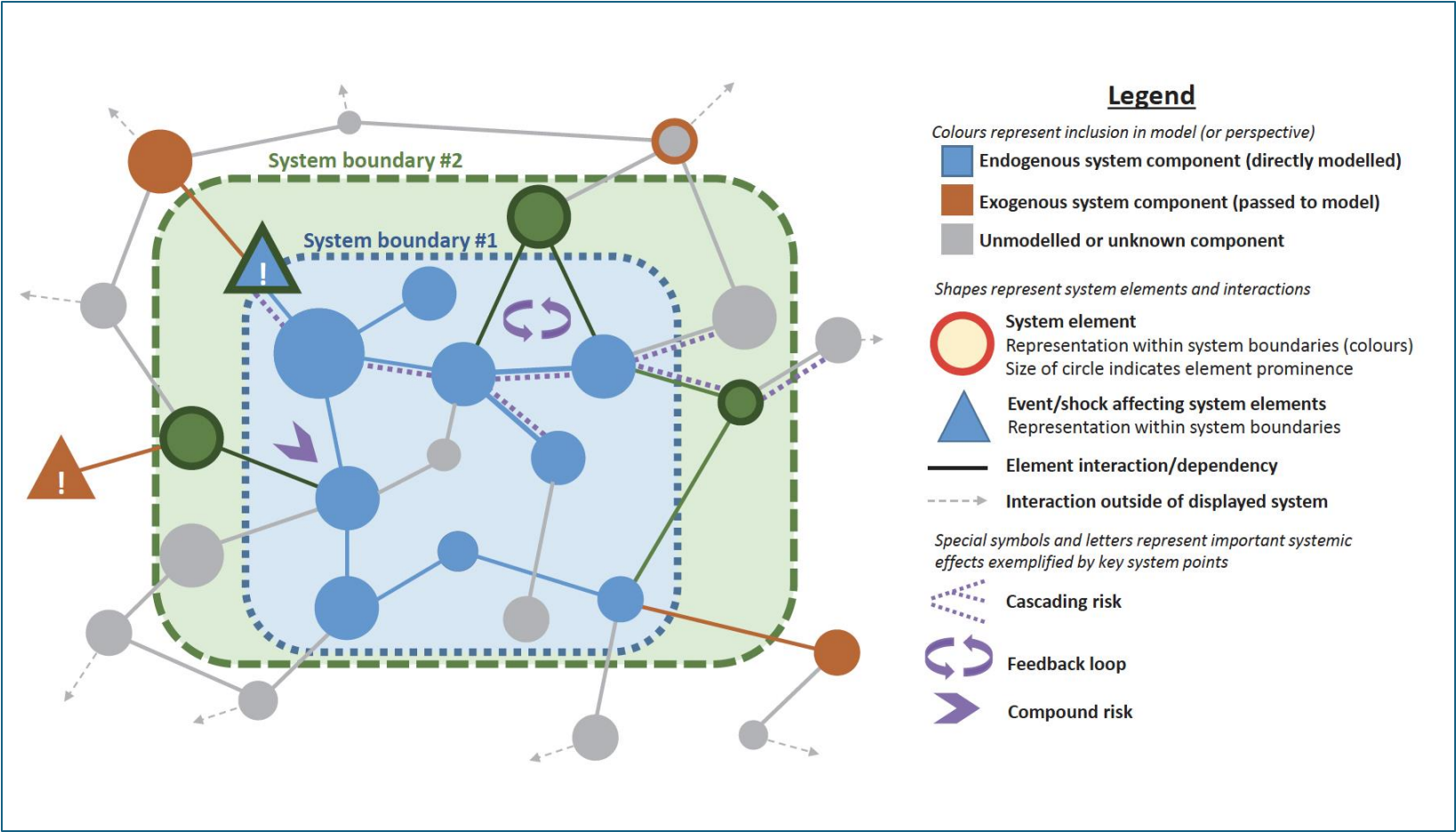
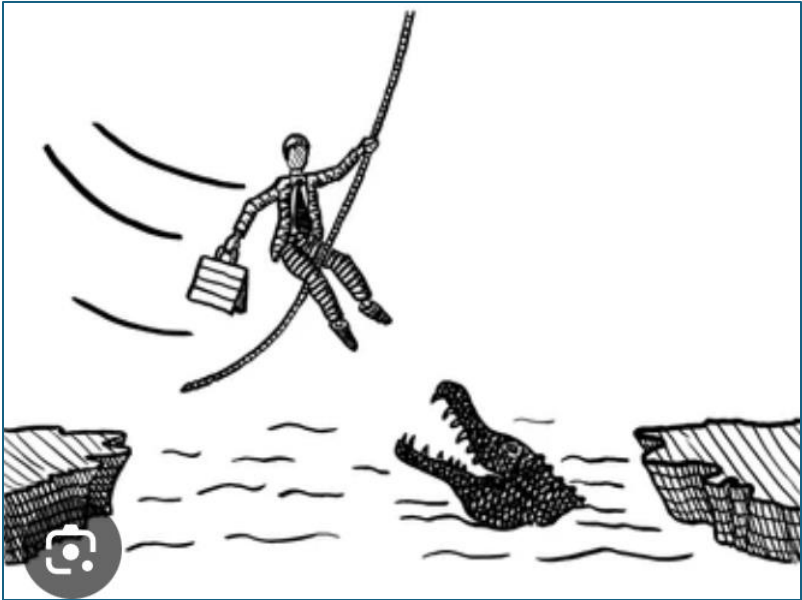
BRIEFING NOTE

