Understanding the resilience of lifelines for regional and remote communities

Conceptual framework and research agenda

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Overview

1. Increasing compounding and cascading disasters
2. Critical infrastructure
3. Lifeline resilience
4. Research agenda
5. Panel discussion

Photo: Friedo Lightart, Natural Hazards Research Australia

Increasing compounding and cascading disasters

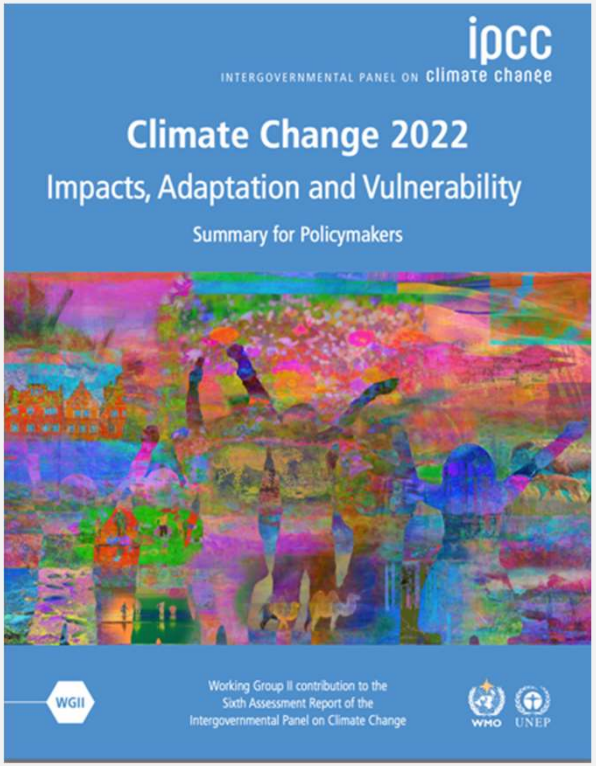
Climate change

‘As climate change intensifies, we are now seeing cascading and compounding impacts and risks, including where extreme events coincide.

These are placing even greater pressure on our ability to respond.

While the work of adaptation has begun, we have found the progress is uneven and insufficient, given the risks we face’

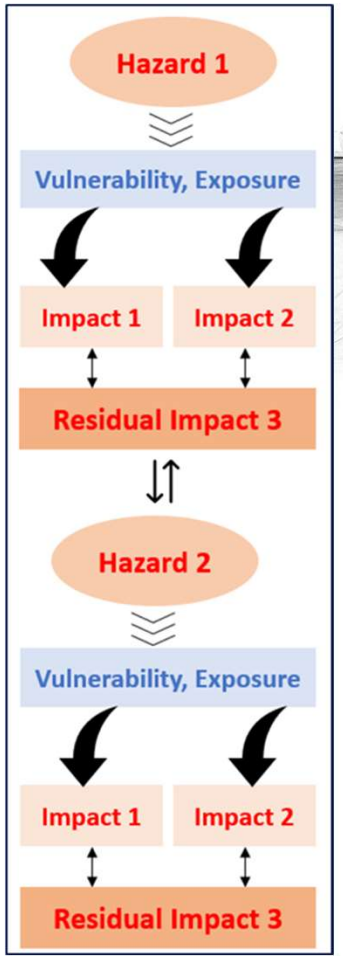
Mackey et al. (2022) New IPCC report shows Australia is at real risk from climate change, with impacts worsening, future risks high, and wide-ranging adaptation needed, *The Conversation*, Feb 28.



