LAND AND WATER
www.csiro.au

Approach, methods and results for co-producing a systems understanding of disaster

Technical Report Supporting the Development of the Australian Vulnerability Profile

Deborah O'Connell, Russell Wise, Rachel Williams, Nicky Grigg, Seona Meharg, Michael Dunlop, Veronica Doerr, Jacqui Meyers, Jill Edwards, Monica Osuchowski, Mark Crosweller

With contributions from David Jones, Shoni Maguire, Karl Braganza, Jane Sexton, Martine Woolf, Claire Krause, Cheryl Durrant, Laurence Plant, Miriam McMillan

October 2018

Citation

Deborah O'Connell, Russell Wise, Veronica Doerr, Nicky Grigg, Rachel Williams, Seona Meharg, Michael Dunlop, Jacqui Meyers, Jill Edwards, Monica Osuchowski, Mark Crosweller (2018). Approach, methods and results for co-producing a systems understanding of disaster. Technical Report Supporting the Development of the Australian Vulnerability Profile. CSIRO, Australia.

Copyright

Important disclaimer

Acknowledgements

The work described in this report is the product of the effort, generosity and expertise of many, many people. This project was a participatory exercise and relied heavily on people sharing their perspectives and life learnings in order for us to synthesise the overview presented here.

Thank you to Mark Crosweller, Jill Edwards and Monica Osuchowski (originally in Emergency Management Australia and later the National Resilience Taskforce in the Department of Home Affairs), who developed the case for the Australian Vulnerability Profile and engaged CSIRO in addition to a broad range of stakeholders, in the co-design and co-development of the Australian Vulnerability Profile. Mark's direction and leadership inspired workshop participants and the project team throughout the project. Jill and Monica were key partners in developing and delivering the work described in this report. They convened the partnerships, and brought a welcome enthusiasm for the science, as well as their insights and guidance on implementation in policy. Thank you also to Luke Brown, Teneille Tress, Sally Kuschel and Sally McLean for their support of, and advice to this project especially in the early stages.

The workshops were a joint effort, with valuable inputs from the co-design team: Cheryl Durrant and Laurence Plant (Department of Defence); David Jones, Shoni Maguire and Karl Braganza (Bureau of Meteorology); Jane Sexton, Martine Woolf and Claire Krause (Geoscience Australia) and Miriam McMillan (Department of Environment and Energy). We enjoyed the opportunity to work together, learned a lot from each other, and established a good base for ongoing collaborations.

Special thanks to Brenton Keen in South Australia, Andrew Sanders in Western Australia, and Iain MacKenzie in Queensland for co-hosting the workshops and inviting a range of key stakeholders. Thank you to the workshop participants who participated with enthusiasm and contributed their ideas and knowledge so candidly and creatively.

We thank the Partnership Team who provided a very generous contribution of time and expertise to this project in terms of shaping, reviewing and contributing to the results. They are Adrian Beresford-Wylie, Beck Dawson, John Richardson, Neil Greet, Celeste Young, Andrew Sanders, Brenton Keen, Rowena Richardson, Danielle Meggos, Toby Kent, and Ramana James. We thank Dr Margaret Moreton, Jim Henry, Brett Ellis for attending one of the Partnership Team workshops and providing their expertise in reviewing and shaping the intermediate results. Thanks to the National Advisory Panel who provided various forms of guidance and review through the project – Prof Tom Kompas, Emeritus Prof Ian Lowe, Prof Petra Tschakert, Prof John Handmer, Dr Ilan Kelman, Dr JC Gaillard, Dr Paul Barnes.

Thank you to Ella Kelly, Harith Halim, Ash Sinai-Mameghany, Jaslyn Allnutt, and Grace Fieg for their help with trawling through workshop outputs to capture the information we needed. Grace provided support in the collation of results and management of the data and diagrams, which required meticulous attention to detail.

Thank you to the technical reviewers of the project for their thorough assessments in short timeframes – Dr Erin Bohensky, Dr Sonia Graham, Dr Russell Gorddard, and Dr Yiheyis Maru. Thanks to Dr Mark Stafford Smith for early input into design and setup of project, and comments on Chapter 6.

We interviewed several people from the arts (authors, designers, film/documentary, plays, games designers) and they provided us with many ideas about narrative structures and approaches which can be used in working with people, bringing creativity and emotions to the process of thinking about futures. Thank you to Michael Tear, Andy Stirling, Dr Paul Hardisty, Kaaron Warren, Dr Geoff Hinchcliffe, Dr Mitchell Whitelaw, David Finnigan, Nikki Kennedy, Nathan Harrison, Rachel Roberts. Thanks also to Sarah Patterson, Dayna Hayman and Phillip Rubery for working with us to design the diagram in Chapter 6.

Thanks to Karin Hosking and Dr Tegan Donald for their skill in editing this report.

We acknowledge Emergency Management Australia and CSIRO for funding this project.

Foreword

The effects of a variable and rapidly changing climate combined with increased potential for loss and harm are forcing us to question what can be done differently – before disaster strikes – so Australians can successfully live with intensifying natural hazards.

To begin to navigate the complexities of a growing and aging population, increasing dependency on interconnected essential services and escalating costs of disasters, we looked for ways and means to better understand how the highly dynamic systems that support Australian society are vulnerable when disasters happen. We sought to answer the question "*what makes Australia vulnerable to disaster when severe to catastrophic events impact what people and society value".*

There is limited knowledge or understanding, not only amongst decision-makers but also the public, of how these complex and highly dynamic systems interact and the cascading impacts when one or other part of the system fails or is disrupted. Also, there is little knowledge about the patterns within them that can build resilience and reduce vulnerability.

In recognising these limitations, Emergency Management Australia (who initially commissioned the work) and the National Resilience Taskforce is delighted to have partnered with CSIRO on an this project as one input into the broader initiative of the Australian Vulnerability Profile. The Australian Vulnerability Profile intentionally focuses on *vulnerability*, the least understood dimension of disaster risk and on *values* – what is at stake and what we stand to lose when disaster strikes.

Working with CSIRO and all our project partners we developed ways to draw attention to root causes of systemic vulnerability and the effect when values influence decisions and when those values shift with changes in circumstances. CSIRO's experience and expertise in guiding us through this complexity was invaluable.

This Report unveils a comprehensive account of the project, the experience of tackling complex subject matter and the co-design journey to create the methods that have now provided an insight into systemic vulnerability that we didn't have before. Its content and key findings contributes to and informs the final report of the Australian Vulnerability Profile initiative.

The Report also reveals new insights into the social and systemic elements of vulnerability and helps us understand the relationship between people and things of value, the choices and trade-offs we make every day, and how the rules and socio-technical structures and processes constrain and enable these choices. Through this understanding we can promote discussion, provide ways to talk about a complex subject and inform proactive, integrated planning and action.

Finally, it is a culmination of the efforts and contributions of a range of passionate, committed and talented people whose generosity of spirit and sharing of their experience is inspirational. I am grateful for and enriched by the stories I heard and the people I have met. I am also grateful to Commonwealth and state and territory colleagues, along with many business and community members for their enthusiastic collaboration and tremendous support for this work.

With grateful thanks,

Mark Crosweller AFSM
Head of National Resilience Taskforce
Department of Home Affairs
September 2018

Contents

Figures

Tables

Who should read this report?

The target audience for this report is: scientists and policy analysts working in the areas of disaster risk reduction, risk mitigation, climate change adaptation, vulnerability and resilience. This report is not aimed at a public audience.

The report covers the scientific and technical detail of work commissioned by Emergency Management Australia (later the National Resilience Taskforce) to inform the development of the Australian Vulnerability Profile. This work draws heavily on our other work on resilience, adaptation pathways and transformation, disaster risk and resilience, and the design of social processes which are ethical and fit-for-purpose. This is the primary source of data captured and analysed to inform the Australian Vulnerability Profile. There are other sources of information that have been used for the Australian Vulnerability Profile, which are not covered in this Technical Report).

For the non-technical reader: A simple 2 page Abstract as well as a longer Executive Summary are provided in order to help navigate the report. The key messages at the end and some of the graphics may be useful to a more general audience. Chapter 6 provides a simpler overarching synthesis.

For the technical readers: Chapter 1 provides a background to the genesis, foundational premises and scope of this report. Chapters 2 to 5 detail the methodology and results. These chapters are pitched at research scientists or any other user who may wish to use or modify the methods. A comprehensive glossary is provided at the end of the report.

Chapters 1 and 6 are most useful to policy analysts or decision makers. Chapter 6 provides a clear logic for an evidence-based narrative about disasters, vulnerability and resilience. It points to the relevant 'building blocks' in earlier parts of the report, which will enable this audience to dig deeper into specific parts of the reports in areas of interest. It also has some discussion of how these methods, tools and results could be applied or further developed.

The companion reports written to describe the Australian Vulnerability Profile include:

1. Emergency Management Australia. Understanding the Drivers of Disaster: the case for developing an Australian Vulnerability Profile (2017). Internal report. Unpublished.
2. National Resilience Taskforce. Deconstructing Disaster: the strategic case for developing an Australian Vulnerability Profile to enhance national preparedness (2018).
3. National Resilience Taskforce. The Case for an Australian Vulnerability Profile: changing the stories we tell about disaster (2018).

Abstract

The Australian Vulnerability Profile is an initiative of Emergency Management Australia. This report documents the research conducted in the project 'Supporting the Development of the Australian Vulnerability Profile'. CSIRO was commissioned by Emergency Management Australia to conduct this Project, in collaboration with a broader team including Emergency Management Australia, the Bureau of Meteorology, Geoscience Australia, the Department of Defence, and the Department of the Environment and Energy. Workshops were co-hosted by South Australia, Queensland, Western Australia and Northern Territory.

The Project explored the following research questions, the first two of which are relevant for the Australian Vulnerability Profile, and all three for the Project:

> *Research Question 1: What do we value, and what do we stand to lose in disaster?*
>
> *Research Question 2: What makes Australia vulnerable to catastrophic disaster?*
>
> *Research Question 3: Has the Project been an effective intervention in helping to shift the narrative, build capacity and networks, change practice and institutions?*

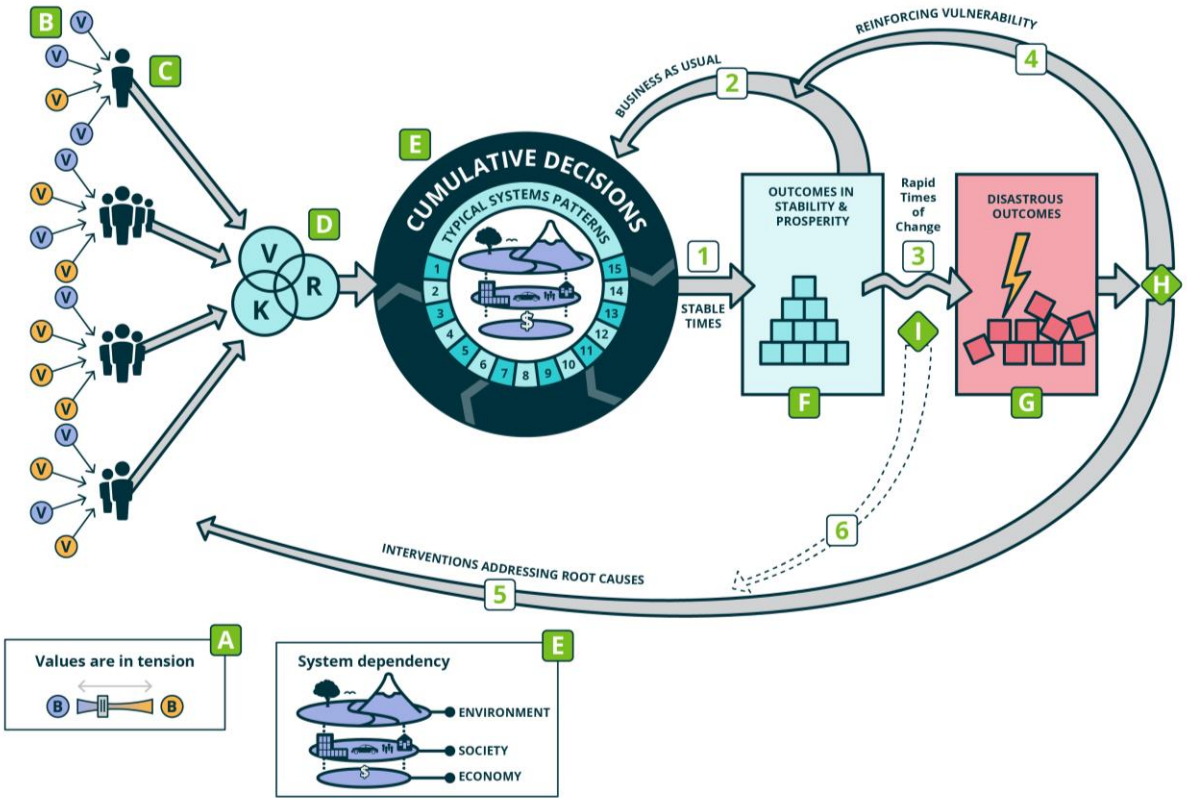
The Project was comprised of the following components:

