PROJECT SUMMARY

Modelling impacts of natural hazards on interconnected infrastructure networks

RESEARCH TEAM

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SUPPORTING ORGANISATIONS

Queensland Fire and Emergency services
Queensland Reconstruction Authority

Project duration: 24 months

Background

Significant damage and disruption is caused by natural hazards impacting infrastructure. Damage often results in cascading consequences that quickly spread across society and the economy. Challenges associated with repairing and restoring infrastructure are exacerbated by compound disasters that see natural hazards occur concurrently or in sequence.

Though research has been undertaken to understand the vulnerability of residential, commercial, and industrial assets across a range of different hazards in Australia, less attention has been given to understanding the vulnerability of infrastructure assets and networks. This means there is often a limited (or inconsistent) understanding of infrastructure risk across private and public infrastructure agencies as well as policy and strategy arms of government. This makes decision-making around investing in building networks and community resilience complicated.

Project description

This project will develop vulnerability models that can be used to quantify how public infrastructure is impacted by natural hazards. The project aims to develop models for both direct and indirect impacts for a selection of infrastructure and natural hazard types. The rationale for developing these models is that they may be used to understand long-term natural hazard risk to infrastructure networks and estimate recovery time following a disaster. The models may be used to facilitate cost-benefit analysis when assessing investments in infrastructure resilience.

The project is broken into three streams of research. 1) **Network mapping** will be used to mathematically model infrastructure networks, their physical assets and interconnections. We will work with end-users to build these maps, understand where network vulnerabilities exist and understand how damage flows through each. 2) Using these maps and observations from previous

damaging events, **damage estimation** models will be developed. These will model physical damage to infrastructure assets (direct damage) and where possible, will model the flow of damage through each network and across networks (indirect damage). 3) The final stream will involve the development of a series of **utilisation case studies** to explore how the damage estimation models can be used to assess risk to current networks, how they can be used for retrofitting or resilience decision-making, and how they might need to be modified for use with compounding events on a network.

Intended outcomes

The intended outcomes of the project will include:

1) improved understanding of network connections and vulnerabilities and a clear and consistent methodology for mathematically modelling connections between networks.

2) Development of open-source damage estimation models (direct and indirect damage) that can be used to better understand the risk (including financial) posed to networks by natural hazards. These models can be used to improve long-term risk assessment or financial decision-making associated with infrastructure investment or betterment.

3) Improved end-user, researcher and community understanding of how natural hazards impact infrastructure networks and the consequences of these vulnerabilities. A suite of case studies will be developed to tell these stories and will be developed in the context of current networks as well as those utilising mitigation or betterment strategies.

Translation and implementation potential

We see several potential implementation avenues for this research:

1) Infrastructure operators could use the models developed to help build a better understanding of the risk, resilience and vulnerabilities of their networks and how they interact with other networks.

2) Disaster management agencies could use damage estimation models leading into an event to better estimate expected impacts and deploy response teams accordingly. They could also be used in long-term management plans.

3) By utilising damage estimation models and utilisation case studies, government and other agencies can build the case for financial investment in betterment or climate adaptation measures.

4) Damage estimation models and network maps could be used within impact forecast models to probabilistically forecast impact on communities.

Further information

For full project details head to: https://www.naturalhazards.com.au/research/research-projects/modelling-impacts-natural-hazards-interconnected-infrastructure-networks

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