



Contest 2015

Title: Full Cost Accounting of Disaster Risk Management Risk, meanings and metrics with uncertainty / Disaster Risk Full Cost Accounting

Leader: Dr Charlotte Brown / Dr Nicky Smith

Organisation: Resilient Organisations / Market Economics

Total funding (GST ex): \$297,000

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Programme Leader: Dr Charlotte Brown / Dr Nicky Smith

Affiliation: Resilient Organisations (contract holders) / Market Economics

Has this report been peer reviewed?

The two major outputs from this research project (the literature review and framework) have been peer reviewed by Rachel Davidson, University of Delaware (both documents) and Martin O'Connor, Professor of Economics, University of Paris-Saclay (framework only). Both conference papers and our journal paper have also been peer-reviewed.

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Key message for media: Why are these findings important?

Disasters, climate change, technology changes, rising inequality and increasing complexity are all challenges facing decision-makers today. Traditional decision-support tools (such as cost benefit analysis and multi-criteria analysis) are not always adequate for supporting decision-makers through such complex decisions. We have developed a framework to help decision-makers better understand and approach the decision evaluation process. Better decision processes will lead to more robust decisions that account comprehensively for social, environmental and economic costs and benefits; future uncertainty; risk appetite; equity and opportunity. This framework is just the beginning: it will help practitioners to identify the key topics and issues to be addressed in risk management decision making, and further work (including under the National Science Challenge, Natural Hazards Platform) will help to further enhance and refine the evaluation tools available.

Abstract:

The quality of disaster risk management decision-making in New Zealand, and internationally, is varied. Disaster risk management decisions are often made using traditional economic evaluation tools. However, these tools often do not adequately account for the increasingly complex and uncertain world we are facing or the current regulatory and policy setting in New Zealand centred around well-being, resilience and sustainability.

In this research project we have developed a framework to guide decision-making for disaster risk management option assessment: accounting comprehensively for social, environmental and economic costs and benefits; future uncertainty; risk appetite; equity and opportunity.

To underpin the development of the framework we initially completed a literature review of current New Zealand and international disaster risk decision-making processes. We also established a local, regional and national government representative stakeholder group to guide the project. Based on the literature review and feedback from our end-user stakeholder group, we developed a prototype decision-making framework. The framework guides users through selection of appropriate option evaluation tools, and helps users to design their assessment specific to their context: considering factors such as distributional equity, risk preferences and uncertainty. The framework helps users to ensure they consider the full range of impacts. It is primarily designed as a tool to improve risk literacy and comprehensive consideration of disaster risk decision-making. The framework has been applied to two case studies– to illustrate the application of the framework and enhance its useability.

We have presented our research to two international conferences, and several national research forums. We have a number of planned outreach activities post contract completion – both with an end user target and with the research community. We have also had a paper published in an international journal.

Our research has identified several areas of disaster risk decision-making that could be improved to support decision-makers navigate increasingly complex and uncertain decision-making environment. Through this project we have secured funding to extend this important research. \$110,000 has been secured through projects in QuakeCoRE and Resilience to Nature's Challenge, National Science Challenge.

Keywords: Disaster risk management; full cost accounting; benefit cost analysis; decision-making framework; multi-capital decision-making

Introduction / Background:

The quality of disaster risk management decision-making in New Zealand is varied. Decision makers are clearly obliged by their empowering legislation (including the Resource Management and Local Government Acts) to consider the full range of potential costs and benefits that may arise from decisions relating to management of disaster risk. In reality, these assessments are often undertaken with limited information, and under significant time and budget constraints. Although there are existing cost-benefit and other decision making guidelines available, these tend to be quite general and not focused specifically on the context of disaster risk management.

The aim of this research was to enable decisions to be made more effectively and efficiently. With this research we hope to help decision makers navigate disaster risk management decisions in the current well-being, resilience and sustainability focused legislative/policy context through guidance on the appropriate selection and use of cost-benefit or multi-criterial analysis tools. The framework will help decision-makers account for uncertainty, equity, and risk preferences to better value disaster risk management investment. It is further intended that the framework will act as a practical go-to-guide to help decision makers quickly identify the specific types of impacts that are likely to occur under risk management option. We recognise that the world is a complex place and that decisions will target a range of potential disasters impacting diverse communities, involve different types and levels of uncertainty, and seek to manage a variety of different types of effects. It is critical that our framework is adaptive to these varying contexts.

This report gives a summary of our research project by research aim. The research aims, and their interrelationships, is shown in Figure 1. Research outputs are noted throughout the report and major outputs are included as appendices to this document.