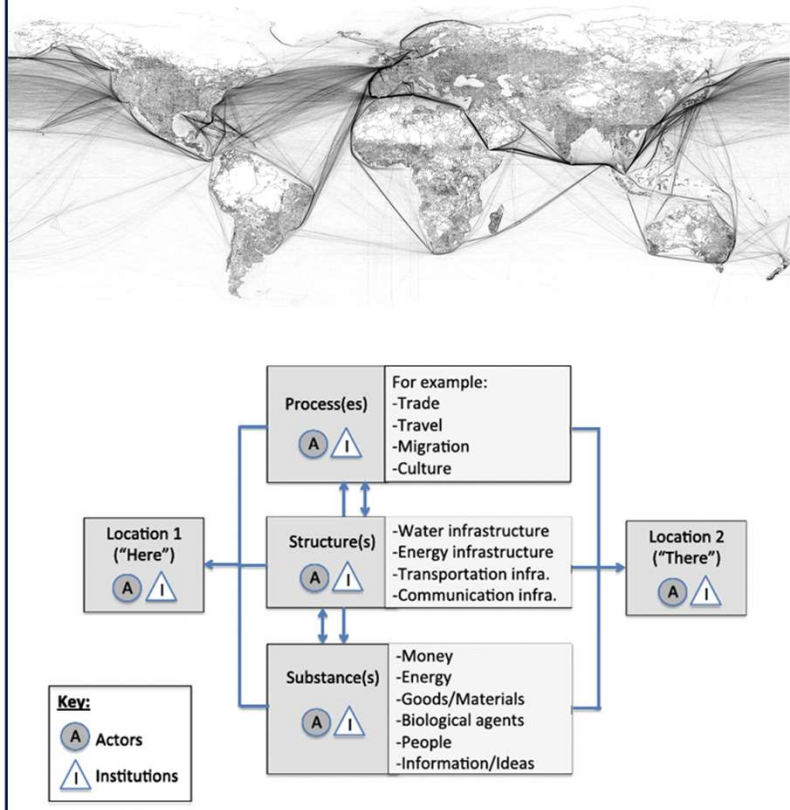
Cascading impacts

Why are impacts cascading?

- More severe extreme events mean functional thresholds in systems are being crossed - dramatically reducing performance
- Infrastructure interdependencies and complex social 'teleconnections' between locations mean that impacts in one system and place can trigger impacts in other systems and places
- Failures of infrastructural systems are impacts and, depending on their function, can greatly worsen impacts



ESCAP, 2023



Moser & Hart, 2015

Views from the sector

Most pressing risks and threats

In addition to climate change, **systems interconnections** were most frequently raised by interviewees as the most pressing risk / threat facing Australians.

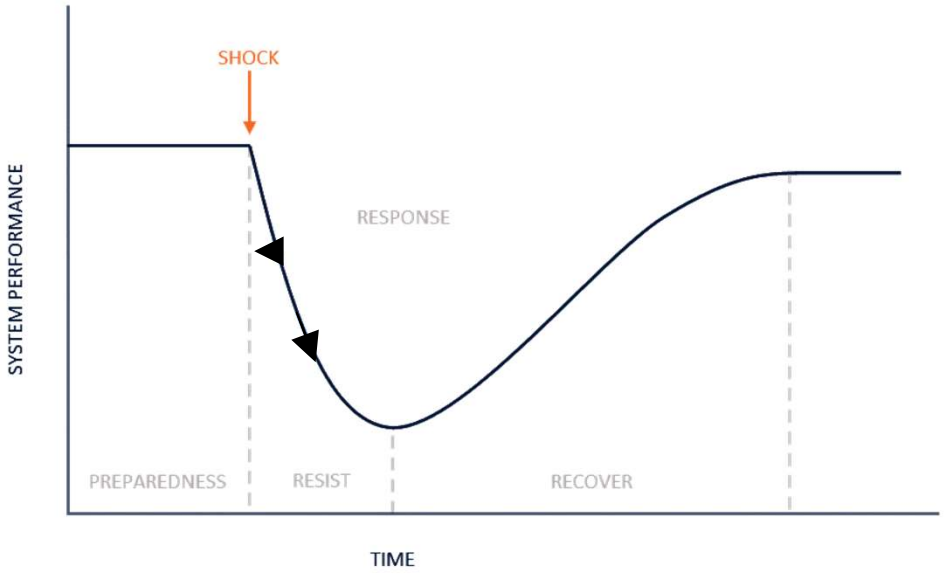
In particular, interconnections involving:

- Communications
- Power / electricity
- Computer systems
- Supply chains

> *Disruptions have significant impacts across the board, it's hard to pull out just one, but maybe that's because I see the whole system. I would struggle to pull one over the other. I think if you said a threat to, say, our energy system - which we know has significant implications for lifelines across the board – you could also pull another one out and equally say it has significant impacts across the board.* ***It's the interconnection that's the threat.***
>
> - Project interviewee

Catalytic impacts

Among systems being affected are the **systems needed for disaster response and recovery**. When these fail, the shock is not resisted, and initial impacts propagate and deepen.