- Designing for impact – a co-production approach. This comprised a number of activities including:
    - Theory of Change – hypothesising how and why desired changes to the emergency management and disaster resilience system might work
    - Stakeholder Engagement – the project uses a co-design approach and is deeply embedded in co-design with a range of stakeholders
    - Tracking Systemic Change – understanding and testing whether the desired changes to the system have been achieved. Partial results from the workshops are provided, and the full results will be published in future when the monitoring and evaluation work is complete.
- 'Deconstructing Disaster' workshops – designed to engage a range of stakeholders to elicit values (or the sets of things or values important to Australian communities and individuals), understandings of how the system works, particularly the social processes and choices creating vulnerability to disasters, and narratives.
- Detailed analysis. The outputs of the Deconstructing Disaster workshops were combined with information from the literature and from a range of experts, to produce:
    - A values framework for guiding the elicitation and assessment of what's important to people, what's at threat in times of disaster, and the unavoidable trade-offs being made between values
    - Typical system patterns – diagrams and their narratives about various dynamics of a social–ecological system relevant to understanding the root causes and impacts of disasters.
- Synthesis and integration. An evidence-based narrative logic based on the results of the other components to inform or underpin a range of specific narratives and perspectives of the causes and consequences of vulnerability and disaster, for use by various stakeholders to communicate and engage with different audiences.

The basic premise is that natural hazards only lead to disasters if they intersect with a society which is exposed and vulnerable. Disasters are increasingly exceeding the capacity of society to respond and recover

– making it necessary to invest more (or smarter) in disaster risk mitigation. Mitigating the risks of disasters requires understanding the direct and indirect (systemic) causes and effects of vulnerability to inform where and how to intervene.

The logic of the results is shown in the diagram below, and in the description following, letters and numbers in square brackets refer to associated elements of the diagram.



Exploring how values affect vulnerability is important to understand. People hold different values and prioritise different things in different contexts, and these values are sometimes in tension [A, B]. Societal decisions affecting vulnerability are the result of multiple, cumulative, non-linear processes by which tensions and trade-offs in different values and knowledge types are managed. Cumulative choices about values, rules and knowledge [D] affect vulnerability. A set of twelve typical system patterns emerged from the analysis. Some were key decision processes, while others were resource-use activities and their interactions. The system dynamics in periods of stability and disaster were explored.

The cumulative choices made in times of stability [1] lead to a set of outcomes reflecting stability and prosperity [F]. The world now faces rapid, unprecedented change [3], encompassing extreme natural hazard events. The balance of choices and trade-offs made in stable times about the values and things that are prioritised can create vulnerability to these changes, with potentially disastrous consequences [G].

After a disaster happens, there are choices [H] which can either reinforce the current state of existing typical system patterns [4], or address root causes of vulnerability [5]. There is an opportunity to create interventions prior to catastrophic events [I] joining arrow [6], to mitigate the risk of disaster. This would be by making choices to alter the system to reduce vulnerability and increase resilience to extreme natural hazard events. Proactive and strategic interventions to shift or rebalance the knowledge, values or rules can create a greater range of options to reduce vulnerability. This is a key area of focus for the Project and the Australian Vulnerability Profile.

Executive summary

The Australian Vulnerability Profile is an initiative of Emergency Management Australia. This report documents the research conducted in the Project 'Supporting the Development of the Australian Vulnerability Profile'. The Australian Vulnerability Profile aims to reframe national narratives around disaster so that harm and suffering is reduced because Australia is prepared in a more systematic way. CSIRO was commissioned by Emergency Management Australia to conduct this Project, in collaboration with a broader team including Emergency Management Australia, the Bureau of Meteorology, Geoscience Australia, the Department of Defence, and the Department of the Environment and Energy. Workshops were hosted by South Australia, Queensland, Western Australia and Northern Territory.

Chapter 1

The Australian Vulnerability Profile aims to reframe national narratives around disaster so that harm and suffering is reduced because Australia is prepared in a more systematic way. This approach represents a step change from the usual approaches to framing, assessing and responding to risk. The fundamental premise is that disasters are not caused by natural hazards – a disaster occurs only when a natural hazard intersects with society. Disasters emerge at the intersection of complex, dynamic biophysical and social systems. They occur because people are located in the way of harm, and it is difficult to change the situation due to positive feedbacks – including economic incentives, path-dependency, or system inertia – that reinforce the status quo. Existing risk assessment and management approaches are useful for some sorts of natural hazards and categories of risk, but are inadequate with dealing with cumulative and cross-scale issues, or situations where the likelihood is low but the consequences are catastrophic.

The Project explored the following research questions, the first two of which are relevant for the Australian Vulnerability Profile, and all three for the Project:

> *Research Question 1: What do we value, and what do we stand to lose in disaster?*
>
> *Research Question 2: What makes Australia vulnerable to catastrophic disaster?*
>
> *Research Question 3: Has the Project been an effective intervention in helping to shift the narrative, build capacity and networks, change practice and institutions?*

The Project was comprised of the following components:

- Designing for outcomes – a co-production approach. This comprised a number of activities including:
    - Theory of Change – hypothesising how and why desired changes to the emergency management and disaster resilience system might work
    - Stakeholder Engagement – the project uses a co-design approach and is deeply embedded in co-design with a range of stakeholders
    - Tracking Systemic Change – understanding and testing whether the desired changes to the system have been achieved. Partial results from the workshops are provided, and the full results will be published in future when the monitoring and evaluation work is complete.
- 'Deconstructing Disaster' workshops – designed to engage a range of stakeholders to elicit values (or the sets of things or values important to Australian communities and individuals), understandings of how the system works, particularly the social processes and choices creating vulnerability to disasters, and narratives.

- Detailed analysis. The outputs of the Deconstructing Disaster workshops were combined with information from the literature and from a range of experts, to produce:
    - A values framework for guiding the elicitation and assessment of what's important to people, what's at threat in times of disaster, and the unavoidable trade-offs being made between values
    - Typical system patterns – diagrams and their narratives about various dynamics of a social–ecological system relevant to understanding the root causes and impacts of disasters.
- Synthesis and integration. An evidence-based narrative logic based on the results of the other components to inform or underpin a range of specific narratives and perspectives of the causes and consequences of vulnerability and disaster, for use by various stakeholders to communicate and engage with different audiences.

Chapter 2

The Project was designed to start achieving desired outcomes in line with the objectives of the Australian Vulnerability Profile. The design of the Project was therefore underpinned by an explicit model for social change, and activities delivered as part of the Project were intended to help to stimulate change. A co-production model, drawing on the knowledge and roles of many stakeholders was central to this approach.

The Project had the explicit aim of providing methods, tools and data to support the development of the Australian Vulnerability Profile. The content development required not only understanding physical processes that are quantifiable (at least in principle) e.g. material and energy flows interacting with infrastructure, but also human behaviours and social constructs (e.g. communication processes, beliefs and expectations). Effective multi-stakeholder engagement and governance is critical to any sound problem framing, as well as the development of appropriate interventions which will rely on the acceptance by stakeholders for effective implementation.

The Project was conducted within a set of approved ethics protocols intended to keep participants within a safe and respectful process for sharing knowledge and perspectives, having honest conversations, and exploring the boundaries of the current and alternative discourse(s) around disasters.

The Project had an overarching goal to answer certain questions in pursuit of gaining a better understanding of values, and vulnerability. In the context of disasters, this meant discussing sensitive issues such as the losses and suffering experienced or observed by people in disasters, and challenging the core values and identities of individuals by questioning the appropriateness or effectiveness of their roles and responsibilities. The activities conducted during the Project needed to provide a safe but also exploratory space for dialogue. This was a balancing act that required a sensitive and pragmatic as well as a courageous approach: if the conversation stayed too close to the current discourse around disaster, it may feel 'safe' but would not achieve the core objective of the Project or the Australian Vulnerability Profile. Conversely, moving too far into alternative discourse could potentially reduce credibility of the Project and could lead to participants feeling unsafe. The contributions to the Project by individuals were kept confidential, and provided to anyone outside the CSIRO team (including in this report) only in de-identified form.

A structured approach was developed to tracking and attributing any systemic change resulting from activities of the Project as well as from the broader activities and outputs of the Australian Vulnerability Profile.

Chapter 3

Three 'Deconstructing Disaster' workshops were held in Adelaide, Brisbane and Perth, based on a design to elicit data about what people value and what is vulnerable, and also to stimulate systems thinking, structured learning, and networks for social change.

In line with the co-design principles underpinning the Project, the design of the workshop was informed by several bodies of literature about:

- Individual and group learning that considers or addresses:
    - the psychology of learning and the importance of engaging the mind and the heart
    - the existence of different knowledge types/cultures and the need to try integrate these
    - the presence of power imbalances, in levels of authority and between knowledge types, and the need to try to promote a level playing field
    - the need to complement experiential learning (i.e. learning from observations and the past) with future-oriented learning (or learning from the future as it emerges) due to increasingly novel/unprecedented nature of change
- Systems theory/thinking (including resilience thinking and sustainability science)
- Transformational adaptation to overcome the systemic constraints and barriers to effective climate adaptation and disaster risk mitigation
- Creating an effective storyline – literature and interviews of professional storytellers and storymakers
- Ethics and creating a 'safe space'.

The science and facilitation expertise underpinning workshop design and delivery methods enabled selection and use of appropriate tools and approaches to enhance the learning experience, as well as providing rapid synthesis across the complexity of the many perspectives of different sectors, scales and different constructs or framings.

The workshops achieved the two goals of providing a source of raw and semi-processed data for answering the overarching questions of the Australian Vulnerability Profile, as well as a range of other outputs and interactions that will help to inform it. It provided an effective forum for dialogue and influencing the current problem framings, narratives and ways forward around disaster resilience and vulnerability.

The data sourced from the workshops are further analysed and described in subsequent chapters. The workshops were clearly successful as standalone activities in terms of:

- providing a forum for dialogue between levels of government, sectors, organisations, scales of operation, different disciplines and perspectives
- introducing stakeholders to a different set of ideas and approaches
- helping to build capacity, trust and networks which will hopefully persist beyond the workshop
- raising 'expert' awareness of the importance of involving and working with communities (this came out strongly in the Adelaide and Brisbane workshops, while the message from the Perth workshop was less clear)
- contributing to a step change in the way many participants frame the challenge, and potential ways forward in addressing systemic, cross-sector and cross-scale issues. There is clear evidence that the nature and depth of conversations, analysis of the problem, and types of interventions suggested, changed over the course of the two days.

The convening power of the Commonwealth and States; the participation of senior and executive leadership was critical to gaining the participation of key stakeholders, and the legitimacy of sharing multiple perspectives across sectors, levels of government, private industry and civil society.

There was a strong representation of people from emergency services, particularly from the executive leadership in the Australian Government as well as State and Territory governments. Along with the workshop design, this created an environment for the workshop in which difficult topics could be discussed and trust could be built.