SYSTEMIC RISK



REVIEW AND OPPORTUNITIES FOR RESEARCH, POLICY AND
PRACTICE FROM THE PERSPECTIVE OF CLIMATE, ENVIRONMENTAL
AND DISASTER RISK SCIENCE AND MANAGEMENT

How is urban resilience related to systemic risk?



Cities are complex systems

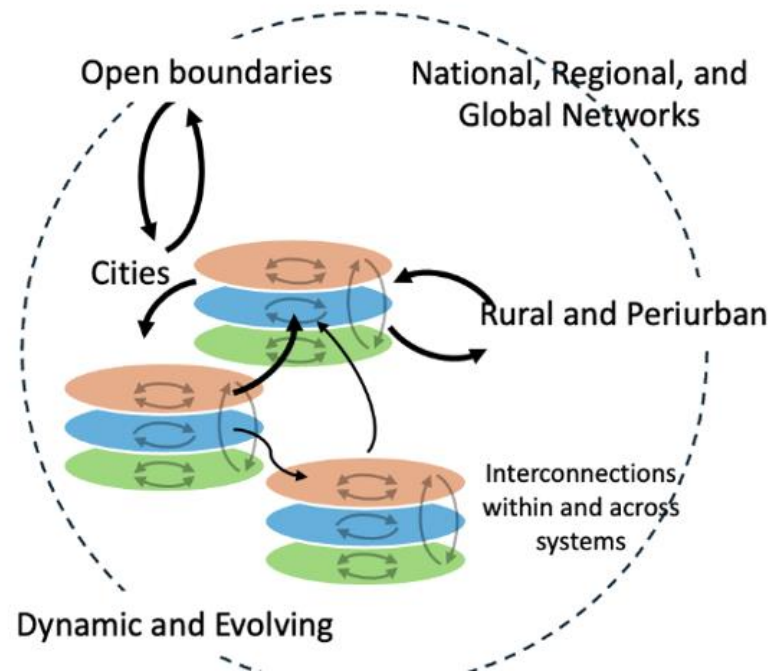


(Adapted from FEMA, 2024, p. 7)