Robinson & Dunk (2020)

e.g. Communications
e.g. Electricity

Optus Outage

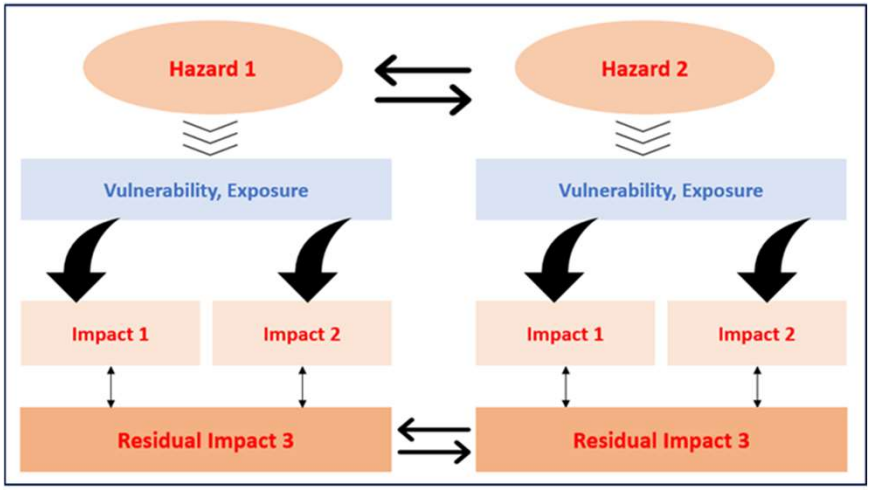
Early Nov 2023, Optus had a core network fault and severe outage, affecting at least 12m customers directly - including an inability to phone 000.

A large, unknown number of people were indirectly affected via impacts on the health system, financial system (EFTPOS facilities) and transport system.

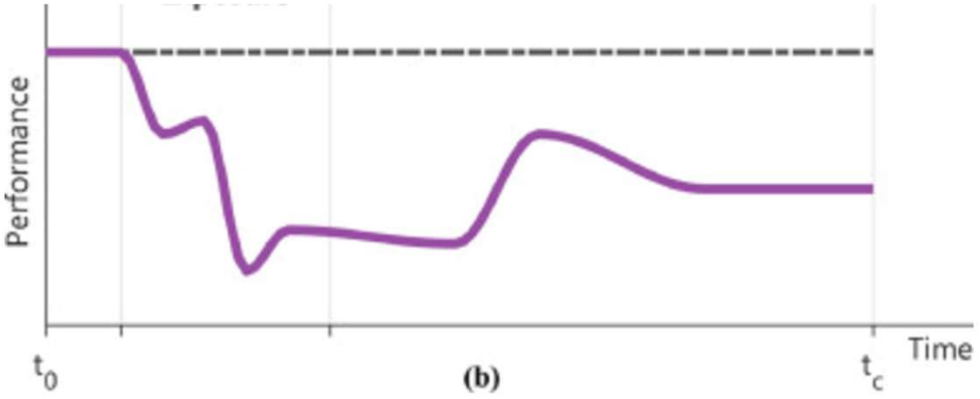
Compounding disasters

Why are impacts compounding?

- Climate change-related extreme events are more frequent
- Disaster 'recovery' is slowed because conventional recovery capacities are eroded
- Long tail of recovery = Residual impacts = Vulnerability to next shock = Worse impacts next time



ESCAP, 2023



Poulin & Kane, 2021

Infrastructure

‘Infra’ = below
Infrastructure = *underlying* structures

The systems of circulation that connect us and enable us to function collectively

Built infrastructure is unevenly distributed, spatially and socially

Social infrastructure = ‘the facilities, spaces, services and networks that support the quality of life and wellbeing of our communities’ (Infrastructure Australia 2019: 388).

Natural infrastructure = the spaces, systems and ecological services that underpin life

Critical infrastructure

Critical infrastructure = “vital systems” of circulation

Critical infrastructure is: ‘those physical facilities, systems, assets, supply chains, information technologies and communication networks which, if destroyed, degraded, compromised or rendered unavailable for an extended period, would significantly impact the social or economic wellbeing of Australia as a nation or its states or territories, or affect Australia’s ability to conduct national defence and ensure national security.’ *Australian Government (2023) Critical Infrastructure Resilience Strategy.*

Sectors categorised as ‘critical’ by the ‘Critical 5’ nations

Australia	USA	Canada	UK	NZ
Energy Communications Financial services and markets Defence industry Food and grocery Water and sewage Transport Healthcare and medical Space technology Data storage and processing Higher education and research	Chemical Commercial facilities Energy Communications Critical manufacturing Dams Financial services Defence industrial base Emergency services Food and agriculture Water and wastewater Nuclear reactors, materials and waste Transportation Health and public health Government facilities and services	Energy and utilities Finance Food Health ICT Manufacturing Safety Transportation Water Government	Chemicals Civil nuclear Communications Defence Emergency services Energy Finance Food Health Space Transport Water Government	Broadcasting Telecommunications Energy Transport Water

Adapting to Evolving Threats: A Summary of Critical 5 Approaches to Critical Infrastructure Security and Resilience, Public Safety Canada (2024)

Interconnected critical infrastructure

‘Due to the increasingly connected nature of critical infrastructure, the impacts of compromises to critical infrastructure can spread rapidly across the economy with immediate and cascading consequences. For example, the consequences of a prolonged and widespread failure in the energy sector […] could be catastrophic [...]’