There is an ongoing opportunity to use the successful elements of the workshop design and find ways to amplify the experiential learning process in other ways beyond this Project.

Chapter 4

What people value, and might lose, can be understood by systematically analysing the relationships that people have with things of value. People value a vast array of things including physical things, other people and experiences. The value of these things is realised through the diversity of relationships people, individually and collectively, have with them. The relationships often depend on specific attributes of the things, and the relationships satisfy a diversity of motivations or held values within people. The relationships people have with different things are dependent on context; in different situations different things or attributes are important, and different motivations come into play.

People value things differently in stable times and in the face of disaster. The workshops identified that, while many of the things people value are important both in times of relative stability and in the face of disaster, there are a range of things that are possibly taken for granted most of the time but whose value is revealed in times of disaster. These include things that are directly damaged or lost during disaster such as houses, mementos, capital, people and services, and amenity associated with these things, but also sense of security, safety, harmony (lack of trauma), normalcy and self-efficacy. Losses may be to the individual or shared through personal or community connections. Understanding how the relative importance of things of value changes can help inform preparation and response actions to more effectively reduce losses and suffering.

People value the processes in society that keep them safe, and prospering. There is another class of things whose value is revealed during disaster: those processes and capacities that have the ability to reduce vulnerability during stable times and to enable coping and recovery during and after disaster. For example, the diffuse system of processes that govern the location and construction of housing and infrastructure, and specifically the ability of that system to reduce known vulnerabilities. Or the ability of service providers, public, community and private, to deliver tailored responses that address the specific needs of affected people, as opposed to focusing on aggregated economic costs. Or more fundamentally, societal norms, business practices and economic policies that could reduce the extent to which the burden of vulnerability is borne by individuals and communities separate from those who profit economically or politically through the processes that create and transfer risk. Recognition that these systems have failed to reduce vulnerability leads to loss of trust and confidence in governments, businesses and even society.

People value resilience, and believe that it has been declining. Resilience in the face of floods, fire or cyclones is often held as a defining Australian characteristic. However, the workshops clearly revealed it is not a given, especially in a rapidly changing Australia. It can readily be eroded by greater focus on cost reduction, near-term outcomes, and increased mobility placing people in unfamiliar situations and communities.

Chapter 5

The cause-effect diagrams from the Deconstructing Disaster workshops were iteratively distilled to a set of typical system patterns of cause, effect, feedbacks and dynamics which may be in play regardless of type, location or timing of a disaster. These typical system patterns highlight systemic structures that lead to common, highly likely or inevitable outcomes and are aimed at generalising so that the ideas are transferrable.

The typical system patterns have been used to diagnose system vulnerabilities at a level where learnings are generalisable enough to be transferable to other places or contexts. This apparent generalisability warrants testing, and in their current level of maturity it is most appropriate for the diagrams to be offered as hypotheses worth further exploration. A common pitfall of taking a 'systems' view is to confuse this with undertaking a comprehensive analysis of everything. Instead, the diagrams offer a way to take a whole of system perspective that informs some identification and prioritisation of particular system properties that stand out as important to pay attention to.

The typical system patterns were of two types: provisioning systems (e.g. food, water, energy, ecosystems, health), or behaviours, social capacities and social processes (e.g. capacity to care, land-use planning processes). People value physical 'things' and they also value processes that keep them safe. The typical system patterns reflect both of these categories as they emerged from the analysis of values and the diagrams from workshops. As well as showing the critical issues (or variables) which need to be considered and the broad patterns of dynamics in these systems, they have been used to diagnose quite specific vulnerabilities at a level or granularity which is helpful for individual sectors or decision makers to appreciate critical connections between biophysical and social processes, as well as across sectors and scales. The typical systems patterns are:

Simple descriptions of the typical systems patterns are:

- **Essential goods and services (#1):** The drive for efficiency in highly interconnected supply chains can see low levels of diversity and redundancy, and a severe disruption can trigger cascading and amplifying failures, with consequences worsened if people's expectations of uninterrupted services have left them unprepared and inexperienced in coping with the loss of essential goods and services.
- **Health and capacity to care (#2):** An emergency incident with high levels of injury and mortality risks overwhelming a system already stretched to provide routine services, with cascading public health consequences that further erode the capacity for emergency response and recovery.
- **Information and communications (#3):** In times of disaster the pressure to make and share complex, difficult decisions with speed and accuracy drives imperatives for fail-safe, interoperable and broad-reaching communication infrastructure, and trusted, respectful communication practices that foster civil peace and support those who are suffering, however these all need to be established well before incidents occur, when there is less imperative to do so.
- **Placement of communities, infrastructure and assets (#4):** The location and quality of housing and other infrastructure is shaped by innumerable considerations and there can be resistance to the increased costs and complexity of planning and building practices that better account for risks from natural hazards, even though failure to do so locks in unwanted cascading consequences during emergency incidents.
- **Risk assessment, ownership and transfer (#6):** When there are different owners, managers and insurers at different stages in an asset's life cycle, short term financial interests of transient owners and stakeholders can see a lower emphasis on long term risk awareness and associated anticipatory actions, resulting in impacts of future hazards being borne by those who have not been party to or beneficiaries of past decisions.
- **Legacy decisions (#7):** The cumulative decisions and actions made by individuals, organisations and governments in the past constrains the options available to current and future decision-makers, creating path-dependencies that risk locking in unwanted consequences, however there many barriers to acknowledging and acting upon the deficiencies of legacy decisions.

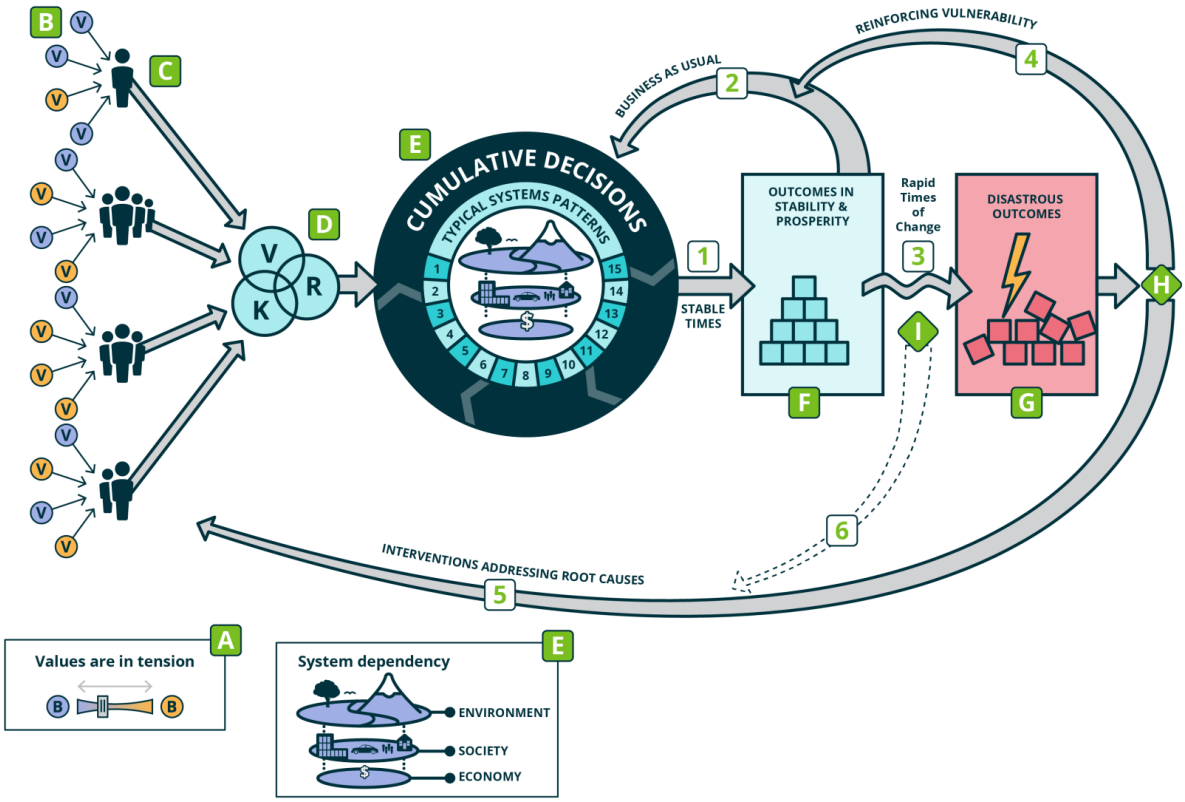
- **Communities of place, interest, identity and necessity (#8):** In daily life most people have considerable freedom to engage with various networks of people as, when and how they wish, however during emergency events communities of necessity are thrown together and may need to work together to secure essentials of life, care for the injured and share information and decision-making, with varying degrees of preparedness to do so.
- **Agency and preparedness (#9):** The means and motivation to prepare and plan for hazardous events is readily displaced by other pressing demands and expectations of daily life, so eroding awareness, preparedness and agency when faced with emergency incidents.
- **Lifelong learning practices, mindset and expectations (#10):** Formal learning in educational institutions equip students for everyday life, which in itself reflects assumptions and expectations about the future. These formal learning approaches are only a small subset of the lifelong learning practices that would more effectively support preparation for, response to and recovery from hazardous incidents.
- **Governance and organised decision-making (#11):** Governance and decision-making can be a highly formal and structured process, or highly agile, flexible and adaptive with 'rules' that emerge from a given context (protocols developed by a community or business in response to a rapidly changing situation). Both are needed in stable times, and higher agility (or the capacity for it) is even more important in a disaster.
- **Leadership (#12):** In times of stability, leadership structures and models in many domains have been characterised by hierarchical use of power and authority, command and control approaches to decision making and implementation, investment in positional leadership and a stronger focus on 'leading from the top'. In situations where rapid change and innovation are required, different leadership structures, styles, skills and cultures may be more useful, and informal, emergent and diverse leadership may be a more useful approach.
- **Nature and people (#14):** Every person's wellbeing is dependent upon natural systems for the provision of goods, services and income, however nature is also a source of dangerous hazards that put lives at risk, and effective balancing of benefits and risks of our interactions with nature depends on the level of understanding of natural systems and governance processes that use that knowledge, and knowledge of the values at stake, to guide decisions.

The typical systems patterns can be built on to inform interventions that build resilience and mitigate risk. Further steps are required to check and test the typical system patterns out with a wider range of literature, experts and a broader range of stakeholders, and they could then be used (in combination with other tools such as Theory of Change) to help identify potential interventions to address the vulnerabilities by addressing systemic risk and root causes. The diagrams are not yet at the stage of fully developed system diagrams. They have utility in moving the conceptualisation of disasters, risk and planning from an 'event' based construct, to one where patterns can be seen.

The typical system patterns are representations of multiple perspectives and types of knowledge and can be used in an ongoing way to complement existing tools such as risk assessment approaches. They can help frame discussions on complex interactions between sectors, scales, and tensions in values and help people to understand the conflicting system representations and systemic points and types of intervention.

Chapter 6

The synthesised results and discussion in this section provide the building blocks for an evidence-based, co-produced narrative logic emerging from this research project. It can be used in various ways, by a range of users, to help support the various stories and narratives that they might choose to communicate to their stakeholders and other audiences. The whole system can be represented by the diagram below.



A short system narrative is as follows.

Exploring how values affect vulnerability is important to understand. People hold different values and prioritise different things in different contexts, and these values are sometimes in tension [A, B]. Societal choices, decisions and actions affecting vulnerability are the result of multiple, cumulative, non-linear processes by which tensions and trade-offs in different values and knowledge types are managed. Cumulative choices about values, rules and knowledge affect vulnerability [D]. A set of twelve typical system patterns emerged from the analysis. Some were key decision processes, while others were resource-use activities and their interactions. The system dynamics in periods of stability and disaster were explored.

The cumulative choices made in times of stability [1] lead to a set of outcomes reflecting stability and prosperity [F]. The world now faces rapid, unprecedented change [3], encompassing extreme natural hazard events. The balance of choices and trade-offs made in stable times about the values and things that are prioritised can create vulnerability to these changes, with potentially disastrous consequences [G].