Cities are complex systems of open systems

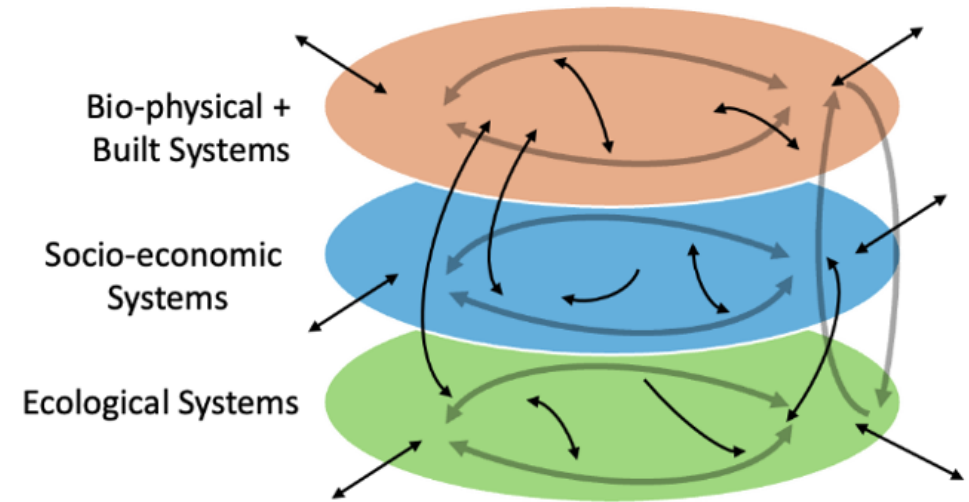
CITIES AS OPEN SYSTEMS

Cities are open systems, both influencing and influenced by the external world via complex linkages and feedback loops