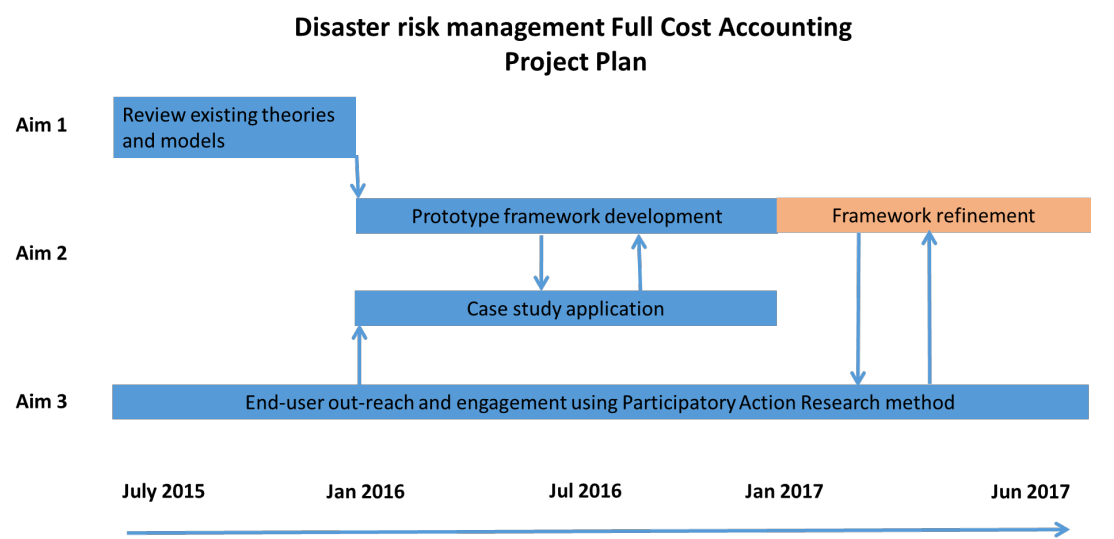


Figure 1 Project timeline

Title – Adoption of FCA framework

❖ 1.1 Research Aim

Title: Review existing theory and models

Budget: \$74,250

Research Aim achieved? Yes

Discuss

The literature review was completed in March 2016 (including international peer review).

The literature review includes:

- a brief discussion of the concepts of risk and risk management, including how these concepts are defined in this project
- an overview of the risk management policy context, including the empowering legislation under which decisions around risk management are exercised
- a summary of formal decision making approaches or frameworks
- an overview of special considerations that arise in the context of evaluating decisions, particularly in a risk management context
- a summary of existing DRM decision-making frameworks, both in NZ and abroad, and
- an overview of information that can be used by decision makers to assist in the identification and evaluation of potential outcomes of risk management options.

Since completing the literature review, we have presented the review findings to our project stakeholder group (June, 2016).

We have also presented our literature review findings (including peer reviewed conference paper) at the 6th International Conference on Building Resilience 2016 (Sep, 2016).

Last, we have prepared, and had accepted and published, a journal paper that builds on the findings of the literature review. The paper is titled “Challenges and opportunities for economic evaluation of disaster risk decisions”. Our project team led the paper writing but worked with researchers across other research programmes, including QuakeCoRE and Resilience to Nature’s Challenges. The paper aimed to define a shared research agenda for this field and has been published in the new journal *Economics of Disasters and Climate Change*. The journal paper has already been viewed by members of the Society for Decision-Making Under Deep Uncertainty and it was described by one member as “an excellent overview of the different challenges in the economic evaluation of climate adaptation projects”.

Outputs

- Full literature review report (March 2016) – this has been downloaded 54 times since it was posted. (See Appendix A)
- Presentation to Project Stakeholders 11 May 2016
- Conference paper accepted and presented at the International Conference on Building Resilience (September 2016) (See Appendix B)
- Journal paper published (June 2017) Smith, N., Brown, C., McDonald, G. et al. (2017). Challenges and Opportunities for economic evaluation of disaster risk decisions. *Economics of Disasters and Climate Change* (2017). doi:10.1007/s41885-017-0007-0. Available at <https://link.springer.com/article/10.1007/s41885-017-0007-0>

End-users

The primary goal of the literature review was to inform the prototype framework development (Aim 2). However, we have taken the opportunity to disseminate the literature review to interested academic audiences. The literature review has been posted to the Resilient Organisations website. The page has been viewed 106 times and the report downloaded 54 times. We have also presented the literature review findings at an international conference in September 2016 to peers researching in this area. The presentation was well received.