Dept. Homeland Affairs, Regulation Impact Statement, 2020, p. 4

Dandenong Storm June 9, 2021

Direct physical damage to buildings, roads, parks (90% trees down in some areas)

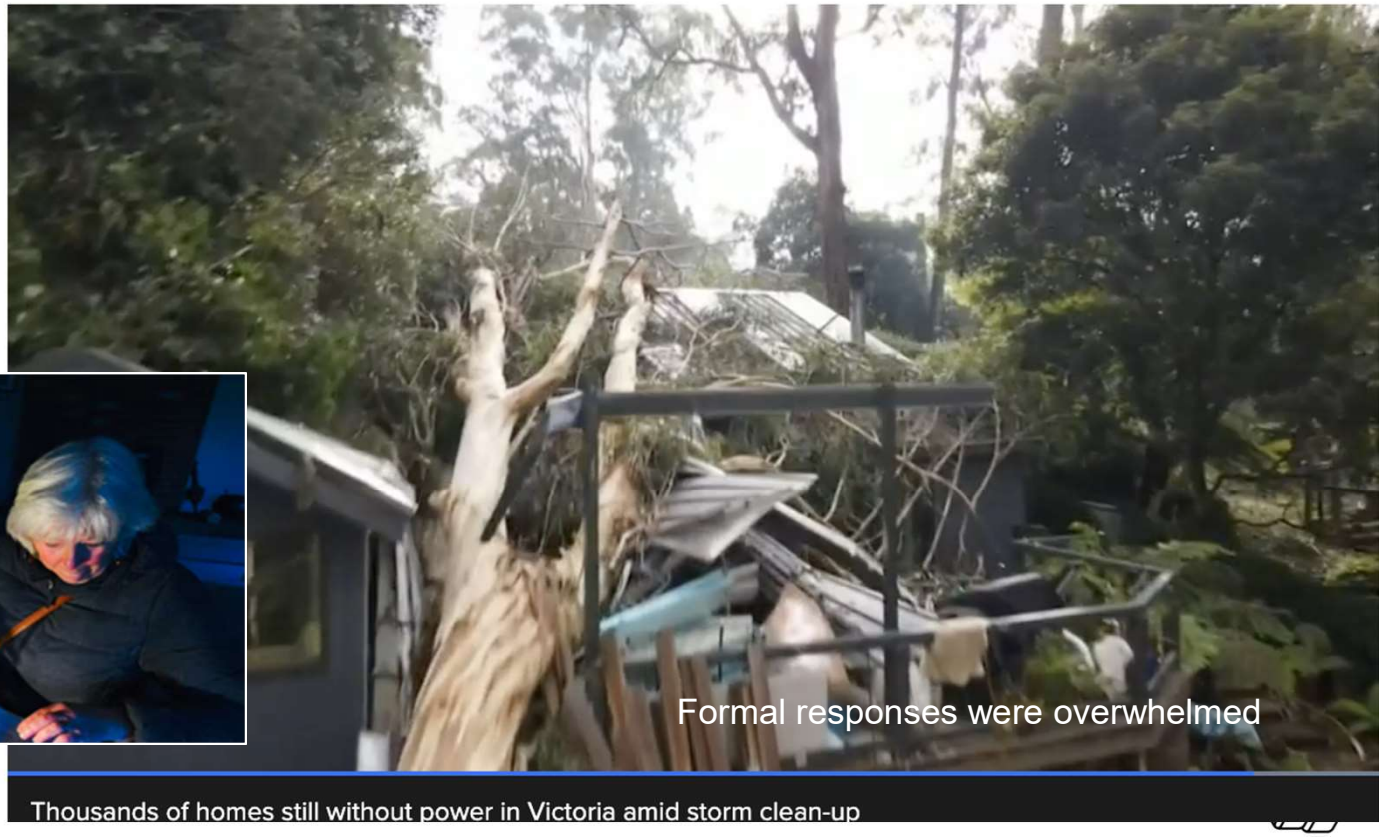
Indirect physical damage to other infrastructure eg water

Electricity outage for weeks

NBN outage for weeks

'The most traumatic night of our lives': Residents still reeling a year after worst storm on record

By Serena Seyfort • Afternoon Editor | 7:34am Jun 9, 2022



Thank you to Belinda Young for work on this example

Outback SA, 2022

Road network washed away in devastating floods.

