



# RISK MODELLING AS A TOOL TO SUPPORT LOCAL GOVERNMENT EMERGENCY MANAGEMENT

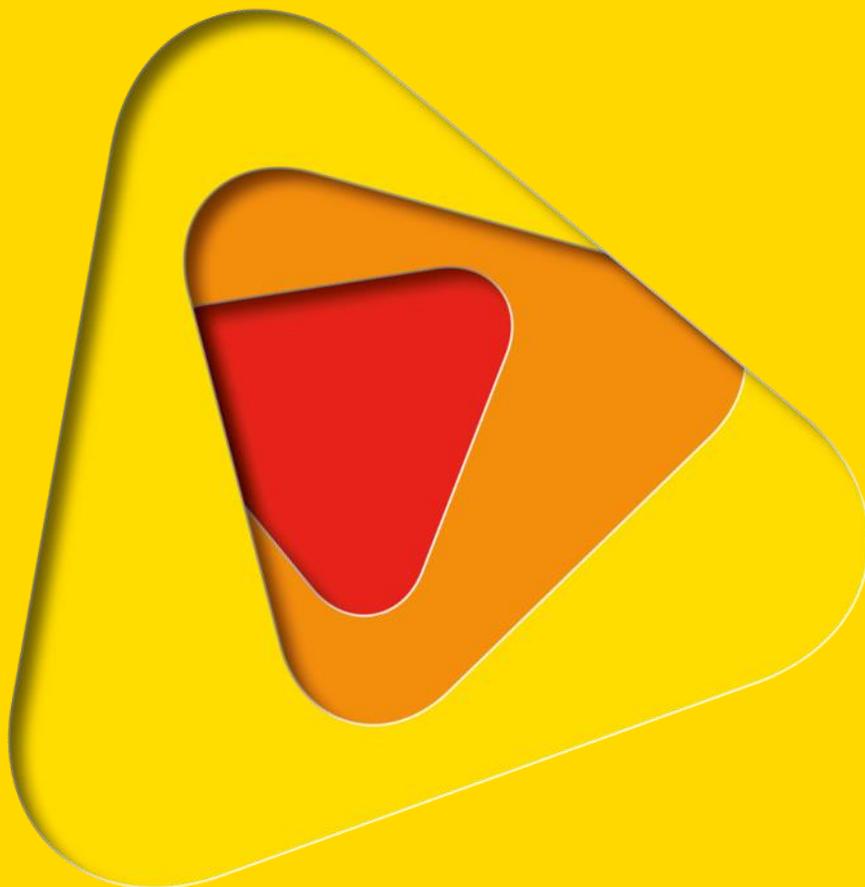
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## SHORT ABSTRACT

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Due to our growing exposure and vulnerability to natural hazards, it is increasingly important for local government to have tools to better understand natural hazard risk and enable effective emergency management. One such tool is risk modelling, an innovative way for local government to assess, prioritize, communicate and manage its natural hazard risks. The Sendai Framework for Disaster Risk Reduction 2015-2030 reflects the importance of risk modelling, where it calls for the development, application and strengthening of models for disaster risk management at the global and regional level. A variety of natural hazard risk modelling tools have been developed, which are increasingly used by government and private organizations. However, to date little research has gone into how effective risk modelling is as a tool to support local government emergency management. This presentation shares the results from recent research on understanding the perceptions that local government emergency managers have on the value of risk modelling tools. While emergency managers see the value in the use of risk modelling relating to communication, decision-making, planning and emergency response purposes, they also see a number of challenges. Challenges identified for the use of risk modelling relate to how emergency management and natural hazard risk is perceived and managed, issues with connecting information and developing data, and the capability of risk modelling software. However, with ongoing mutual engagement, risk modelling can become an effective tool to communicate natural hazard risk and better inform emergency management policy and procedure.



## EXTENDED ABSTRACT

Due to our growing exposure and vulnerability to natural hazards, it is increasingly important for local government to have tools to better understand natural hazard risk and enable effective emergency management. One such tool is risk modelling, an innovative way for local government to assess, prioritise, communicate and manage its natural hazard risks. The Sendai Framework for Disaster Risk Reduction 2015-2030 reflects the importance of risk modelling, where it calls for the development, application and strengthening of models for disaster risk management at the global and regional level (UNISDR, 2015). A variety of natural hazard risk modelling tools have been developed, which are increasingly used by government and private organizations. However, to date little research has gone into how effective risk modelling is as a tool to support local government emergency management. Literature on end-user perception of modelling and decision support systems (DSS) is scarce in general, and is even more so for natural hazard risk, and emergency management. Komendantova et al. (2014) discuss how the feedback from stakeholders is important for informing the usability of natural hazard models and how they are applied; Reiter et al. (2017a) report that DSS have a positive influence on end-user adaptation activities for climate change, but then add how this positive influence is limited (Reiter et al., 2017b); Newman et al. (2017) stress the importance of end-user participation for natural hazard DSS development and use; and Crawford et al. (2018) find that while natural hazard risk modelling is useful for the end-user, there are a number of policy and organisational challenges that limit its effectiveness.