The journal paper, published at the start of June has been downloaded 5 times from the journal website in the first month.

❖ 1.2 Research Aim

Title: Prototype framework development with case study application

Budget: \$148,500

Research Aim achieved? Yes

Discuss

We have developed a prototype framework as a stand alone resource for decision-makers. Our framework is called The DAMAGE framework. The full title is: *DisAster risk ManAGement Evaluation (DAMAGE): framework for assessing and comparing disaster risk intervention options.*

The DAMAGE framework is designed to guide users (any user making an evaluation of disaster risk management intervention options), to

- 1) select an appropriate analysis tool based on their objectives and nature of the decision,
- 2) make 'risk' specific considerations in their analysis (such as accounting for uncertainty, distributional effects and risk preferences), and
- 3) select and assess a wide spectrum (social, environmental, economic) of impacts.

The DAMAGE framework is designed to be an educational tool with simple language, guiding the user through sound risk decision analysis.

The DAMAGE framework has been developed based on the literature review process (Aim 1.1), discussions with stakeholders, peer review and through case study application.

The DAMAGE framework was applied to two post-hoc case studies. The purpose of the case studies was to test the framework; to demonstrate the application of the framework to a real world problem; and to illustrate how disaster risk decisions can change depending on the perspective taken and design of the assessment process. The case studies we have completed are:

- Flockton Basin/ Dudley Creek flood mitigation project (Christchurch City Council).
- Island Bay Seawall (Wellington City Council).

The DAMAGE framework was peer reviewed in May/June 2017. One reviewer noted: *"This document takes on a very difficult task. Analysing disaster risk management policy decisions can be very complex, and this document seeks to provide guidance on how to do it in a way that is accessible, understandable to a broad range of readers, applicable for a broad range of decisions, but still meaningful and that will lead to high quality decisions. No easy feat!*

Overall, the document is very well done. I was very pleased to see that the key issues are identified and explained well, including topics such as, sensitivity analysis, distributional effects, community engagement. In all cases, it provides sound advice about how to address these issues."

We will have the DAMAGE framework graphically designed in July. It will be formatted so that it can be printed in hard copy and also as a user-friendly e-document. We also plan to secure funds to create an interactive online version of the tool (possibly through National Science Challenge – Resilience to Nature’s Challenge). The aim of the on-line tool is to improve user engagement.