CITIES AS COMPLEX SYSTEMS

Interconnected elements, subsystems and systems



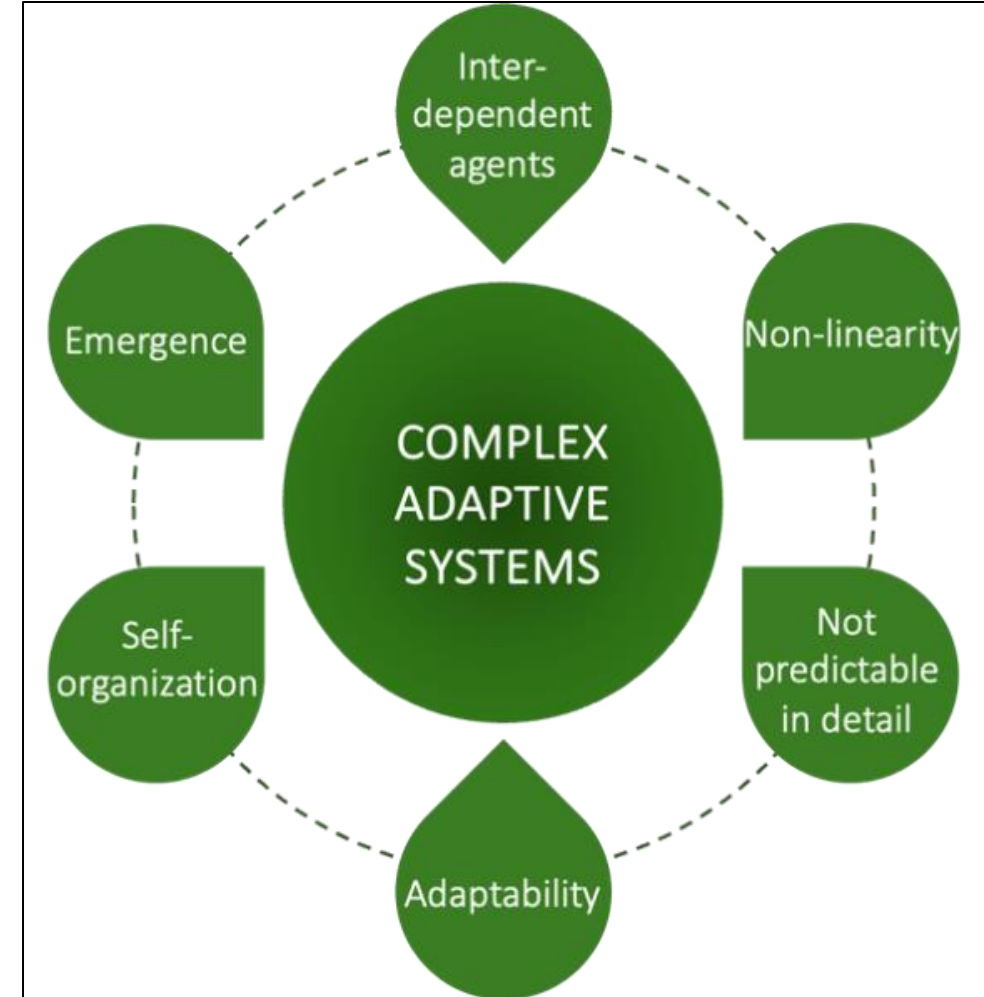
Cities are a particular type of system

Cities are complex adaptive systems (CASs)

When disruptions occur, they have the capacity not just to **self-organise**, but to continuously re-organise their elements, sub-systems, and the patterns and impacts of their interactions.

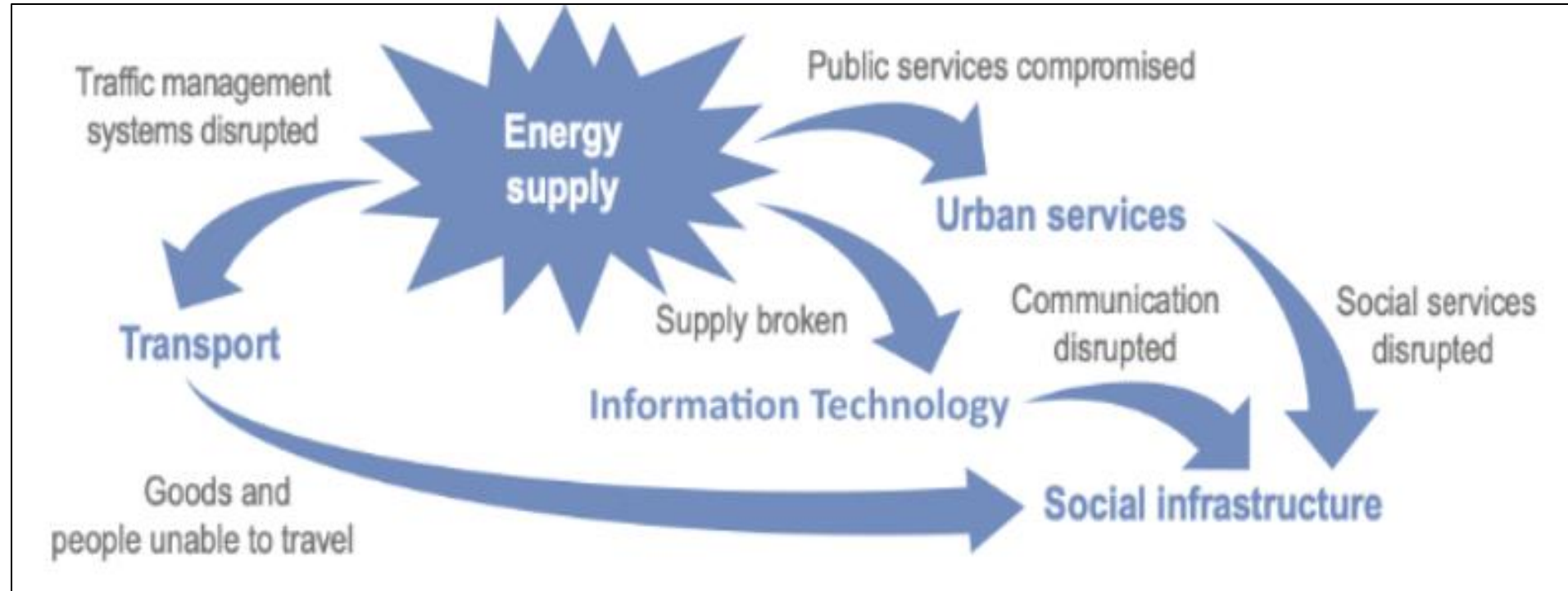
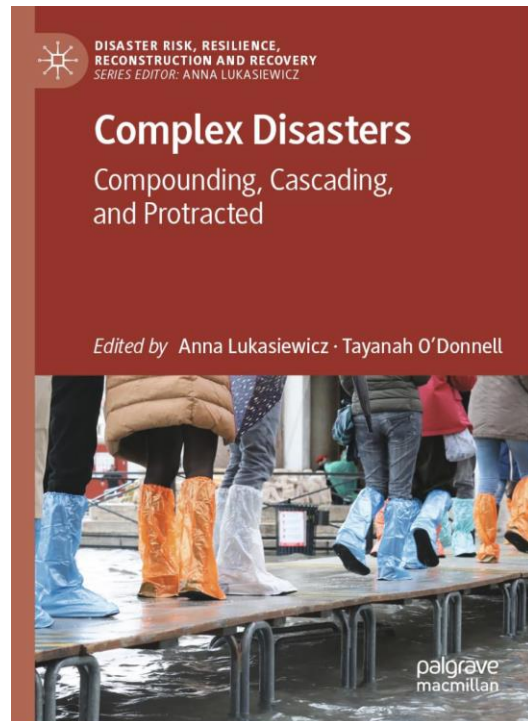
Their **emergent** properties are more than the sum of the individual parts but feed back to the parts and contribute to new ongoing interactions.

