A Multi-Criteria Decision Tool to Support Seismic Resilience Investments Under Deep Uncertainty

Project Aim

- Create a tool to assist decision makers in understanding the synergies and trade-offs between different resilience investments.
- Create a process for using the tool that enables decision makers to acknowledge and work with an uncertain future.

Considering the long-term impacts of major investment decisions, in particular for land-use and infrastructure, the context gets more complicated under deep uncertainty. The solution included using plausible future scenarios and Multi-Criteria Decision Support methods to draw out assumptions, preferences, and uncertainties within the decision making process.

What is Deep Uncertainty?

Deep uncertainty occurs when analysts and decision makers do not know or agree on the likelihood and nature of future events, the value of possible outcomes, or even the best method of relating potential actions to outcomes. *(Lempert et al 2003)*

The Multi-Criteria Decision Support Process

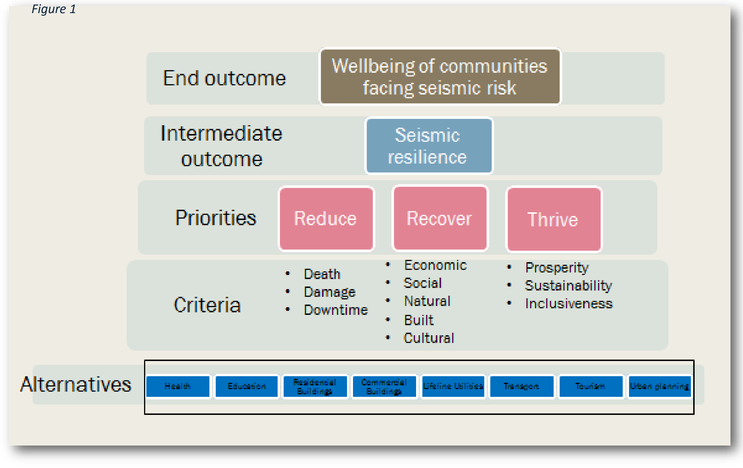
Each potential resilience investment is scored against the criteria, then the priority areas are assigned a weight.

The assumption is that each priority would not contribute equally to seismic resilience but it should not be up to the analysts to decide —how they are prioritized is up to the decision makers who are responsible for the investments. The outputs from this process are displayed in a Performance Matrix enabling decision makers to discuss their assumptions and preferences and perform sensitivity tests. Visual outputs help demonstrate the relative strengths of each project within each priority area.

The Decision Support Framework

Figure 1 illustrates the basic framework for the decision making process.

Figure 1



The end outcome is the wellbeing of New Zealand communities facing seismic risk. The means to that end is developing seismic resilience. Seismic resilience in this case is developed through three priority areas—Reduce, Recover, Thrive. These priorities were generated to align with the QuakeCoRE vision of reducing the impact of earthquakes through mitigation measures, preparedness, and increasing the capacity of thriving communities to recover quickly. Criteria for fulfilling the priorities were generated to reflect the key attributes of these areas. The Civil Defence Emergency Management Recovery Framework, the Canterbury Earthquake Recovery Authority's Recovery Strategy, and the Higher Living Standards Framework were used as guides for the criteria.

Step 1

Score Alternatives Against Criteria

	Criteria	Water System	Historic Buildings	Seismic Research	Health Care	EQC Fund
1.1	Reduce deaths					
1.2	Reduce damage					
1.3	Reduce downtime					
2.1	Improves economic recovery					
2.2	Improves social recovery					
2.3	Improves recovery of the natural environment					
2.4	Improves recovery in the built environment					
2.5	Improves cultural recovery					
3.1	Promotes economic growth					
3.2	Supports natural resource management for current and future generations					
3.3	Contributes to social cohesion and equity					

Step 2

Weight the Priorities

Priorities	Weight
1. Reduce	
2. Recover	
3. Thrive	

Step 3

Apply weighting to criteria

Priorities	Weight		Criteria	Point Allocation
1. Reduce		1.1	Reduce deaths	
		1.2	Reduce damage	
		1.3	Reduce downtime	
2. Recover		2.1	Improves economic recovery	
		2.2	Improves social recovery	
		2.3	Improves recovery of the natural environment	
		2.4	Improves recovery in the built environment	
		2.5	Improves cultural recovery	
3. Thrive		3.1	Promotes economic growth	
		3.2	Supports natural resource management for current and future generations	
		3.3	Contributes to social cohesion and equity	

Performance Matrix				Unweighted Rating					Weighted Score				
Priorities		Criteria	Weight	Water System	Historic Buildings	Seismic Research	Health Care	EQC Fund	Water System	Historic Buildings	Seismic Re-search	Health Care	EQC Fund
1. Reduce	1.1	Reduce deaths	25	10	8	0	8	5	250	200	0	200	125
	1.2	Reduce damage	12.5	10	10	0	1	2	125	125	0	12.5	25
	1.3	Reduce downtime	12.5	8	6	2	5	5	100	75	25	62.5	62.5
		Total Priority Score		*28*	*24*	*2*	*14*	*12*	*475*	*400*	*25*	*275*	*212.5*
		Highest Possible Score	*500*										
2. Recover	2.1	Improves economic recovery	10	8	8	10	7	6	80	80	100	70	60
	2.2	Improves social recovery	5	8	10	2	3	0	40	50	10	15	0
	2.3	Improves recovery of the natural environment	1	4	5	8	10	0	4	5	8	10	0
	2.4	Improves recovery in the built environment	1	10	0	9	8	6	10	0	9	8	6
	2.5	Improves cultural recovery	8	5	1	10	3	8	40	8	80	24	64
		Total Priority Score		*35*	*24*	*39*	*31*	*20*	*174*	*143*	*207*	*127*	*130*
		Highest Possible Score	*250*										
3. Thrive	3.1	Supports macroeconomic stability and work-force productivity.	5	2	0	5	10	3	10	0	25	50	15
	3.2	Supports sound management of environmental resources and kaitiakitanga responsibilities.	5	5	0	8	10	2	25	0	40	50	10
	3.3	Provides opportunities for economic and social participation.	5	8	5	8	10	6	40	25	40	50	30
		Total Priority Score		*15*	*5*	*21*	*30*	*11*	*75*	*25*	*105*	*150*	*55*
		Highest Possible Score	*150*										

Literature Cited

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Find Out More

Visit https://wiki.canterbury.ac.nz/display/QuakeCore/

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Resilient ORGANISATIONS

QuakeCoRE NZ Centre for Earthquake Resilience