Major indirect impacts on emergency services and supply chains for and through the area.

Road repairs to major highways were prioritised.

Smaller roads left unrepaired for months.

Thank you to Ariane Gienger, Melissa Nursey-Bray and Masud Kamal for work on this example

Northern Rivers floods, 2022

Far-reaching direct physical damage to houses, government buildings, schools, doctor surgeries, roads, electricity networks, mobile phone towers, farms…

Indirect physical damage to myriad other infrastructure including food and grocery, health care

Supermarkets in Lismore shut for 4 months

The town of Lismore in the NSW northern rivers region was hit by two huge storms in February and March last year. The floods were the most expensive disaster in Australian history. Photograph: David Maurice Smith/The Guardian

Thank you to Rebecca McNaught and Tegan Larin for work on this example

Dandenongs

“The on-the-ground people, that haven’t got any labels or positions or anything, were the ones who came out to help everyone” (Valerie Budge, 89 yr old resident)
https://www.9news.com.au/national/dandenongs-storms-residents-still-reeling-a-year-later/103068ad-295d-41db-9618-27386380c498

Outback SA

Community members sourced equipment and supplies to repair roads themselves.

Northern Rivers

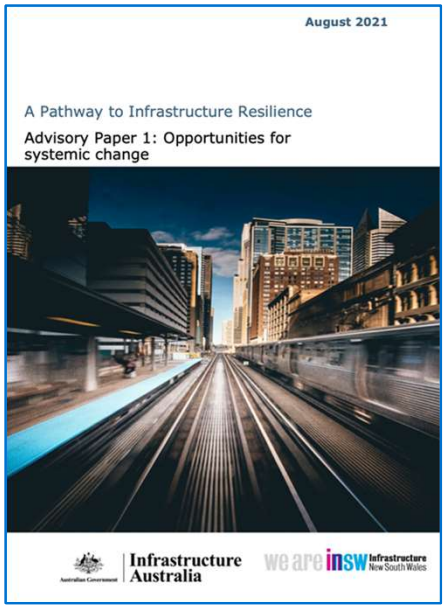
Community members rescued 100’s of people. They created accommodation, they sourced, grew and prepared food for each other. They helped keep the hospital functioning.

When infrastructure fails, it is local people that keep the associated systems functioning.

People are critical to infrastructure as much as infrastructure is critical to people.

Lifeline resilience

Evolution of thinking



Protection of critical infrastructure assets

Resilience of critical infrastructure functions
OR
Critical infrastructure for resilience

Resilience of lifelines
Links for and by life

Past

Future

Views from the sector

Resilience thinking

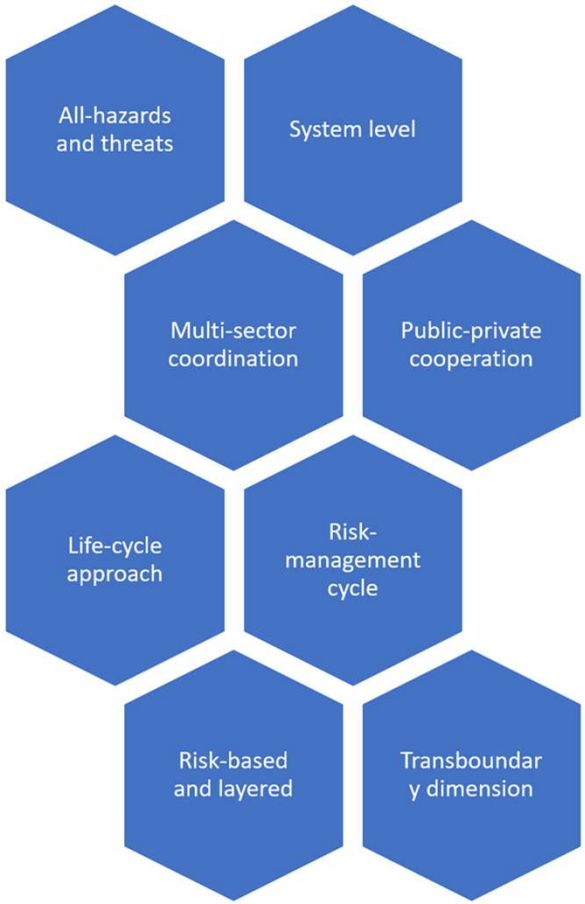
Interviewees are increasingly practicing "resilience thinking". They expressed significant support for resilience-based approaches, particularly highlighting the importance of:

