

Using foresight and modelling to stress-test risk reduction options under various climate and socio-economic scenarios

H. van Delden^{a,b}, **R. Vanhout**^a, **A. Jeanneau**^b, **H.R. Maier**^b, **A.C. Zecchin**^b, **T. McNaught**^c

^a *Research Institute for Knowledge Systems (RIKS), Maastricht, the Netherlands*

^b *School of Architecture and Civil Engineering, The University of Adelaide, Adelaide, South Australia*

^c *Department of Fire and Emergency Services, Western Australia*

Email: hvdelden@riks.nl

Abstract: Australia is subject to significant impacts from natural hazards, the risk of which is increasing due to population growth and climate change. Western Australia is not immune to these risks and has been impacted by bushfires and floods in recent years. With increasing temperatures and rising sea levels, alongside development along the coast and in the peri-urban and rural areas, this risk is likely to increase substantially in the coming decades.

If we could, it would be cheaper, and cause less harm, to deal with some of these threats in advance to make our communities more resilient. The difficulty is knowing how to prioritize what to plan for, and how to make best use of available resources, which are generally scarce. This difficulty can be addressed by developing risk reduction strategies, which requires a good understanding of not only current, but also future risk, together with the effectiveness and feasibility of (combinations of) risk reduction options.

The projected increase in risk, together with the awareness of the complexity of the underlying dynamics affecting this risk, has led to the recognition that there is an urgent need to better understand the components of disaster risk and their dynamics. In response, over the past ten years, we have developed UNHaRMED (Unified Natural Hazard Risk Mitigation Exploratory Decision Support System) to assist government agencies to better understand how risks arising from multiple natural hazards change over space and time under different plausible future conditions (e.g. climate change, population growth, economic development), as well as the relative effectiveness of different risk reduction strategies (e.g. structural measures, land use planning, land management, building code changes etc.). The development of UNHaRMED has been supported by the inputs of many stakeholders around Australia, including Western Australian State Government agencies such as the Department of Fire and Emergency Services (DFES) and the Department of Planning, Lands and Heritage (DPLH), shaping what the tool should be able to do and what it should look like.

Use of the system will be illustrated through an application to the Busselton area in Western Australia for bushfire and flood risk, for which we combined foresight, risk assessment modelling, and a quantitative and qualitative assessment of risk reduction options. We started by developing socio-economic storylines through a series of workshops involving key stakeholders. These storylines were next translated into UNHaRMED model inputs to simulate future land use and risk profiles. Calculated maps were provided to local stakeholders who used them to design alternative planning strategies for future urban development and qualitatively assessed these alternatives together with additional risk reduction options on criteria that could not be simulated using UNHaRMED (e.g. political acceptance, social acceptance, implementation time, implementation and maintenance costs). Combinations of planning alternatives and additional risk reduction options were then simulated using UNHaRMED to assess their risk reduction potential alongside a set of liveability indicators.

We found that in a rapidly growing area, the impact of socio-economic development exceeds the impact of climate change, and well thought out spatial planning strategies in combination with other risk reduction measures can substantially reduce future risk. Nevertheless, when exploring different spatial planning strategies for reducing risk it is also important to consider the liveability of these options as part of a broader regional development strategy.

The application of the UNHaRMED tool and process showcases its potential in better understanding future uncertainties and leveraging this information to assess the impact of risk reduction options under a range of conditions. Lessons learned from this can then be incorporated in the design of robust and/or adaptive risk management strategies.

Keywords: *Disaster risk reduction, Decision Support Systems, Spatial planning, Scenarios, Stakeholder engagement*