As part of further exploring this gap in research, this extended abstract refers to interviews held with emergency managers on their perceptions of risk modelling and its use. It briefly explains how emergency management is achieved in New Zealand and how risk modelling is used as a tool for natural hazard risk management. It sets out the results from the interviews, showing that while emergency managers see the value in the use of risk modelling relating to communication, decision-making, planning and emergency response purposes, there are also a number of challenges inhibiting its use. We discuss these benefits and challenges, and conclude with some recommendations on how these challenges can be managed in order to better enable risk modelling for emergency management.

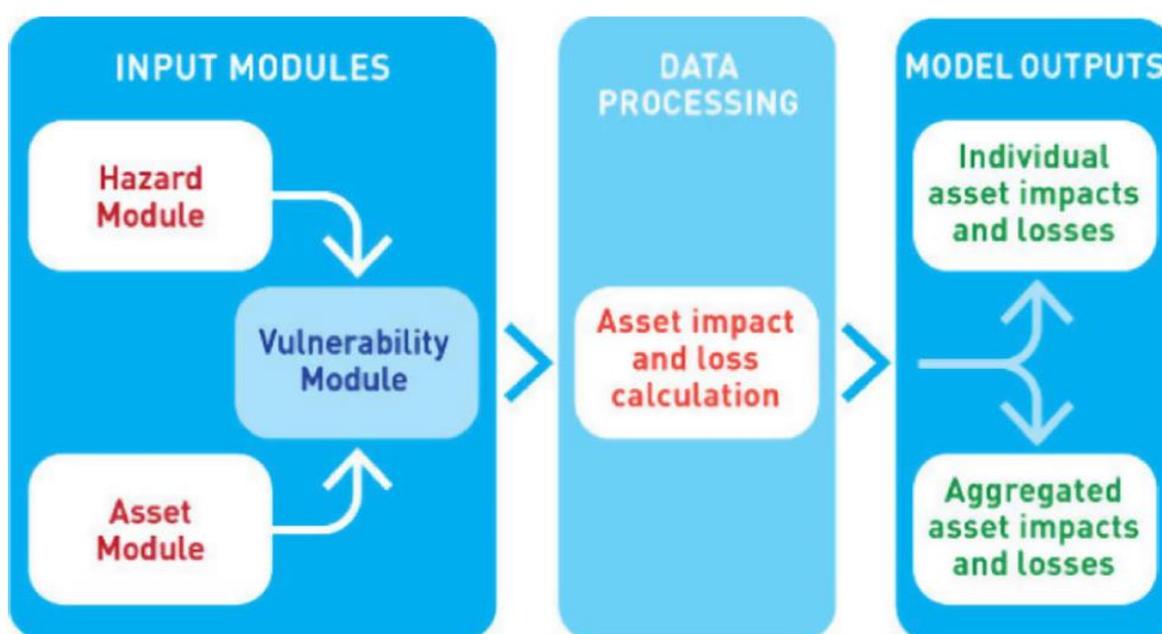
Emergency management in New Zealand, commonly referred to as CDEM (Civil Defence Emergency Management), is devolved from central government legislation down to local government for application. It promotes the sustainable management of hazards and encourages communities to manage natural hazard risk via a framework of Reduction, Readiness, Response and Recovery, known as the 4R's (New Zealand Government, 2002). CDEM is expected to follow a risk-based approach to achieving the 4R's:

*The requirement to practice sound risk management is implicit throughout the CDEM Act. CDEM Groups are required to apply risk management to their planning and activities. Whilst planning is not a linear process and may involve many iterative steps, it is expected to follow a risk management based approach (MCDEM, n.d.).*

By assessing the consequences of these hazards, the focus can move to measures for reducing the risks and for proactively managing residual impacts. However,

emergency management sits within a complex structure for natural hazard governance in New Zealand (Basher, 2016; LGNZ, 2014). This results in a misperception of CDEM as primarily an emergency response role (Petak, 1985; Britton & Clark, 2000; Waugh & Streib, 2006), which then impacts on how enabled emergency management is to access and use risk modelling data and software.