After a disaster happens, there are choices [H] which can either reinforce the current state of existing typical system patterns [4], or address root causes of vulnerability [5].

Interventions can be made prior to a natural hazard event, to mitigate the risk of disaster, by making choices to alter the system to reduce vulnerability and increase resilience to extreme natural hazard events.

The most important opportunity for decision makers in all sectors, at all levels, in government, industry and civil society, is shown by decision point [[I] leading to arrow [6]. These are the decisions that can be made now, while the warning signs of an increasingly unstable system and higher risks of catastrophic disaster are clear, to prevent or reduce the harm and suffering that would eventuate if such a disaster occurred.

This has been the major focus of this Project, and of the Australian Vulnerability Profile more broadly. This is the point at which choices, decisions, actions, interventions can be made to recognise the identified vulnerabilities, and take action to address them. The Deconstructing Disaster workshops appear to show some early promise at instigating some intentions in the participants to make some different choices.

The challenge, and hope, is to find effective ways to shift the thinking of our political leaders, government agencies, industries and businesses, investors, communities and individuals to start creating the adaptive and transformative changes that go beyond mitigations of individual risks and instead tackle systemic drivers so that the pathways represented by arrow [6] are made effective before catastrophic disaster arrives. As well as reducing vulnerability to catastrophic disaster, these actions also hold the possibility and promise of redesigning systems that can stay within a safe ecological ceiling, and based on a strong social foundation.

The interpretation and implementation of the outputs of this Project for use in the Australian Vulnerability Profile are within the remit of the Australian Government, and beyond the scope of this Project and report. However, the report provides suggestions on how existing disaster risk assessment approaches can be readily broadened or complemented with the approaches and tools deployed in this Project. There is a real opportunity to use the successful elements of the learning design and find ways to amplify the experiential learning process in other ways beyond this Project.

1 Introduction and overview of this report

Authors: Deborah O'Connell, Jill Edwards, Monica Osuchowski, Mark Crosweller, Veronica Doerr, Seona Meharg, Russell Wise, Rachel Williams, Nicky Grigg, Russell Wise, Michael Dunlop

1.1 The need for a different approach to understanding disasters

This report documents the research conducted in the project 'Supporting the Development of the Australian Vulnerability Profile'. The research project will be henceforth referred to as the Project, as distinct from the Australian Vulnerability Profile which is the overarching concept owned by the Australian Government. CSIRO was commissioned by Emergency Management Australia to conduct this project. In April 2018 responsibility for the Australian Vulnerability Profile was transferred to the newly created National Resilience Taskforce. The Project ran from September 2017 to August 2018.

Much of the existing effort in disaster risk reduction, or disaster resilience, is focused on improved characterisation or quantification of risk – particularly the elements of likelihood, and impact (or consequence) through a standard risk assessment lens. The implementation of local scale, single hazard risk assessment and design of mitigation and response strategies is widely operational (though focused more on assessment than mitigation). This approach is based on the assumptions that natural hazards or disaster risks can be understood and quantified in terms of likelihoods (e.g. probabilities) and consequences (e.g. impacts, losses, and suffering can be adequately approximated and compensated for in monetary terms) and that these risks can be managed or controlled (Beck, 1992). And yet in the context of interacting global changes such as climate change, population growth, technological disruption and economic forces, the reality is that neither likelihoods nor consequences of disasters can be fully understood or predicted, and the intangible nature of the impacts, loss and suffering cannot adequately be quantified or compensated in monetary terms (Stirling and Scoones, 2009, Wise et al., 2014, Tschakert et al., 2017).

For effective risk assessment and mitigation to be implemented in contexts of uncertainty and ambiguity, a broad set of stakeholders will need to take action, and the actions of each group will affect others. Additionally, it is well recognised that the tools and data for risk assessment and mitigation are only useful if they are deployed within effective institutional processes to underpin robust and adaptive decision-making – and mostly, they are not (O'Connell et al., 2015, Lukasiewicz et al., 2017). There are outstanding challenges in assessing and effectively responding to risks across multiple stakeholders, multiple hazards, and scales, and in accounting for the cumulative or compounding interactions between risks of different types, especially under increasingly variable and uncertain conditions.

This project represents a step change from the usual/traditional approaches to framing, assessing and responding to risk. The Attorney-General's Department, through Emergency Management Australia (EMA), led the development of a new approach to understanding the drivers and consequences of disaster, titled the Australian Vulnerability Profile. Emergency Management Australia (2017) described the case for developing a new 'national narrative' to enhance preparedness for severe to catastrophic disaster. The Emergency Management Australia (2017) paper proposed that being better prepared for the inevitability of small-likelihood high-consequence events would need an understanding of the human and biophysical drivers of disaster, and of what is at stake when severe to catastrophic disasters affect Australian communities, so that the adverse impacts on the things most valuable could be anticipated and managed. Emergency Management Australia (2017) set the context for the Project, and the Terms of Reference

(section 1.4) for CSIRO to deliver the Project 'Supporting the Development of the Australian Vulnerability Profile' described in this report. The Emergency Management Australia (2017) discussion paper laid out some foundational premises and set the overarching objectives and research questions for the Project, and these are described further below.

The Emergency Management Australia (2017) discussion paper was targeted at severe to catastrophic disasters that are triggered by natural hazards such as tropical cyclones, bushfires, floods, severe storms, earthquakes and tsunamis, and emerged from a growing concern regarding the intensification of natural hazards and the occurrence of disasters that test, and increasingly overwhelm, the capacity and capability of individuals, communities, governments and businesses to respond and recover in Australia.

1.2 Foundational premises for the Project

The following premises were foundational to this Project:

1. Disasters are not caused by natural hazards – a disaster occurs only when a natural hazard intersects with society. The premise proposed by Emergency Management Australia (2017) is consistent with others who have written that disasters emerge at the intersection of complex, dynamic biophysical and social systems. Disasters occur because people are located in the way of harm, and it is difficult to change the situation due to positive feedbacks – including economic incentives, path-dependency, or system inertia – that reinforce the status quo (Abel et al., 2011, Barnett et al., 2015, Manuel-Navarrete and Pelling, 2015, O'Hare et al., 2016).
2. The choices made by individuals, communities, institutions and governments about where and how communities are placed have the potential to increase vulnerability to disaster – or create more resilience to disaster (Kelman et al., 2016, Emergency Management Australia, 2017).
3. Policies to reduce the impact of disasters would look different if they focused on reducing risk – if risk is narrowly defined as likelihood x consequence and quantified in terms of probabilities of an event happening and monetary values alone are assigned to the consequences (e.g. the ISO 31000 risk assessment approach (ISO, 2009)) – compared to focusing on reducing vulnerability. The distinction between vulnerability and risk has important implications for dealing with severe to catastrophic disasters – for example, focusing on risk would lead to an emphasis on further characterising or quantifying the hazard (which there is little opportunity to manage *per se*) rather than starting to understand the elements of exposure and vulnerability (which rely on human decisions and choices and are therefore more amenable to management). Therefore, a broader understanding and framing of risk is required that accommodates a deeper understanding of the causes and effects of vulnerability that can inform larger, or smarter, investments in disaster risk mitigation (Emergency Management Australia, 2017). This premise builds on a substantial body of literature reviewing and reframing of different approaches to risk based on simple, complicated or complex risks and the characteristics of decision-making as they relate to methods, approach, stakeholder strategies, mental models, values and outcomes, and monitoring – for example as described by Jones et al. (2014). There is also a depth of work on relating risk approaches, decision-making and the relationship between disaster risk reduction and climate adaptation (Jones and Preston, 2011, Serrao-Neumann et al., 2015) and many others.
4. A catastrophic disaster is possible and plausible. If this occurred, the capability for effective emergency response would be exceeded, and the loss and suffering would be immense. Therefore, a different way of thinking about the inevitability of catastrophic events is required (Crosweller, 2015).

These foundational premises, and proposed reframing of the issues, formed the basis for the design and delivery the Project documented in this report, 'Supporting the Development of the Australian Vulnerability Profile'.

1.3 The Australian Vulnerability Profile

Emergency Management Australia (2017) proposed that defining a new narrative on the drivers of disaster 'would lay a foundation to unify efforts towards':

- Reducing harm and suffering for Australians
- Systematically advancing Australia's preparedness
- Aligning international and national strategic commitments
- Enhancing early warnings (red flags of risk)
- Avoiding hazards turning into disasters
- Reducing disaster risk rather than letting it grow and accumulate
- Avoiding new and reducing existing vulnerabilities
- Strengthening individual, community, government and institutional resilience.

They also proposed that development of the narrative would:

- 'Support the priority actions of the National Strategy for Disaster Resilience (NDSR), the Sendai Framework for Disaster Risk Reduction and the Sustainability Development Goals (SDGs). Further, it will create a connection between international commitments, the work of jurisdictions including the Commonwealth, and will provide guidance to ANZEMC for determining national-level policy priorities.'
- 'Provide jurisdictions an authoritative source of knowledge for the risks that are beyond the capacity of each state to mitigate. It would support the concept of shared responsibility and benefit states through synthesising and raising collective knowledge at the national level to identify national policy challenges, inform future policy initiatives and better understand national capability gaps. It would also benefit stakeholders across all sectors that play a role in disaster resilience including business and community leaders and the not-for-profit sector.'
- Enable stakeholders engaged throughout the project to participate in the development of the Profile as well as identify synergies with their own work, to create links to other aligned projects, provide advice and guidance, and potentially collaborate on solving other complex national challenges related to disaster preparedness and resilience.
- Represent collective investment in resilience by re-imagining and better connecting existing activity and investment streams.

Emergency Management Australia (2017) envisaged that the Australian Vulnerability Profile would comprise a central component of a broader strategic context: advancing Australia's preparedness and capability to deal with the impacts of severe to catastrophic disasters by providing a rationale for deeper explorations of vulnerability. They recognised that there are:

  - complex systems which will not ever be fully understood
  - multiple legitimate perspectives on the system, problems and solutions
  - ambiguity about goals

- increasing hazard likelihood/frequencies and intensities, and increasing exposure and sensitivities of people – and that the combination of these may make it harder to manage/lower the consequences.

They also proposed that the Australian Vulnerability Profile would provide background on values-based approaches and why to move toward explicit consideration of values.

1.4 Contracted Terms of Reference for CSIRO to deliver 'Supporting the Development of the Australian Vulnerability Profile'

The 'Australian Vulnerability Profile' was originally an initiative of the Attorney-General's Department (AGD), and the EMA team housed within AGD sought to work with states and territories, the community, the private sector and other key stakeholders to construct and publish the first iteration of the Australian Vulnerability Profile. The definition or specification of the Australian Vulnerability Profile was not made at the outset of this Project, other than being 'a systems narrative' about what makes Australia vulnerable to disaster – what causes hazards to become disasters. In doing so, it was hoped that it would:

1. test and respond to the following premise:

   'vulnerability is a product of our expectations and what we value; and that how we live our lives plays a part in creating the environment for our vulnerability. With increasing dependency on access to interconnected systems to support our health, safety and wellbeing, any disruption or damage to these systems can exacerbate existing vulnerabilities and expose new ones'

2. answer the question: '*what makes Australia vulnerable to disaster*?'
3. initiate a new national narrative around how Australia can enhance its preparedness for severe to catastrophic disasters, to reduce their impact and improve Australia's economic and social sustainability into the future
4. provide a short communication.

A co-production approach was taken to designing and delivering the Project 'Supporting the Development of the Australian Vulnerability Profile'. CSIRO was contracted to deliver the work described in this report. The Deconstructing Disaster workshops were designed and delivered in collaboration with a broader team including Emergency Management Australia, the Bureau of Meteorology, Geoscience Australia, the Department of Defence, and the Department of the Environment and Energy (see Chapter 2). Workshops were co-hosted by South Australia, Queensland, and Western Australia (with representation from the Northern Territory) (see Chapter 3).