(Adapted from Folke, 2006, pp. 5-6)

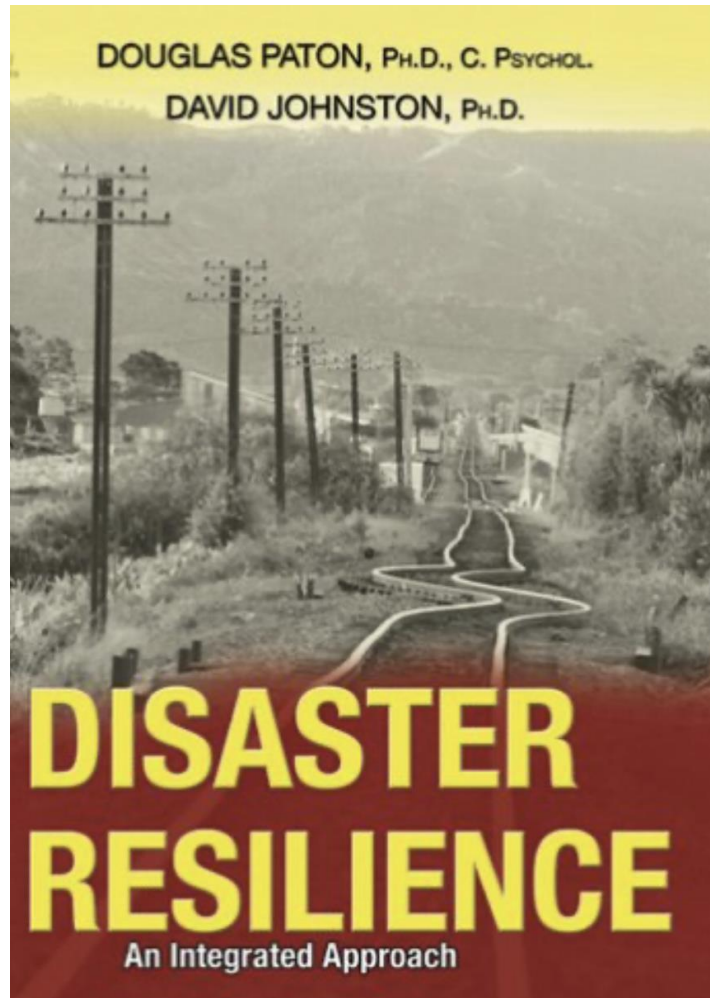


(Adapted from Akinboade, 2021, p. 5)