The use of natural hazard risk modelling software has developed over the past few decades as decision-makers seek to better understand the potential loss from disasters. Quantitative risk modelling combines deterministic or probabilistic hazard models, with exposure data and vulnerability models to assess loss, most often depicting economic loss but can also depict infrastructure or societal impacts depending on risk management objectives. Figure 1 sets out the risk modelling framework for how natural hazard data is combined to produce quantitative risk information.



**Figure 1:** Natural hazard risk modelling framework. Source: RiskScape Model Framework (n.d.)

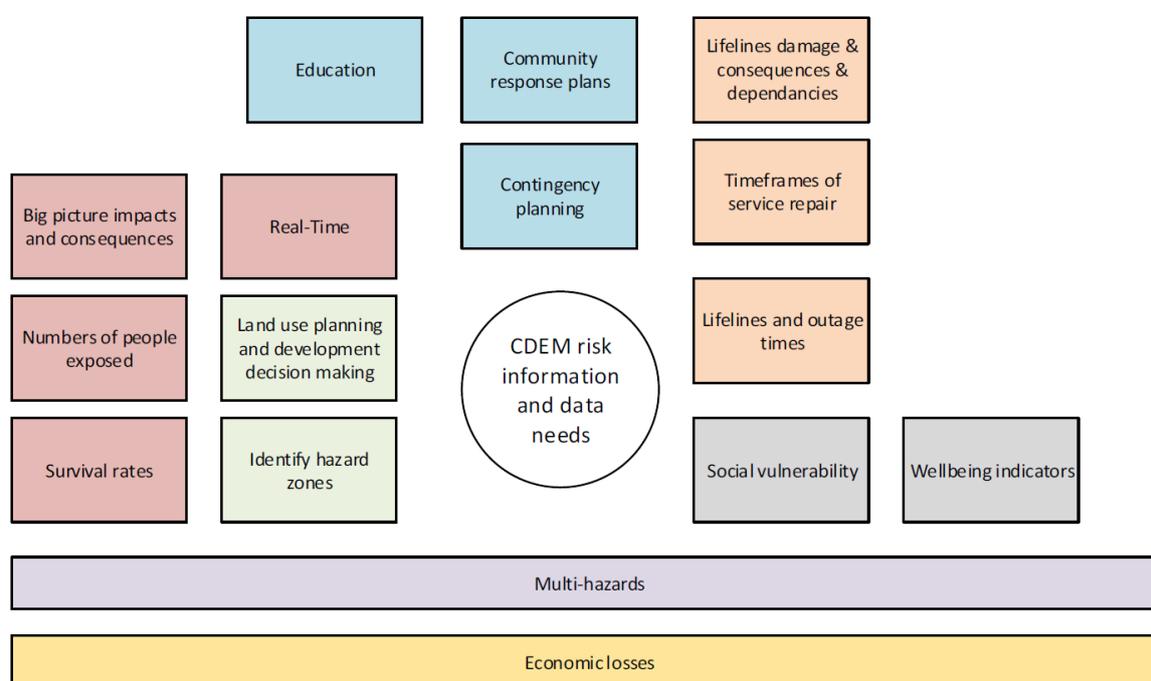
Pondard and Daly (2011) illustrate how risk modelling can give a more comprehensive insight into natural hazards and their socioeconomic consequences, setting out three key benefits:

1. A clearer overview of geographical concentrations of natural hazard risks, across different frequencies and magnitudes;
2. Quantification of potential physical damage, business interruption and casualties; and
3. Identification of key risk drivers.

Decision-makers and communities can then use this information as a starting point for how they manage risk reduction measures and respond to actual events (Donovan & Oppenheimer, 2015; Edwards et al., 2012; Eiser et al., 2012; King & Bell, 2009; UNISDR, 2015).



As part of understanding the needs of the New Zealand CDEM sector within local government for risk modelling, we held interviews in five local government regions across New Zealand to understand how emergency managers perceived and used risk modelling. These areas were: Wellington, Hawke's Bay, Canterbury, Nelson/Tasman (combined CDEM Group) and The Bay of Plenty. Following this research, Crowley, et al. (2016) identify five common areas of CDEM risk information and data needs. Figure 2 sets out these areas, where red is for response related information needs, blue is for pre-event communication, orange is for lifelines information, green is for land use planning and grey is for socio-cultural information. Whilst multi-hazards and economic losses cross cut the needs identified.