The Project was specified as a set of components, and the findings of each component was used to specify the methods, outputs and deliverables of ongoing phases of delivery (see Chapter 2). Although informed by the work described in this report, the design and deployment of the Australian Vulnerability Profile *per se* is explicitly beyond the remit of the Project.

1.5 Key overarching research questions for the project

The foundational premises laid out in section 1.2 and the Terms of Reference described in section 1.4 led to the distillation of the following overarching research questions, the first two of which are relevant for the Australian Vulnerability Profile, and all three for the Project itself:

Research Question 1: What do we value, and what do we stand to lose in disaster?

Research Question 2: What makes Australia vulnerable to catastrophic disaster?

Research Question 3: Has the Project been an effective intervention in helping to shift the narrative, build capacity and networks, change practice and institutions?

These questions are elegant in their simplicity, but there are no simple answers. They were supplemented by some subsidiary research questions and addressed through the detailed analysis presented in Chapters 3 to 6.

1.6 Overview of the approach of the Project, and structure of the report

The Project was comprised of a number of components:

- Designing for impact – a co-production approach (Chapter 2). This comprised several activities including:
    - Theory of Change – hypothesising how and why desired changes to the emergency management and disaster resilience system might work
    - Stakeholder Engagement – the project used a co-design approach and was deeply embedded in co-design with a range of stakeholders
    - Tracking systemic change – understanding and testing whether the desired changes to the system have been achieved. The approach is outlined in section 2.6, and partial results from the workshops provided in Chapter 3. The full results will be published in future when the monitoring and evaluation work is complete.
- 'Deconstructing Disaster' workshops – designed to engage a range of stakeholders to elicit values (or the sets of things or values important to Australian communities and individuals), understandings of how the system works, particularly the social processes and choices creating vulnerability to disasters, and narratives (described in Chapter 3).
- Detailed analysis. The outputs of the Deconstructing Disaster workshops were combined with information from the literature and from a range of experts, to produce:
    - A values framework for guiding the elicitation and assessment of what's important to people, what is under threat in times of disaster, and the unavoidable trade-offs being made between values (Chapter 4)
    - Typical system patterns – diagrams and their narratives about various dynamics of a social–ecological system relevant to understanding the root causes and impacts of disasters (Chapter 5).
- Synthesis and integration. An evidence-based narrative logic based on the results of Chapters 3, 4 and 5 to inform or underpin a range of specific narratives and perspectives of the causes and consequences of vulnerability and disaster, for use by various stakeholders to communicate and engage with different audiences.

1.7 Conclusions and key messages

Key message 1: This report documents the research conducted in the project 'Supporting the Development of the Australian Vulnerability Profile'. The Australian Vulnerability Profile aims to reframe national narratives around disaster so that harm and suffering is reduced because Australia is prepared in a more systematic way.

The research project will be henceforth referred to as the Project, as distinct from the Australian Vulnerability Profile which is the overarching concept owned by the Australian Government. CSIRO was commissioned by Emergency Management Australia to conduct this project. The Project ran from September 2017 to August 2018.

Key message 2: Disasters are not caused by natural hazards – a disaster occurs only when a natural hazard intersects with society.

The premise proposed by Emergency Management Australia (2017) is consistent with others who have written that disasters emerge at the intersection of complex, dynamic biophysical and social systems. Disasters occur because people are located in the way of harm, and it is difficult to change the situation due to feedback loops, economic incentives, path-dependency, or system inertia – that reinforce the status quo

Key message 3: This project represents a step change from more typical approaches to framing, assessing and responding to risk.

For effective risk assessment and mitigation to be implemented in contexts of uncertainty and ambiguity, a broad set of stakeholders will need to take action, and the actions of each group will affect others. Additionally, it is well recognised that the tools and data for risk assessment and mitigation are only useful if they are deployed within effective institutional processes to underpin robust and adaptive decision-making – and mostly, they are not (O'Connell et al., 2015, Lukasiewicz et al., 2017). There are outstanding challenges in assessing and effectively responding to risks across multiple stakeholders, multiple hazards, and scales, and in accounting for the cumulative or compounding interactions between risks of different types, especially under increasingly variable and uncertain conditions.

Key message 4: This project set out to answer three key research questions, the first two of which are relevant for the Australian Vulnerability Profile, and all three for the Project itself:

Research Question 1: What do we value, and what do we stand to lose in disaster?

Research Question 2: What makes Australia vulnerable to catastrophic disaster?

Research Question 3: Has the Project been an effective intervention in helping to shift the narrative, build capacity and networks, change practice and institutions?

2 Designing to deliver outcomes – a co-production approach

Authorship: Seona Meharg, Rachel Williams, Deborah O'Connell, Veronica Doerr, Jill Edwards, Monica Osuchowski, Russell Wise, Michael Dunlop, Nicky Grigg.

Introduction

2.1 Rationale

The Project had the explicit aim of providing methods, tools and data to support the development of the Australian Vulnerability Profile. The content development required not only understanding physical processes that are quantifiable (at least in principle) e.g. material and energy flows interacting with infrastructure, but also human behaviours and social constructs (e.g. communication processes, beliefs and expectations). Effective multi-stakeholder engagement and governance is critical to any sound problem framing, as well as the development of appropriate interventions which will rely on the acceptance by stakeholders for effective implementation – this has been a central tenet of a great deal of theory and practice, and some guidelines for approaches relevant to the methods used here were summarised in O'Connell et al. (2016). Therefore approaches to bring together the diverse knowledge held by stakeholders, governments and funders were used to build an understanding of the plural views about problems and solutions, roles, responsibilities and accountabilities.

Questions of why to engage, and the objectives of each engagement; who to engage, and how to engage were crucial to the success of the Project. Multi-stakeholder engagement processes are much more successful when stakeholders are given specific tasks to undertake; when they feel that they have some control in the process; and that it is of benefit to them to be engaged in the process as well as the project outcomes. Identifying the learning environment was critical, and in this case the Project could be considered an intervention and capacity building activity in its own right.

The rationale and methods for designing for impact are covered in this short chapter, with salient or exemplifying references rather than a comprehensive review of each area, including a list of essential ingredients for any project which has to deal with issues of:

- systems thinking,
- diverse and contested values,
- ambiguities in system dynamics and goals, and
- providing credible, legitimate, and salient support and evidence of the need for, and how to, reframe national narratives about disasters.

Co-production is an essential component of the approach because knowledge about the causes and consequences of disasters is incomplete with high levels of uncertainty in understanding or predictability of the likelihoods or consequences of natural hazards and responses (mitigation or recovery) to these. Therefore, there is unavoidable ambiguity or ignorance where multiple, often contested/conflicting, perspectives of the situation (problem-solution spaces) legitimately exist and where difficult choices/trade-offs in the priorities and values between many diverse stakeholders need to be made. One way conflict, partisanship and antagonisms can be managed or avoided in such contexts is through inclusive

participatory processes of discovery, deliberation and negotiation that acknowledge and recognise the plurality of values, perspectives and knowledge types, and which promote and enable the co-production of new, shared understanding, perspectives and knowledge (Stirling and Scoones, 2009, Brugnach and Ingram, 2012).

Co-production involves multiple stakeholders in decision-making processes, which implies accepting that there can be simultaneously many different sensible ways of understanding a problem and finding solutions (Brugnach and Ingram, 2012). People frame a decision situation according to their backgrounds, experiences, societal positions, values and beliefs. The co-production of knowledge requires the integration of knowledge holders into the process of knowledge creation, and this means using an analytical frame in which humans are not considered external but rather are considered to be integral to the social–ecological system being managed (Brugnach and Ingram, 2012).

Therefore, a co-production approach was used to combine scientific resources (CSIRO, BoM, GA, Department of Defence, Department of Environment and Energy, and a range of experts and National Advisory Panel) and governance capability (Australian Government, and State and Territory Government departments and others in implementation roles on the Partnership Team). Workshops involved a wide range of stakeholders such as public, private and civil society representatives to explore scientifically informed social change through the lens of disasters. As outlined by Van Kerkhoff and Lebel (2015), this interconnectedness and interplay changes the discussion from identifying gaps, to grappling with the underlying causal social and political drivers and gaining a better understanding of what is or is not possible (Ely, 2018).

2.2 Ethics

Research where information is collected from and about humans has to be covered by a human ethics research protocol. The Project was cleared in accordance with the ethical review processes of CSIRO, within the guidelines of the National Statement on Ethical Conduct in Human Research. This required a detailed assessment of potential risks to participants which was then evaluated by CSIRO's Social Science Human Research Ethics Committee. The ethics protocols were intended to keep all participants within a safe and respectful process for sharing knowledge, to acknowledge the intellectual contribution that they made to the Project. The contributions to the Project by individuals were kept confidential, and provided to anyone outside the CSIRO team (including in this report) only in de-identified form. Informed consent was sought for all potential future uses of the information provided by the participants, and mechanisms for withdrawal, questions or concerns were provided. The information sheet for participants is provided in Appendix A.1 Ethics Information Sheets for Participants.

2.3 The project as an intervention for creating change

The Project had an overarching goal to answer certain questions in pursuit of gaining a better understanding of values, and vulnerability. In the context of disasters, this meant discussing sensitive issues such as the losses and suffering experienced or observed by people in disasters, and challenging the core values and identities of individuals by questioning the appropriateness or effectiveness of their roles and responsibilities. It also sought to develop the underpinning logic and evidence for a new national narrative (see sections 1.2, 1.3 and 1.4). This required understanding the current values and narratives, as well as exploring different values and narratives. In this sense, the activities conducted during the Project needed to provide a safe but also exploratory space for dialogue. This was a balancing act that required a sensitive and pragmatic as well as a courageous approach: if the conversation stayed too close to the current discourse around disaster, it would not achieve the core objective of the Project. Conversely, moving too

far into alternative discourse could potentially reduce credibility of the Project and could lead to participants feeling unsafe.

The key research question explored in this Chapter is:

> *Research Question 3: Has the Project been an effective intervention in helping to shift the narrative, build capacity and networks, change practice and institutions?*

The rationale and methods are described in this Chapter. The research question can only be partially answered at this stage of the project based on preliminary results from the Deconstructing Disaster workshops (Chapter 3). Further evaluations would need to be undertaken post-project to better understand the effectiveness of the project as an intervention.

Methods

2.4 The model for how social change happens

In order to support the Australian Vulnerability Profile objectives, the Project team required a good understanding of systemic processes which lead to vulnerability, as well as those that may lead to the desired changes required to enhance the preparedness of the nation.

When interventions are successful at creating systemic change, it is often because an individual, or group of individuals, recognise and accept that change is unavoidable with no fixed destination and is therefore best undertaken as an adaptive journey; and with the perseverance to work multiple pathways to achieve their goal (Westley et al., 2009). There is increasing recognition that these people, known as Agents of Change, respond and adapt to challenges in particular ways due to cognitive and psychological factors. While everyone has the potential to be an agent of change, not everyone will actually become one due to efficacy, context or temporal constraints (Bandura, 2018).

Interventions can be designed to 'prime' these agents, by growing their capacity to 'see' change and opportunities, and by growing and strengthening their networks (Butler et al., 2016b, Trimble and Plummer, 2018). These capacities and competencies include systems thinking, anticipatory competence, normative competence (values, principles and connected to the concepts of multi-loop learning etc.), strategic competence and the ability to be at ease with uncertainty (Brown and Westaway, 2011, Wiek et al., 2011). In addition, by building interpersonal competence, including trust and relationships, these individuals (or groups) are more likely to come across opportunities to promote the change they seek. Therefore, for the Profile, in this Project a network of Agents of Change was stimulated through purpose-designed 'priming' activities and engagement, with a particular focus on nurturing Agents of Change in the Partnership Team.

A more detailed analysis of how social change might occur through the Profile was outlined in an initial Theory of Change, which was developed by the project team and colleagues. It was based on three interdependent impact pathways, with each pathway contributing to the anticipated social change outcomes, intersecting and overlapping at key points. A brief overview of the three pathways is outlined below:

- Pathway 1 focused on the development of shared responsibility for mitigation and managing residual risk through increasingly inclusive and collaborative networks.
- Pathway 2 sought to create new national governance arrangements that enable action towards National Resilience, through the development of collaborative leadership and appropriate incentives and financial arrangements.