Hazards, risks and impacts in a CAS are multidimensional, compound, cascading, and changing over time



Interdependence matrix of a flooded power station



| <div>Depends on</div> | Water Supply | Gas Supply | Sewerage | Storm Water | Mains Electricity | Standby Electricity | VHF Radio | Telephones | Roads | Rail | Air transport | Fuel Supply | Fire Fighting | Air-conditioning | Total Importance |
|---------------------------|--------------|------------|----------|-------------|-------------------|---------------------|-----------|------------|-------|------|---------------|-------------|---------------|------------------|------------------|
| Water Supply | * | 1 | * | * | * | * | * | * | * | * | * | * | 3 | 2 | 6 |
| Gas Supply | * | * | * | * | * | * | * | * | * | * | * | * | * | * | 0 |
| Sewerage | * | * | * | * | * | * | * | * | * | * | * | * | * | * | 0 |
| Storm Water | * | * | * | * | * | * | * | * | * | * | * | * | * | * | 0 |
| Mains Electricity | 2 | 1 | 2 | 2 | * | 2 | 3 | * | 1 | 3 | 2 | * | 3 | 21 | |
| Standby Electricity | 3 | 1 | 3 | 3 | * | 1 | 3 | * | * | 3 | 2 | * | 2 | 21 | |
| VHF Radio | 3 | 3 | 3 | 2 | 3 | * | 2 | 2 | 2 | 3 | * | 3 | * | 26 | |
| Telephones | 2 | 1 | 1 | * | 1 | 1 | 2 | * | 1 | 1 | 1 | 2 | * | 13 | |
| Roads | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 2 | * | 2 | 3 | 2 | 3 | 1 | 27 |
| Rail | * | * | * | * | * | * | * | * | * | * | * | * | * | * | 0 |
| Air Transport | * | * | * | * | * | * | * | * | * | * | * | * | * | * | 0 |
| Fuel Supply | 3 | 1 | 1 | 1 | * | 3 | 1 | 2 | 3 | 2 | 3 | * | 3 | * | 23 |
| Fire Fighting | * | * | * | * | * | * | * | * | * | 2 | 1 | * | * | * | 3 |
| Air-conditioning | * | * | * | * | 2 | 2 | * | 3 | * | 2 | * | * | * | * | 9 |
| Equipment | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 40 |
| Total Dependence | 18 | 12 | 16 | 12 | 12 | 11 | 10 | 18 | 8 | 11 | 23 | 10 | 17 | 11 | |
| Priority Factor | 24 | 12 | 16 | 12 | 33 | 32 | 36 | 31 | 35 | 11 | 23 | 33 | 20 | 20 | |