- Community engagement
- Decentralisation
- Empathy and compassion
- Understanding interdependencies
- Building social capital

> *"You know, if you're looking at solving a problem from a systems level, you actually need to be hearing the voices of the people impacted first and foremost, and that's what needs to inform your direction and your understanding."*
>
> -Project interviewee

Resilience thinking in infrastructure systems

"...shift from a protection-centric strategy to one that emphasises resilience."

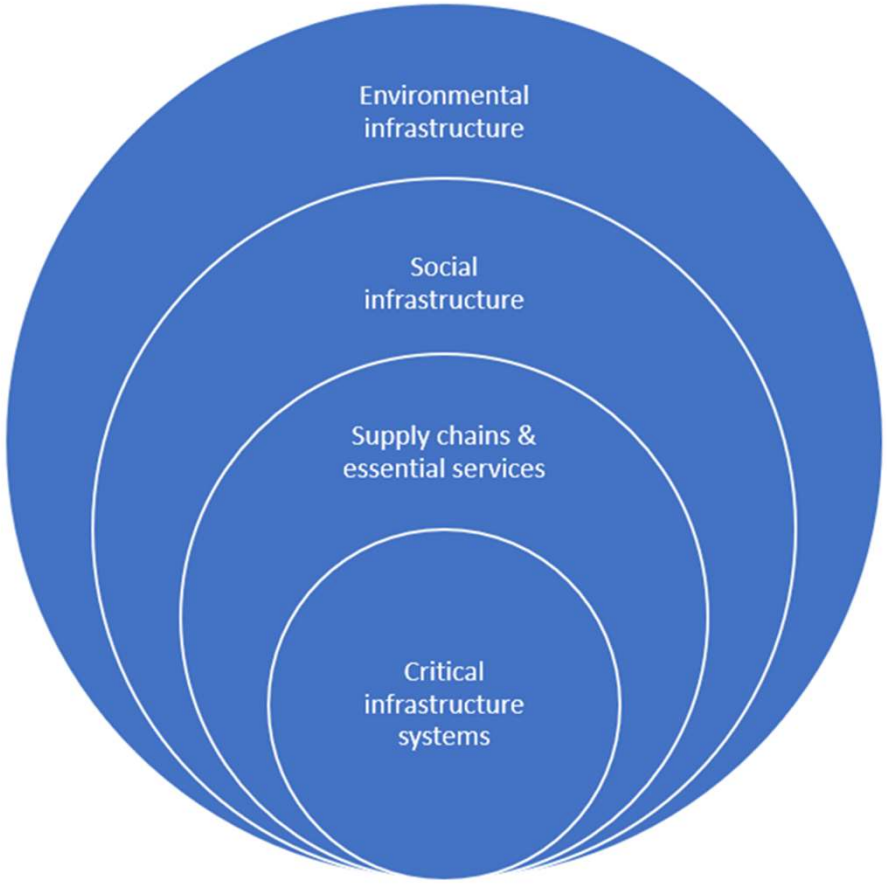


Lifelines

The successful functional integration of critical infrastructure (e.g., transport infrastructure, telecommunications, access to healthcare and so on), supply chains, and essential services, *in ways that sustain people's lives and day-to-day activities.*

This ***requires people***. Lifelines include not only assets, but the people and capabilities required to operate and use and compensate for them when they fail. They are ultimately reliant on social relationships and the broader socio-ecological systems we are part of.

They are 'systems of systems' where **the most critical elements are *links for and by life.***



Lifeline resilience in action

Warburton Highway Repair

- Oct-Nov 2022, La Niña driven rainfall resulted in landslips in the Upper Yarra & Dandenong Ranges, Vic.
- Warburton Highway half closure of already critical road. Repair estimated to take 12 weeks, completely cutting off three townships and 2500 people.
- Council convened an all agency forum to coordinate recovery and elevate community voices.
- DTP redesigned road repair plan, final road closure only 3 weeks, with upgrades and supplementary lighting installed.
- Governance arrangements that enable place-based connections are critical for lifelines resilience.