**Figure 2:** Most common risk data and information needs identified by CDEM Groups. Source: Crowley et al. (2016).

Results show that emergency managers see the outputs from risk modelling as beneficial for managing emergency events, increasing natural hazard awareness for the public, and for communicating risk to decision-makers for cost-benefit analysis, risk reduction and land use development measures:

*We can use it as a response tool ... as long as the data is available.*

*Managing development ...making sure that we don't develop in risky places. Being aware and making sure the right rules are in place.*

*[It] would be a huge benefit for us to be able to show [modelling results] to our politicians, to our community members, so they could understand what the impacts of these events might be so that they are*



*encouraged to take those mitigation options that we believe they need to take now.*

As such, emergency managers agree that risk modelling can provide valuable information for emergency management.

In saying this however, emergency managers report that in general, they don't use risk modelling. Current research by the author reveals that the emergency management function is not very well enabled to use it. This is because of how well the emergency management function is integrated within the council, how well resourced emergency management is to access and use risk modelling data, and how emergency management maintains a response focus for risk modelling.

Results show that emergency management is commonly misperceived as an emergency response function and is therefore marginalised from being integrated into holistic council planning and policy-making for hazards and risk management.

*... usually civil defence is the 'gimp', if you remember that movie, usually they sit in a box and they only bring the gimp out when things get really, really bad...when it's over they put civil defence back in the box. So I think the challenge is for civil defence to be out of the box all the time and actually be working with other parts of local authorities.*

*[Emergency management] tends to operate much more on the response and recovery side and try as you might there's not actually a lot of crossover between, and dialogue between the emergency management and the planning and policy people.*

Given that emergency management is in general not well integrated into the holistic council hazard and risk management, they are not well resourced to access and use data for hazard and risk management purposes. As such, Crowley et al. (2016) report that emergency management is the 'gatherers' of risk information rather than the instigators.

*We pull this information from various consultancies, research, local authority information and science.*

*[The data] was never really designed for CDEM. We can use it ... as long as the data is available.*

While emergency management is trying to break away from misperceptions that it is only a response function, emergency managers primarily see value in risk modelling for emergency response. Taking into consideration that risk models are more capable of assessing risk before an event, as opposed to during an event, it seems that current models may not be suitable for emergency management objectives.

*In terms of CDEM we need information that is as up to date as possible. We can use it as a response tool as long as the data is available.*

*I know that ... the [emergency management] people weren't too keen on it. Maybe because that is just too hard to use in an event.*

This extended abstract paints a thought provoking picture for risk modelling's use as a tool to support emergency management. The challenges associated with this are not just how risk modelling is perceived and used by emergency management, but also how the emergency management function is perceived and used within New Zealand local government.



There are a multiple ideas and opportunities for how these challenges can be managed in order to better enable risk modelling for emergency management. Crowley et al. (2016) focus on making risk modelling more usable, recommending:

- The development of new vulnerability functions for risk modelling that are more closely aligned with emergency management information needs.
- Giving risk models capability to have shorter run-times, enabling risk models to run scenarios quickly and to produce a tailored real-time report.
- Improved ability for risk models to inter-connect across existing tools containing hazard information.
- More frequent interaction between risk model developers and emergency managers to better understand their modelling needs and to provide training.

Crawford et al. (2018) focus on better enabling the surrounding governance system to support risk modelling, recommending:

- Stronger legislated mandate for how natural hazard risk management, and risk modelling is achieved in New Zealand local government
- Greater focus on building capacity and capability for collecting, managing and using natural hazard risk data so that it is well known, available, and usable.
- Effective and meaningful participatory approaches for crossing the 'science to policy gap', improving natural hazard risk management policy, and better enabling the use of risk modelling.

Building on these previous recommendations, we focus on how perceptions of risk modelling could be improved so that risk modelling is seen as more of a valued tool for emergency management, recommending:

- Further development of shared mental models that give greater connectivity, advocacy and significance for emergency management initiatives, like risk modelling, across different council roles.
- Participatory co-development of risk modelling through a bottom-up approach to enhance understanding of the capability of risk models, develop confidence in the information that they provide, and build the value of risk modelling across the council.
- Regular risk management workshops to review levels of exposure and vulnerability to hazards and how risk modelling can help clarify and prioritise reduction options, and aid decision making.

While risk modelling is a valued tool to support local government emergency management, in the whole, it is not used. Through a better understanding for how emergency management perceives and uses risk modelling, we can more clearly acknowledge and work to overcome challenges that currently inhibit its use. With enhanced usability of risk modelling, stronger legislated support for its application, and improved perceptions on how it adds value for emergency management, our communities are safer, better enabled, and more resilient.



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