- Pathway 3 centred on creating a shared sense of responsibility and risk ownership for mitigating impacts of severe to catastrophic events by risk owners being informed and supported.

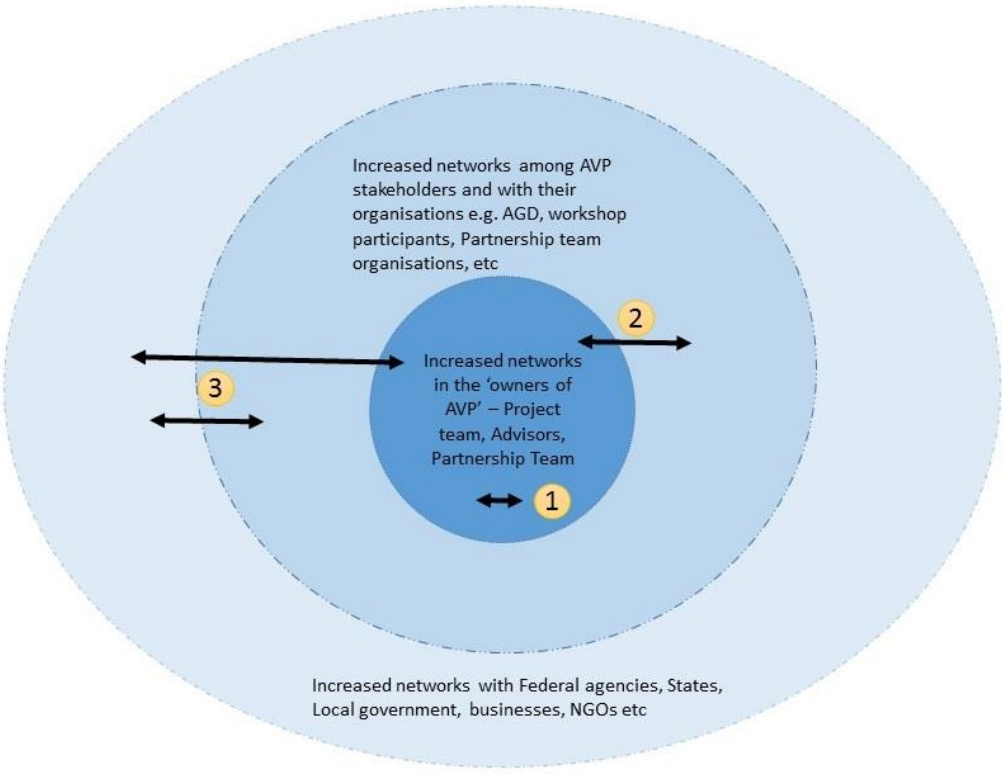


Figure 1 Cross-scale social networks: Information, values and norms extend across three network scales from the project team, through the agents of change to the wider community (adapted from Meharg, unpublished PhD thesis)

2.5 The co-design plan

As mentioned in section 2.2.2, engagement was designed to build co-ownership with key stakeholders who potentially have a role in driving change. One purpose was to 'prime' them as described above. Co-ownership from participating in co-design was also intended to improve the chances that others would want to use the outputs of the Australian Vulnerability Profile to promote change around them and that the outputs would be easy for them to use – because their language was represented, the decisions they made were addressed, etc. These stakeholders were expected to contribute to informing the design, content and uptake of a new narrative. It was anticipated that stakeholders would be able to identify synergies with their own work, create links to other aligned projects, provide advice and guidance, and both contribute to and benefit from a new national narrative on disaster preparedness.

2.5.1 The Core Team (EMA and CSIRO) and the Co-Design Team (including BoM, GA, DoD and DoEE)

The Co-Design Team included a Core Team (comprising of key staff from EMA and CSIRO), as well as key partners with specific technical or methodological expertise, contributing to specific tasks associated with the Profile such as the development of hazard scenarios. These additional Project Team partners included the Department of Defence, the Bureau of Meteorology, Geoscience Australia, and the Department of the

Environment and Energy. The Core Team carried the major tasks of project design and delivery, with key strategic input and delivery of specific elements of the project from the broader Co-Design Team.

2.5.2 Design of key strategic partnerships for co-production

Co-design was first initated with the Core Team (key staff from EMA and CSIRO) and a broader set of EMA colleagues by developing a Theory of Change, exploring how the project team and broader leadership within EMA through the project could increase disaster preparedness and reduce vulnerability. The Theory of Change also informed the design of the engagement strategy to ensure it was a more deliberate way to achieve specific outcomes. The Theory of Change process made it clear that there are two distinct purposes to engagement as part of the Australian Vulnerability Profile:

- To gather knowledge about key drivers of vulnerability from a wide cross-section of people involved in disaster preparedness/mitigation, response and recovery to best identify key drivers
- To develop the Profile in true collaboration with those who can enhance preparedness through policy and effect change, so they have co-ownership of it and so that it meets their needs in driving change.

While the engagement plan was designed to achieve these two purposes, this section focuses on the latter goal using different methods for different subsets of stakeholders. Different engagement methods were targeted toward specific groups of stakeholders based on the purpose of engaging and capacity of individual stakeholders to contribute to the work. This approach was designed to support the development of a core group of target 'Agents of Change' (the 'Partnership Team') who were anticipated to be the first adopters of the Profile and hopefully the first to act in reducing vulnerability. Each governance entity and stakeholder type is briefly described in Table 1. These specific groups, their anticipated membership, and the methods used to engage them are detailed more fully in the Engagement Plan.

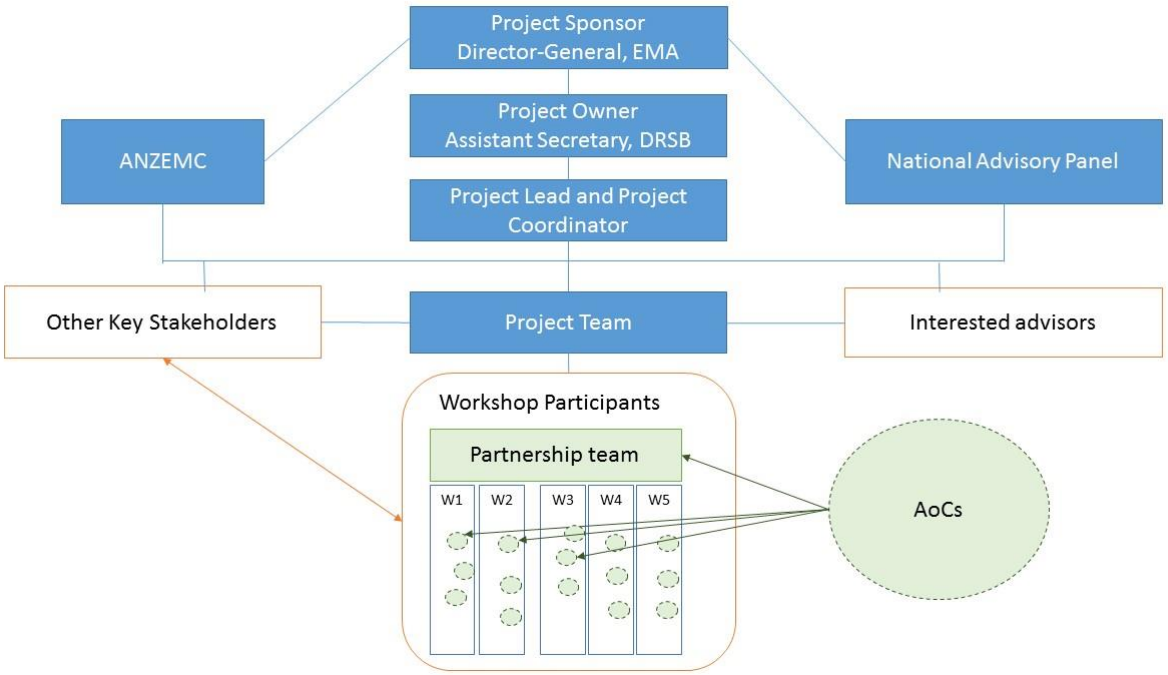


Figure 2 The governance structure for the project (in blue) and relationships with different stakeholder types. Each type and their roles are detailed in the Australian Vulnerability Profile Engagement Plan (unpublished internal document). Note that AoCs refers to Agents of Change and these are shown with a dot

2.5.3 The Partnership Team

A deeper co-production process was designed to build stronger co-ownership with the subset of stakeholders known as the Partnership Team. These stakeholders represented federal government, state government, national bodies, and NGOs with ability to pull higher-level structural levers. It was anticipated that this team would be highly involved, playing a substantial role in helping to develop the Profile, having strong ownership of it, and thus hopefully being the first wave of Australian Vulnerability Profile champions adopting the Profile and acting on it. Also, by being part of a new cohort/network they would have the support not only of the project team, but also each other, as they shared and tested the Profile with their own networks. Co-design and production with the Partnership Team involved:

- participation in multiple workshops to share early ideas before writing commenced
- collaborative synthesis of some of the information gathered in workshops
- deeper review and discussion of drafts of the Australian Vulnerability Profile and the option to co-write examples, case studies and stories included in the Profile.

To 'prime' the Partnership Team to become Agents of Change, specific techniques were used to engage them more deeply in co-production of the knowledge underpinning the Profile, as well as co-production of the final product(s) to better meet their specific needs. Such co-production has been shown to increase a sense of co-ownership, which in turn makes it more likely that action will result. It also aimed to ensure that final products had the language, format, and general look and feel that would make them easier to share with others to gain further support for change/action.

As anticipated it was difficult to co-produce knowledge with stakeholders who were spatially distributed and thus didn't necessarily know each other prior to the project. The following methods were used to attempt as much co-production as possible given these challenges:

- Teleconference briefings and meetings with the Partnership Team in addition to participation in multiple workshops. This was designed to help build relationships and make the team itself into a new network
- Direct involvement in finalising workshop results, digging deeper, and synthesising
- Encouraging them to use some of the same engagement techniques used in the workshops to engage with their own networks about vulnerability to disasters when they expressed intent to do so
- Getting them to review very early, partially formed drafts of the Profile so they had ample opportunity to guide it
- Organising teleconferences to provide their reviews of early drafts, allowing them to hear others' views as well and help decide what actions should be taken based on a synthesis of feedback
- Working with individual members of the Partnership Team to co-write example boxes, case studies, etc. – small portions of the final Profile that help to 'make it real' and can be credited with co-authorship.

Another aim was also to run discussion-based delivery sessions with Partnership Team members' organisations, to contextualise the Profile with them, resulting in richer interpretations and new ideas about actions they can take. As at the time writing this report, such discussion-based delivery had not been possible yet as the Profile itself was still in development, though discussion-based delivery is still intended.

Most of these activities were facilitated by a specific relationship broker, a person who was not directly involved in leading the workshops or doing a majority of the writing of the Profile, and could therefore help create 'safe spaces' for Partnership Team members to provide frank and honest feedback. However, it was also important for EMA to build direct relationships with Partnership Team members so in reality, this brokering model was only partially used, with EMA hosting and/or leading some of these activities.

2.5.4 Periodic basic engagement

To allow the opportunity for additional change to emerge as a result of the work (beyond what the project itself can help build and guide), and to ensure the work was contextualised within broader strategy and scholarship, the engagement plan also included some periodic basic engagement with other interested parties. These included:

- The Australia-New Zealand Emergency Management Committee (ANZEMC) and associated sub-committees, providing strategic leadership on policy and capacity/capability development for disaster resilience
- The National Advisory Panel, a small number of additional scholars from outside the Project Team, providing additional scholarly insights and conversations
- Workshop-specific stakeholders, other interested advisers and other key stakeholders to keep them informed about and interested in the development of the Profile.