Temporary one lane operation following the landslip.
Image credit: Stewart Chambers, Upper Yarra Mail

Lifeline resilience in action

Friends of the Tenterfield Aerodrome

- 2022 Tenterfield Shire Council wants to sell the aerodrome. Local volunteers takes over.
- FOTA organise a 210,000 litre water tank, finished Oct 18 2023. Oct 26 2023: lightning storm ignites 50 bushfires in the region (section 44 bushfire).
- Aerodrome becomes the RFS base of operations, credited with saving many properties.
- Community social capital resulted in water and suppressant application at least 5X greater than would have been possible without the aerodrome.
- Estimated to have saved $60,000 per day, per aircraft.

Aerial firefighting aircraft at Tenterfield Aerodrome, 2023. Photo credit: Rob Evans

Enablers of lifeline resilience

- Strong communities
- Healthy environments
  - *Both of which require addressing the sometimes harmful side-effects of and unjust access to large infrastructural systems.*
- More specifically
  - Lifeline resilience is enabled by strong functional links between different human groups/sectors – notably between local communities and formal systems (e.g. gov)
  - Two-way collaboration is crucial – before, during and after disasters.

Research agenda

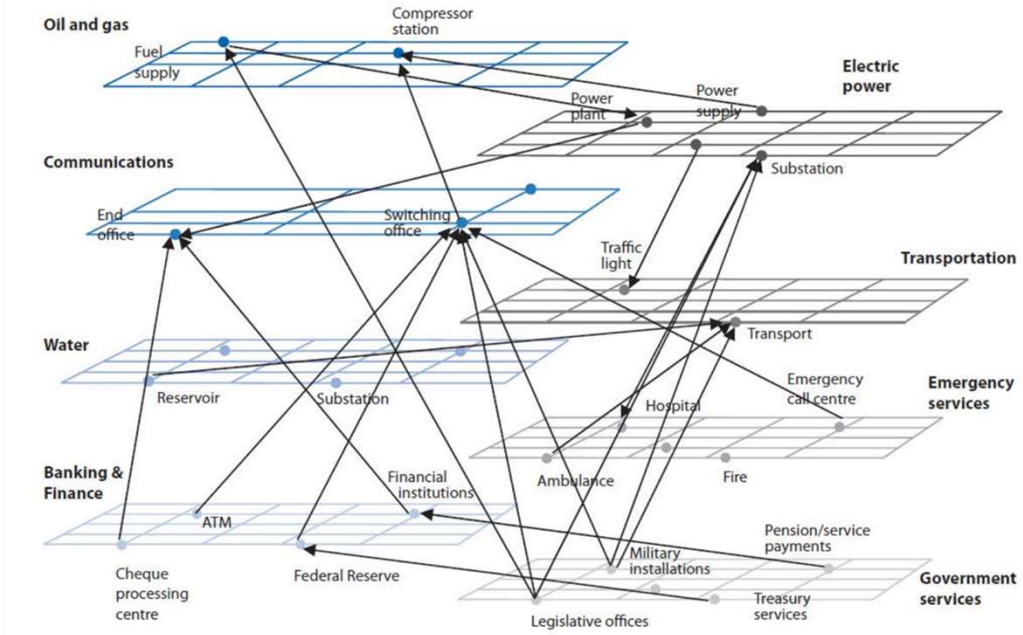
Decentralisation, redundancies and how to finance it

> *Building resiliency may require legislation changes... It's not just about productivity and cost savings. Resiliency has to be an inbuilt cost; somebody has to pay for it.*
>
> ***-Project interviewee***