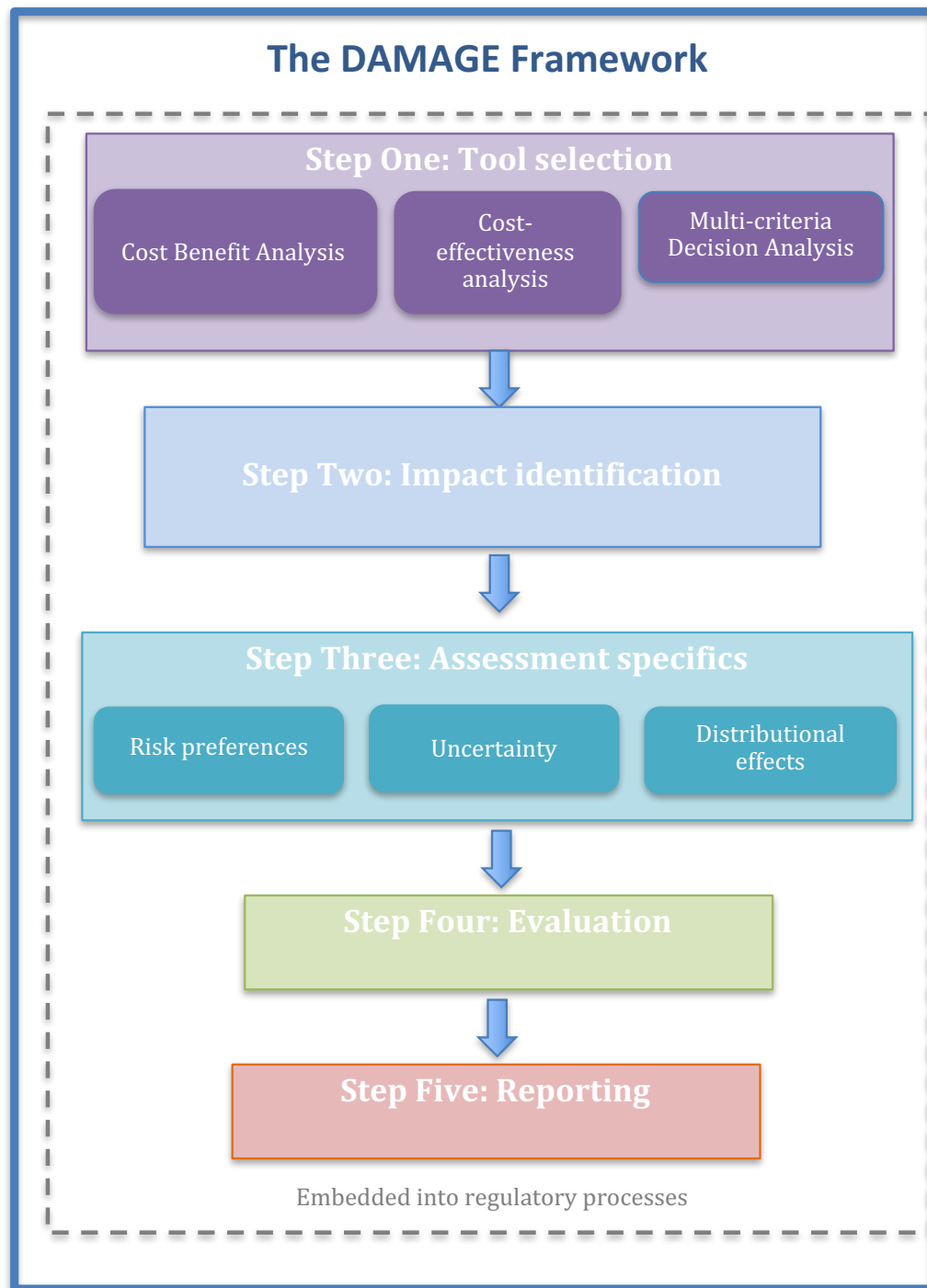


Figure 2 The DAMAGE framework. Disaster Risk Management Evaluation: a framework for comparing and assessing disaster risk intervention options.

Outputs

- Framework prototype, ready for professional graphic design/publication (see Appendix C)
- Presented prototype framework at 4th International Conference on Urban Disaster Reduction (October, 2016). An extended abstract was submitted and published in conference proceedings (see Appendix D).

End-users

See Aim 1.3.

❖ 1.3 Research Aim

Title: End user outreach

Budget: \$74,250

Research Aim achieved? Yes

Discuss.

The framework development has been developed in parallel with stakeholder outreach. Our goal was to develop a user-friendly framework that met the needs of disaster risk decision-makers. At project inception we established a stakeholder group consisting of 7 representatives of key government authorities (local, regional and national level) that are involved in disaster risk management decision-making.

Over the course of the project we have met with our stakeholder group to better understand current needs and to steer the development of the framework. We have conducted two workshops with the stakeholder group. We have also sought feedback via email on project outputs such as the literature review and the draft framework.

As well as engaging with end-user representatives, we have sought to disseminate and extend the work we are doing through our research networks. The project has highlighted the need for on-going work in this area to develop effective user-friendly tools. There is a need for considerable further research to develop robust tools that are suitable for practitioners and decision-makers.

We have secured funds, and begun work, to extend our framework within the Economics Toolbox of the National Science Challenge (NSC), Resilience to Nature's Challenge (RNC). In this project we will review current risk decision-making models, including this framework and will explore how they can be extended into a resilience paradigm. We will endeavor to use this collaboration to create an online, interactive version of this framework. We are also working with other NSC researchers (both in the Resilience to Nature's Challenges and Deep South Challenge) to coordinate efforts on the creation of various decision-making tools and to identify opportunities for applying this framework to case studies within NSC.

We also continue to work with QuakeCoRE. Under Flagship 5 of QuakeCoRE, a decision-support tool for seismic decision-making has been developed and we have connected with the developers of that tool to share lessons and collaborate. Additionally, in December 2016, we were granted funding to support a PhD student to develop a system for defining the value of the built environment to complement and extend this research project. The project will provide a nomenclature and system mapping of all the services and values that the built environment provides to communities. The framework will help decision-makers (e.g. users of this framework) to better value the built environment and to more clearly define the costs and benefits of disruption.

The journal paper, described in Aim 1, was a cross-research programme effort to develop a shared understanding and research agenda related to disaster risk and resilience economic

evaluation challenges. The paper authors, led by our research team, included representatives from QuakeCoRE and National Science Challenge: Resilience to Nature's Challenges.