2.5.5 Wider set of stakeholders

In order to engage with a wider set of stakeholders a series of workshops was held in Adelaide, Brisbane and Perth, each involving a cross-section of local, state and national organisations and representatives including those from government, business and the community. In addition to eliciting information on key

drivers of vulnerability, the workshops were designed to build a basic sense of co-ownership, respect and value for all contributors, and a sense of empowerment to reduce vulnerability.

Ultimately, the information obtained by tracking systemic change will be used to inform a broad range of stakeholders. Participants in the process will be able to see whether the project, and their contribution to the endeavour, is making the difference to which they aspire. Senior leaders who have endorsed and invested in this work will be able to see whether it has been an effective investment and has achieved some of the bold aims. More broadly, many who are searching for more effective ways to navigate and effect systemic change will be able to learn about the utility of the approach taken in the Profile. An understanding of how the project has created change with reference to the Theory of Change, the social networks (Figure 1), and the triple-loop learning (Butler et al., 2017) will help to underpin the broader contribution to learning.

2.6 Designing and tracking systemic change

The Designing and Tracking Systemic Change component enabled the Profile team to understand whether the anticipated priming for systemic change required to improve Australia's disaster preparedness was in train, and the extent to which the Profile may have been effective in catalysing these changes. This was done by creating a set of indicators to assess the preconditions to the vision and associated outcomes, outputs and activities.

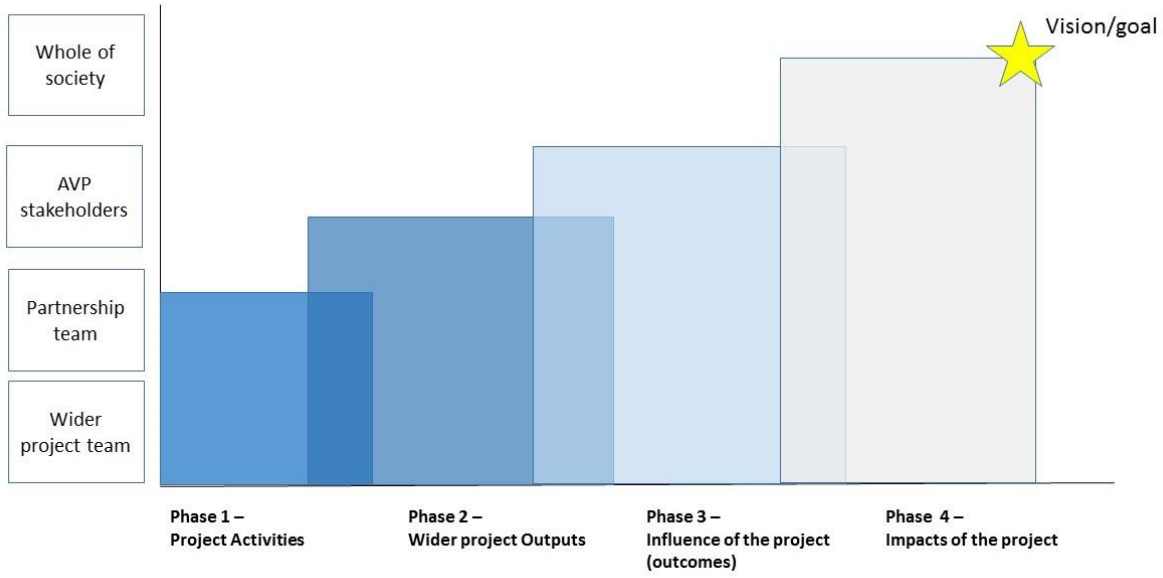


Figure 3 How the project aligns to the four phases of the Theory of Change, reaching the desired vision or goal over time (Butler et al., 2016b)

The Tracking Systemic Change component of the project (see section 2.6) was designed to test the assumptions of the project, based primarily on the three impact pathways of the Theory of Change and the associated engagement strategy and workshop processes. This was operationalised by creating a set of indicators to assess the preconditions to the vision and associated outcomes, outputs and activities. A mixed methods approach was then used to facilitate a structured way for reflecting on the process, concepts and the project. By integrating several approaches, there was a chance to capture a broader range

of preconditions for impact and associated challenges to the assumptions, while minimising the limitations of any one method or approach.

One instrument designed to assess the effectiveness of specific engagement activities and processes was an online or hard copy survey. Pre- and post-workshop surveys, and a partnership team engagement survey, were designed based on indicators associated with the three pathways of the Theory of Change and aligned to the four impact phases anticipated (see Figure 3). This included testing the creation of cross-scale social networks (Figure 1) which underpinned the assumption that cross-scale social networks were required to enable social learning; double- and triple-loop learning; self-organisation; as well as whether resources were mobilised for problem-solving and innovation.

Table 1 Indicators, alignment with project impact phases over time

Alignment with Project impact phases (time)	Indicator
Phase1 – Project activities	• Participation
	• Engagement
	• Knowledge of the problem enhanced
	• Trust created
	• Leadership emerging or changing
	• Creation of compelling narratives
	• Ownership of the narratives
Phase 2 – Wider project outputs	• New networks established, old networks strengthened
	• Questioning of values, norms and governance underlying the problem
	• Efficacy
	• New narratives gaining traction with a range of different audiences
Phase 3 – Influence of the project (outputs to outcomes)	• New cross-scale networks established, old networks strengthened
	• Creation of new ways to undertake risk assessment (tools) and management
	• Changes to institutions (formal and informal rules)
	• New policies and programs created or old policies and programs adjusted
	• New partnerships formed
Phase 4 – Impacts of the project	• New cross-scale networks established, old networks strengthened
	• New ways of doing
	• Catalysed to act for enhanced preparedness (National, State or Territory Government)
	• Catalysed to act for enhanced preparedness (Community, Local Government or Private Corporation)

Results, discussion, conclusion and key messages

2.7 Preliminary results only

Preliminary tracking systemic change results can be drawn from the three Deconstructing Disaster workshop evaluations, reported in section 3.7.7. However, a clearer picture of the effectiveness of this Project as an intervention will not be possible until the post-project evaluation is undertaken later in 2018.

Participants' expectations were largely met by the workshops, highlighting that they gained 'innovative ideas' from attending, as well as gaining 'new information' and experiencing a 'shift in thinking' while making 'new contacts'. Participants felt that their capacity and networks had grown, suggesting that the 'priming' aspects of the intervention were triggered. Most workshop participants suggested that they intended to do something differently either in their work practices or in their personal lives after participating in the workshops.

2.8 Conclusions and Key Messages

Key message 1: The Project was designed to start achieving desired outcomes in line with the objectives of the Australian Vulnerability Profile. The design of the Project was therefore underpinned by an explicit model for social change, and activities delivered as part of the Project were intended to help to stimulate and support change. A co-production approach, drawing on the knowledge and roles of many stakeholders was central to this approach.

The Project had the explicit aim of providing methods, tools and data to support the development of the Australian Vulnerability Profile. The content development required not only understanding physical processes that are quantifiable (at least in principle) e.g. material and energy flows interacting with infrastructure, but also human behaviours and social constructs (e.g. communication processes, beliefs and expectations). Effective multi-stakeholder engagement and governance is critical to any sound problem framing, as well as the development of appropriate interventions which will rely on the acceptance by stakeholders to be effective.

Co-production involves multiple stakeholders in decision-making processes, which implies accepting that there can be simultaneously many different sensible ways of understanding a problem and finding solutions. People frame their decisions according to their backgrounds, experiences, societal positions, values and beliefs, and the co-production of knowledge requires the integration of knowledge holders into the process of knowledge creation. Therefore, a co-production approach was used to combine scientific resources (CSIRO, BoM, GA, Department of Defence, Department of Environment and Energy, and a range of experts and a National Advisory Panel) and governance capability (Australian Government, and State and Territory Government departments and others in implementation roles on the Partnership Team). Workshops involved a wide range of stakeholders such as public, private and civil society representatives to explore scientifically informed social change through the lens of disasters.

Key message 2: The Project was conducted within a set of approved ethics protocols intended to keep participants within a safe and respectful process for sharing knowledge and perspectives, having honest conversations, and exploring the boundaries of the current and alternative discourse(s) around disasters.

The Project had an overarching goal to answer certain questions in pursuit of gaining a better understanding of values, and vulnerability. In the context of disasters, this meant discussing sensitive issues such as the losses and suffering experienced or observed by people in disasters, and challenging the core values and identities of individuals by questioning the appropriateness or effectiveness of their roles and responsibilities. The activities conducted during the Project needed to provide a safe but also exploratory space for dialogue. This was a balancing act that required a sensitive and pragmatic as well as a courageous approach: if the conversation stayed too close to the current discourse around disaster, it may feel ‘safe’ but would not achieve the core objective of the Project or the Australian Vulnerability Profile. Conversely, moving too far into alternative discourse could potentially reduce the credibility of the Project and could lead to participants feeling unsafe. The contributions to the Project by individuals were kept confidential, and provided to anyone outside the CSIRO team (including in this report) only in de-identified form.

Key message 3: A structured approach was developed for tracking and attributing any systemic change resulting from activities of the Project as well as from the broader activities and outputs of the Australian Vulnerability Profile.

It is intended that a full analysis of the Project’s three impact pathways (as outlined in the Theory of Change developed as part of the Project activities) will be undertaken through a post-project evaluation. Initial results based on feedback from participants in the deconstructing disaster workshops suggest that some of

the preconditions, such as a shift in thinking and the development of new contacts, have already been met for the project to achieve the impact anticipated. In particular, most participants felt that their expectations of the workshop were met and that trust had been built through the process. The most important things they acquired from the workshops were innovative ideas and shifts in their thinking and most felt that they had acquired enhanced knowledge, skills and awareness as well as made new contacts. Assessing whether these initial results lead to wider and ongoing change will be the focus of the tracking systemic change evaluation anticipated to be undertaken later in 2018.

3 ‘Deconstructing Disaster’ workshops

Authors: Deborah O’Connell, Russell Wise, Veronica Doerr, Michael Dunlop, Nicky Grigg, Seona Meharg, Rachel Williams, David Jones, Shoni Maguire, Cheryl Durrant, Laurence Plant, Jane Sexton, Martine Woolf, Claire Krause, Miriam McMillan, Jacqui Meyers, Karl Braganza, Jill Edwards, Monica Osuchowski, Mark Crosweller.

Introduction

3.1 Background and context

Three ‘Deconstructing Disaster’ workshops were held between November 2017 and March 2018, in Adelaide, Brisbane and Perth, as part of the Project. The workshops were designed to engage a wide range of stakeholders to help answer the question ‘*what makes Australia vulnerable to disaster when severe to catastrophic events impact what people value*?’

3.1.1 Workshop participants

The workshops each had between 55 and 65 participants as well as a science and facilitation team of eight people. Participants were from a range of different government departments and sectors, with high representation from the emergency services. There was a range of levels from mid-level to senior or executive officers and leaders. There were some (but fewer) participants from businesses or utility providers, some from non-government organisations representing civil society, and some individuals who were there as members of the public. The attendees were selected by the state-based hosts. Some members of the Partnership Team (who have roles in implementation of disaster risk management or emergency response either in policy or on-ground) and National Advisory Groups (experts and academics) (see section 2.5) attended some of the workshops.

3.1.2 Overall workshop approaches

The workshops were two days long and required a significant input of time from participants. Several methodological approaches were combined. These included the use of cause-effect diagrams (sometimes also called causal logic or influence diagrams), and the values-rules-knowledge model to diagnose and describe the systems, visioning and scenario planning to explore possible futures, and ‘leverage points’ to identify key points of intervention; as well as the inclusion of emotion and narrative to supplement rational logic. Analysis focused on eliciting different stakeholders’ values, knowledge and perceptions about how the world works, before, during and after a disaster. Together these were used to encouraged creativity and trust-building, and enhance communication.

3.1.3 Workshop objectives and research questions

The workshops had the following objectives:

- To elicit structured data for the Project which would be useful in the Australian Vulnerability Profile, and answer the fundamental research questions behind the Profile:

Research Question 1: What do we value, and what do we stand to lose in disaster?