Understanding interdependencies: data and models

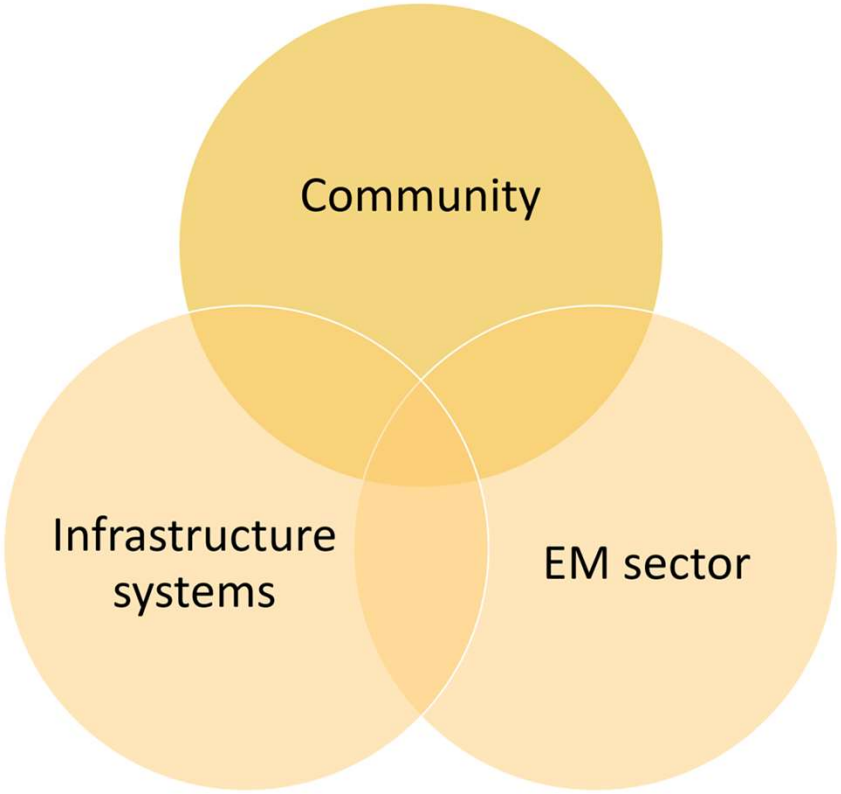
There's a lot of fragmentation in data – different scales, different methods, different data holders who are not sharing it. There's a lot of disasters data that is difficult to get hold of. There's a need for some research into that. At the national level the TISM tried to do this but it's not working very well. We need to think through the data and how it's communicated and the barriers to how it's communicated, from private and public.

-Project interviewee



Source: NARUC (The National Association of Regulatory Utility Commissioners), (2005), Technical Assistance Brief on Critical Infrastructure Protection "Utility and Network Interdependencies: What State Regulators Need to Know", US, available at www.naruc.org/Publications/CIP_Interdependencies_2.pdf

Out of the silos and onto the ground



From an EM perspective a lot of the disaster management conversation rhetoric really comes back to the role that emergency managers play – mostly response, with a little dabbling in recovery – how do we help them share the load or bring others to the picture? They don't have all the answers, they're very operational, practical people. But ***the lifelines stakeholders play such an important role but that's invisible, often even to them.*** *How can they be part of that conversation?*

I think the EM sector might be a bit territorial but they're also very aware of the limited resources they have and what they have to work with. If they're given the opportunity to bring other key stakeholders to the table that support them they would be ok with that.

-Project interviewee

Cross- and trans-disciplinarity

- Collaboration b/w physical scientists -> hard
- Collaboration b/w physical and social scientists -> harder
- Collaboration b/w scientists and practitioners -> harder still
- Collaboration b/w scientists, practitioners and communities -> very challenging but possible and necessary and ultimately transformational

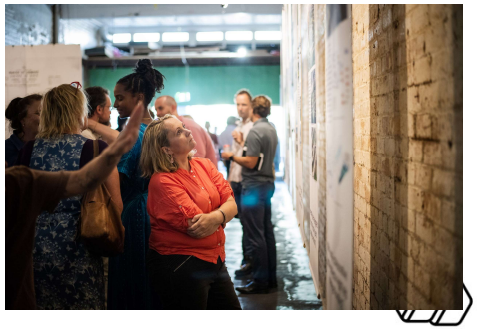
Starting with the self:

- Self-awareness of the constrained way we see the world
- Willingness to listen
- Open-mind
- Willingness to adapt
- Willingness to spend time on building relationships
- Valuing non-traditional academic outputs

More broadly, what is the role of research in lifeline resilience?

- Researchers inquiring with communities, co-designing research as a resilience skill – e.g. Fire to Flourish
- Appreciating and addressing research as vulnerable to disruption and something that needs to be more resilient (Rickards and Watson 2020)
- Recognising research as a form of critical infrastructure that is, like all CI, ultimately reliant on people
- Research institutions as anchor institutions in communities that can step up and offer practical help - e.g. Southern Cross Uni and Living Lab Northern Rivers
- Researchers as intermediaries and translators that can help build links between places, groups, ideas (as perhaps we are doing today…)

Uni soccer field houses flood victims



Panel discussion

Prof Lauren Rickards - La Trobe University (formally RMIT) and NHRA

Dr Adriana Keating - Monash University and NHRA

John Richardson - Australian Institute of Disaster Resilience (AIDR)

Dr Blythe McLennan – NHRA (host)

Please put your questions in the Q&A function!

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