Outputs

- Stakeholder meetings (November, 2015 and May, 2016)
- Meetings with Wellington City Council and Christchurch City Council to discuss case study application and framework (May, 2016)
- Meeting with NZTA, and review of draft NZTA CBA tool, drawing on elements highlighted in this framework.
- Presentation at the Economic Research on Disasters and Resilience in NZ workshop (October, 2016)
- Funding under Economics Toolbox to extend this research to the resilience paradigm (Valuing Resilience project, \$90,000)
- Funding for a PhD student to develop a framework for valuing the services (\$20,000) (December, 2016)
- PLANNED – article in MCDEM Impact, dissemination through LGNZ network and workshop (August-September 2017)
- PLANNED – Presentation at QuakeCoRE annual meeting (September 2017)

End-users

Our end users are primarily represented by our stakeholder group. This group represents a cross section of local, regional and national government authority representatives that are involved in disaster risk decision-making. They have guided the framework development to ensure it is a practical, relevant and usable for disaster risk management decision-making across government authorities. Once the framework is in a published form we will disseminate more widely to analysts and practitioners. The framework will be available on the Resilient Organisations website. Our stakeholder group will be a key conduit for this, as well as Local Government New Zealand and Ministry of Civil Defence and Emergency Management. For example LGNZ have indicated they will circulate a copy of the framework to their members and have several potential up-coming risk-focussed workshops that we can participate in. We also intend to publish short articles about the framework in practitioner publications such as MCDEM Impact.

As well as practitioners, we have also engaged heavily with the research community to extend the research into other research programmes. Our research has shown that there is still significantly more effort required by the academic community to develop user-friendly tools that support robust decision-making. We have engaged effectively with both QuakeCoRE and the National Science Challenge, Resilience to Nature's Challenges, and have secure funding to extend this work.

Conclusions & Recommendations:

We have successfully created a practical tool to support local, regional and national government decision-makers. The tool is designed to support users through the decision-evaluation process and to help improve risk literacy. Feedback on the tool to date has been positive and we will continue to work to disseminate the findings amongst end-users once the formatted version of our framework is ready.

Through the development of the tool, we have identified the need for more research into risk and resilience decision-support tools. We have found that current, common, economic evaluation tools are inadequate to support decision-makers through decisions involving deep uncertainty. They also, typically, are not suitable for assessing decisions that have significant equity implications or that might be subject to diverse risk preferences within a community.

We have worked to ensure that our efforts on this research project are continued through a variety of other research forums. We have successfully secured \$110,000 worth of additional research funding so far to extend this work across both QuakeCoRE and National Science Challenge, Resilience to Nature's Challenges.

Beyond this additional funding there is still a need to progress this area of research. It will take a significant on-going effort to develop and implement tools and techniques that can support decision-makers to confidently make decisions that reduce risk and increase in our resilience in the uncertain, complex environment we live in.

Acknowledgements:

We would like to gratefully acknowledge the financial support of the Natural Hazards Research Platform / Ministry of Business Innovation and Employment. We would also like to thank the in-kind support from our knowledgeable stakeholder group and peer reviewers as well as researchers in the National Science Challenges and QuakeCoRE that have contributed to this research.

References:

References are included in the appendices

List of Figures:

- Figure 1 Project timeline
- Figure 2 The DAMAGE framework. Disaster Risk Management Evaluation: a framework for comparing and assessing disaster risk intervention options.

Appendices:

- **A Literature review:** Smith, N., Brown, C., and Saunders, W. (2016) "Disaster risk management decision-making: review. Full cost accounting of disaster risk management decisions,". Resilient Organisation Research Report 2016/04, New Zealand. Available at: <http://www.resorgs.org.nz/Publications/disaster-risk-management-decision-making-review-full-cost-accounting-of-disaster-risk-management-decisions.html>
- **B Conference paper 1:** Smith, N., Brown, C., and Saunders, W. (2016) "Disaster Risk Management Decision-Making: a review," in *6th International Conference on Building Resilience, Auckland, New Zealand, 7-9 September, 2016*.
- **C The DAMAGE framework** (content – unformatted). Disaster Risk Management Evaluation: a framework for assessing and comparing disaster risk intervention options
- **D Conference paper 2:** Brown, C. and Smith, N. (2016) "Designing a full-cost disaster risk decision-making framework for New Zealand," in *4th International Conference on Urban Disaster Reduction, Wellington, New Zealand, October 2016*.
- **Journal paper** (provided separately due to copyright restrictions) Smith, N., Brown, C., McDonald, G. et al. (2017). Challenges and Opportunities for economic evaluation of disaster risk decisions. *Economics of Disasters and Climate Change* (2017). doi:10.1007/s41885-017-0007-0.