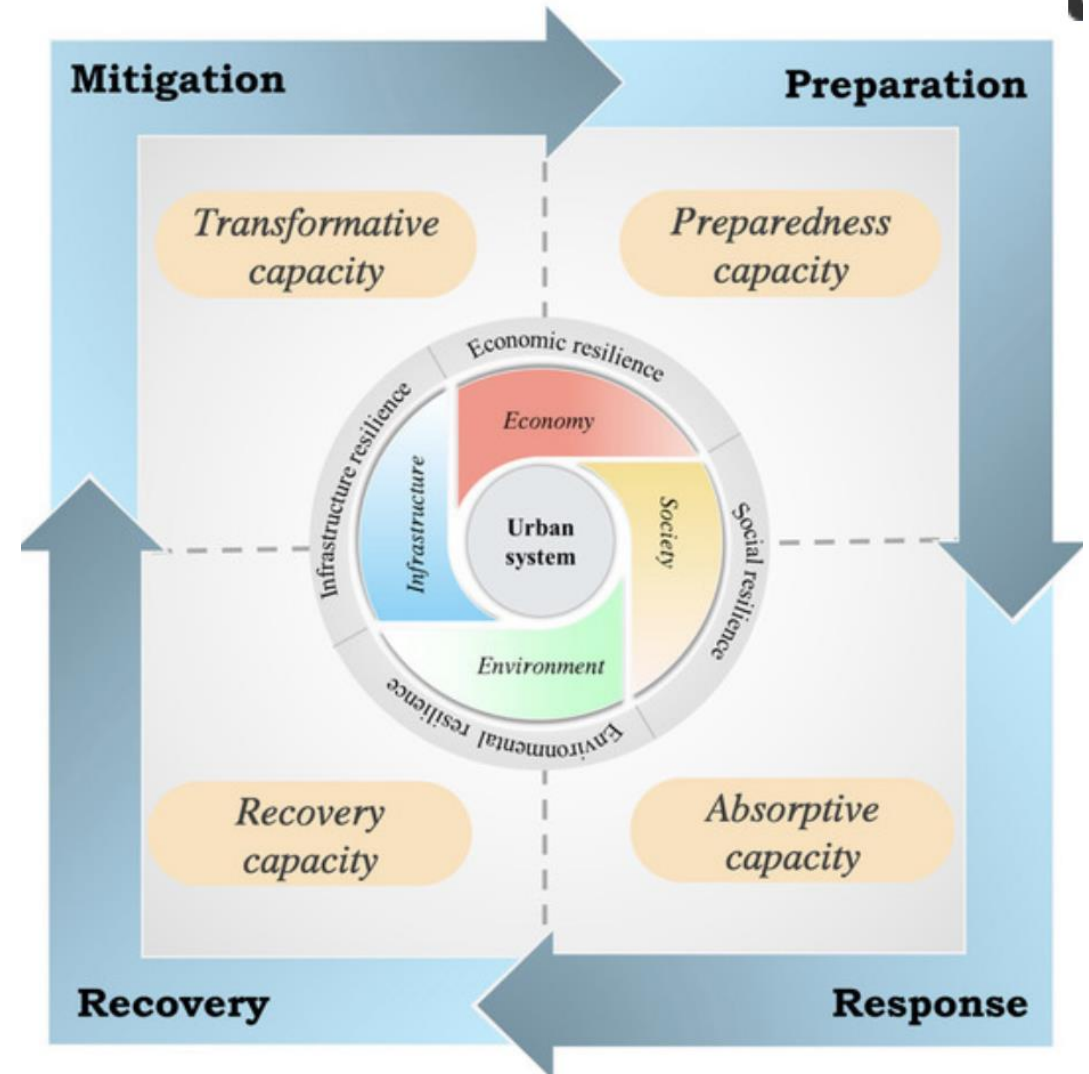
Note: 3 = High Dependence
2 = Moderate Dependence
1 = Low Dependence
* = No Dependence

Priority Factor = Importance + Dependence

Inherent resilience

All cities have a degree of pre-existing resilience

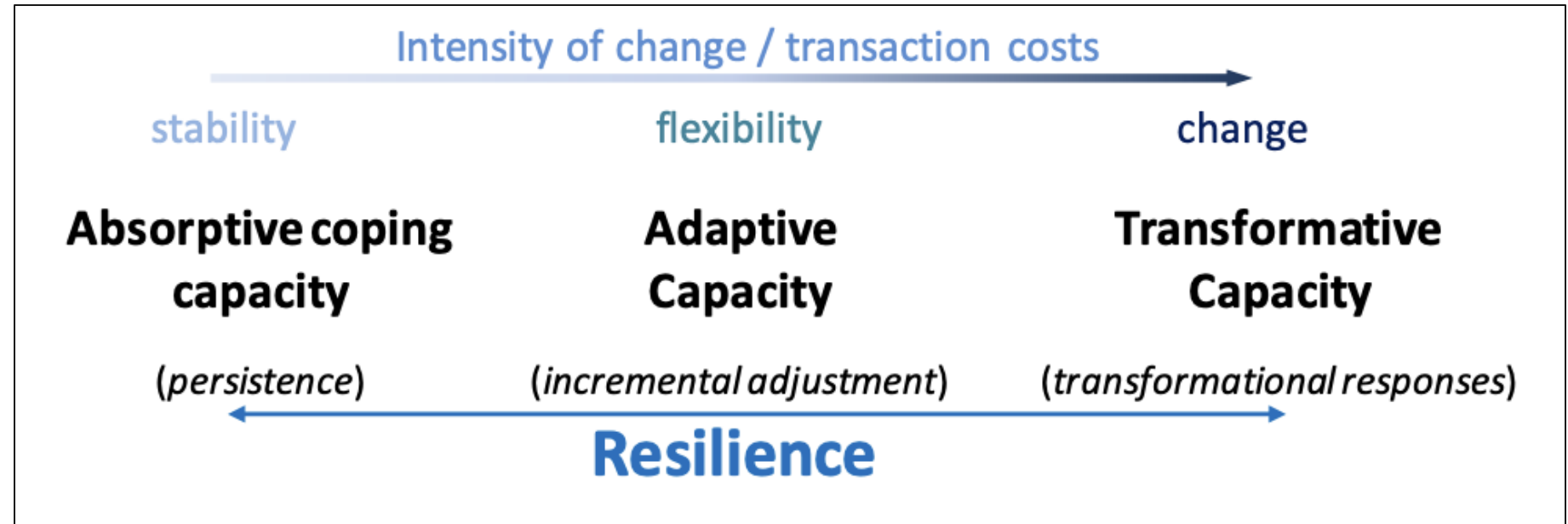
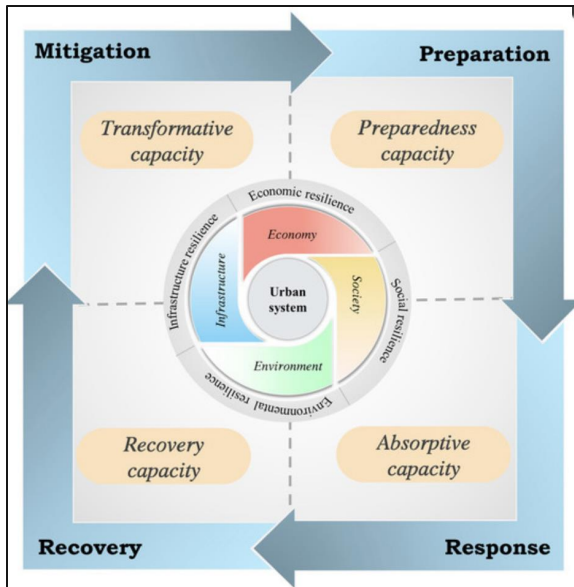
- Based upon a variety of capacities.
- But these are unevenly distributed in society – and urban centres
- Capacities for resilience can be strengthened
- **Planned resilience**



(Scheffran, 2016, Figure 1)

And here we have decisions to make!

- How do we define resilience?
- Do we want to address drivers of shocks or the stressors that intensify vulnerabilities
- What capacities need strengthening?
- How much change can society tolerate? What transaction costs will we bare?



But what decisions ?

| Forms | Purpose and Mechanisms |
|-----------------------------|---|
| Engineering resilience | <p>Purpose: To prevent, absorb or resist shocks through physical interventions that seek to make a system “fail-safe” by increasing the resistance or absorptive capacity of a system to disturbance.</p> <p>Examples: Levee banks / sea walls / stronger building codes / fire breaks</p> |
| Socio-ecological resilience | <p>Purpose: As well as absorb or resist shocks, socio-ecological resilience involves adapting system elements, subsystems, and their interconnections in order to retain essential system functions without fundamentally altering its core identity. (self-organising and emergent behaviour)</p> <p>Examples: Nature-based solutions / education, communication and capacity building / urban farming</p> |
| Transformative resilience | <p>Purpose: To achieve climate and disaster justice by reducing socio-economic vulnerabilities in order transform – fundamentally change – the power dynamics in a society to promote long-term sustainability.</p> <p>Examples: Participatory decision-making and governance / Application of FN knowledges / doughnut economics / foresight</p> |

With what effect?