Research Question 2: What makes Australia vulnerable to catastrophic disaster?

Research Question 3: Has the Project been an effective intervention in helping to shift the narrative, build capacity and networks, change practice and institutions?

- In convening discussion across sectors, levels of government, private and public players, and community, provide an effective forum to start to shift the thinking, narratives and capability around disasters and vulnerability. This raises another three research questions for the Project about the effectiveness of the workshop process *per se*, over and above the Profile core questions:

  Research Question 3a: Does bringing the disaster experience closer to lived experience through the use of narrative and imagined scenarios lead to different understandings, conversations, and analysis of values and vulnerability?

  Research Question 3b: Were particular workshop tools and approaches useful – for example, did taking a systems view, a cause-and-effect approach, use of the values, rules and knowledge tool change the way the workshop participants frame the problem and ways forward?

  Research Question 3c: Did the workshop activities help the participants to update their understanding of how disasters play out and what might be done to reduce the potential impacts? Did the participants carry these ideas and possible actions through from the workshop into the day to day work and networks of the participants?

The workshops provided one major source of data for the Project, and these data were combined and synthesised with other sources including literature, and consultations with the Partnership Team (see Chapters 3 to 5). It was not expected that they would fully address research questions 1 and 2 and they would only partially address Research Question 3.

Therefore, this chapter focuses on:

- documenting the methods and data elicited from the workshop process, which are then used as a basis for further analysis in subsequent chapters
- responding directly to questions about the utility of the workshop methods and processes in terms of participants reframing their framing of disasters and vulnerability, shifting the narrative, and building capability.

The methods are explored in detail below.

Methods

3.2 Workshop design

The design of the workshop was informed by several theories or bodies of literature about:

- Individual and group learning that considers or addresses:
  - the psychology of learning and the importance of engaging the mind and the heart
  - the existence of different knowledge types/cultures and the need to try to integrate these (Brown, 2008)
  - the presence of power imbalances, in levels of authority and between knowledge types, and the need to try promote a level playing field (Brown, 2008)

    - the need to complement experiential learning (i.e. learning from observations and the past) with future-oriented learning (or learning from the future as it emerges) due to increasingly novel/unprecedented nature of change (Scharmer, 2007, Scharmer, 2018)
- Systems theory/thinking (including resilience thinking and sustainability science)
- Transformational adaptation to overcome the systemic constraints and barriers to effective climate adaptation and disaster risk mitigation
- Creating an effective storyline – literature and interviews of professional storytellers and storymakers
- Ethics and creating a 'safe space'.

The design of the Project workshops was also informed by the lessons learned from the FlashJam process held by the Department of Defence with relevant key stakeholders that specifically explored the ways in which people values and loss through different framings of sector/topic, before/during/after, or in a freeform way. The FlashJam workshop framings were used to help frame the design of the Deconstructing Disaster workshops.

3.2.1 Systems theory/thinking

A body of work on sustainability science, resilience and adaptation underpins the approaches used in the workshop design. Sustainability has been a word in common usage for twenty years or more, and is still an evolving science. O'Connell et al. (2013) reviewed the development of sustainability science, including many methods and approaches directly relevant to this Project including (in rough order of being operationalised) impact assessment, risk assessment and mitigation, capital stocks and flows and the triple bottom line, systems analysis and process modelling, adaptive management and adaptive governance, ecosystem services, resilience thinking and planetary boundaries, and adaptation pathways.

When complex problems are being addressed, the more simplistic approaches to risk that have often been employed in disaster and emergency management are not matched to the complexity of the task. There has been a lot of work done in the area of matching appropriate methods of risk assessment to adaptation planning (Jones and Preston, 2011). There is an extensive body of work on resilience thinking (Carpenter and Cottingham, 1997, Walker et al., 2006, Folke et al., 2010, Walker and Salt, 2012) as well as adaptation and adaptation pathways (Haasnoot et al., 2013, Wise et al., 2014, Abel, 2016) and transformation (Pelling, 2014, Lonsdale, 2015). Some of the disparate approaches in different communities of theory and practice were reviewed and consolidated by O'Connell et al. (2016).

3.2.2 Learning and psychology

Different people learn in different ways, and the workshop was designed to cater to a range of learning styles, and take people through multiple learning cycles across the two days in order to maximise effective learning.

The workshop design drew on the interactive collective learning cycle of Brown (2008) (Figure 4), which was developed to assist collective learning for collective action for change across five knowledge cultures, in relation to a central issue of concern. The knowledge cultures she identifies are **individual**, drawing on lived experience through reflection and learning; **local** (individuals, families, communities, businesses) shared lived experience, in the form of stories, events and histories; **specialised**, in the form of case studies and experiments; **organisational** governance, policy and strategies, in the form of agendas, alliances and

plans; and **holistic** knowledge of the core of the matter, vision of the future or a common purpose, in the form of symbols, visions and ideas.

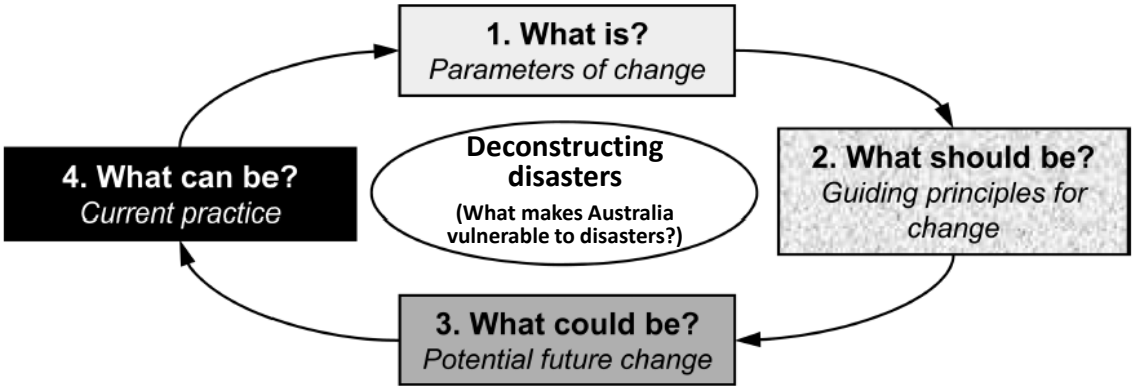


Figure 4 The collective 'decisions-into-practice' open learning cycle underpinning the workshop process to enable the deconstruction of disasters in Australia and build understanding of what makes Australia vulnerable to disasters (adapted from Brown, 2008)

Brown identifies four phases to be iteratively worked through in a 'spiral' of ongoing learning, each with an associated guiding question, drawing on all five knowledge cultures.

Phase 1 – What is? – individuals share and discuss their perspectives on the current state in relation to the focal issue.

Phase 2 – What should be? – individuals share and discuss their own ideals in relation to the issue.

Phase 3 – What could be? – they collectively explore ways to translate their ideals into practice, being as creative as possible. The workshops were future-oriented, and the facilitators emphasised suspending disbelief, drawing on and legitimising the use of imagination (drawing a vision) and the use of vivid salient and disruptive scenarios of the future.

Phase 4 – What can be? – is about action planning, i.e. what will be done, by whom, how and when?

This learning cycle was deeply embedded into the workshop design (for example see Figure 6).

The methods used are also consistent with those developed by those of Kolb (1984), and particularly the easy to use 4MAT learning styles (McCarthy, 1981, McCarthy, 1996).

The process of co-production requires understanding and actively managing the formal and informal rules that shape the ways knowledge is produced; research agenda-setting and financing; sharing or protecting knowledge; access and availability to knowledge, and implementation and use of the knowledge (Clark et al., 2016). Many co-production processes afford different knowledge cultures varying levels of influence and recognition (with technical and scientific knowledge given more recognition and influence than traditional knowledge, for example). This can impede learning about complex systems where local and traditional knowledge is critical and needs to be given equal consideration. The workshop process tried to address this by legitimising the different knowledge cultures and giving time for this knowledge to be shared and captured, and by working within an explicit ethics protocol (section 2.2).

3.2.3 Transformational adaptation

Adapting to climate change can require fundamentally altering the way natural resources are managed or regulated and the feasibility of the economic and social activities connected to, or dependent on, these resources. And yet the prevailing social context generally constrains the options available to policy makers,

planners and managers to adequately respond to such novel and systemic change. The 'values-rules-knowledge' model or perspective of the social context within which decisions are made has shown itself to be a useful heuristic in a range of contexts to help decision makers analyse how the social system shapes their decision context; constraining or enabling the options available to them. Put simply, the model portrays the decision context of any particular decision-making process as the intersection of the societal systems of values, rules and knowledge (Gorddard et al., 2016) where:

- Values are the set of ethical precepts that determine the ways people select actions and evaluate events.
- Rules are both rules-in-use (norms, practices, habits, heuristics) and rules-in-form (regulations, laws, directives).
- Knowledge includes both evidence-based (scientific and technical) knowledge and experiential knowledge.

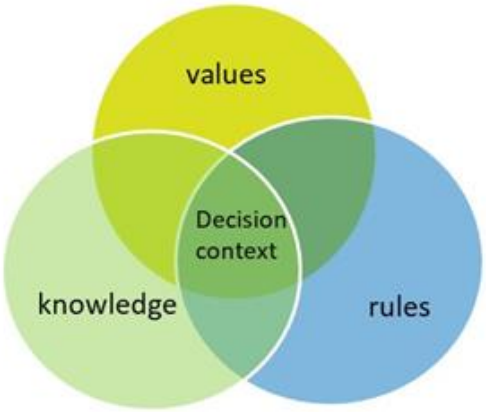


Figure 5 Venn diagram representing the values-rules-knowledge model or perspective of the decision context for any particular decision-making process (adapted from original in Gorddard et al., 2016)

For decisions to be credible, legitimate and legal the decision maker needs: knowledge of the nature of change, response options and the implications of both; values to assess the options in terms of their legitimacy and feasibility; and rules that enable implementation. An important entailment of this perspective on the decision context is that relevant values, knowledge or rules may be excluded from being considered in any particular decision process. Adaptation may therefore involve changing the decision context to allow consideration of new or different rules, values or knowledge types.

A perspective of the decision context such as this, especially when shared by a group, can provide a valuable starting point for effective adaptation action. For example, it is well recognised that rules, both formal and informal, that define decision processes can be hard to influence. A values, knowledge and rules perspective on this can provide a useful basis for interrogating the interactions among the societal values, rules and knowledge that shape, reinforce or weaken these rules. In this way leverage points and strategies can be identified to influence these.

3.2.4 Engaging the heart and the mind through the use of story and narratives

There are many ways that stories and narratives are used in daily conversation as well as advertising, corporate branding, popular culture, and in communicating public policy, where they are sometimes referred to as 'strategic narrative' (Eder, 2017).

It is well known that in order to create change in attitudes and behaviour, data and logic are generally insufficient – change happens when people's hearts, as well as their minds, are engaged. Stories have the capacity to engage emotions in a way that data and graphs do not. There is a neurobiological basis for the importance of story-telling (Zak, 2015). For example, there are actual changes in the resting-state connectivity of a brain that persist, at least for a few days, after reading a novel (Berns et al., 2013). There is a very substantial body of evidence about the importance of stories as a means to make sense of complex information that is collected, and turn it into something that helps humans navigate the world (Marshall, 2015, Monbiot, 2017a, Monbiot, 2017b).

Narratives are therefore powerful in terms of people changing their behaviours, decisions, and actions. The stories that we tell ourselves help to define who we are as an individual, a family, a community, an organisation, a state or a nation (Puchner, 2018). There is a growing realisation that stories and narratives are needed to help change prevailing thinking and framing that lead to vulnerability. Using narrative as a way of explaining complex science to non-scientists is seen as an increasingly important approach (Dahlstrom, 2014, Jones and Crow, 2017, Clemens, 2018), but the issue is more complex than just one of communication. Recent explorations of the power of narrative and story-telling in framing interactions with issues such as climate change (Marshall, 2015, Monbiot, 2017a) draw on psychology and literature to discuss why different people respond (or do not respond) to scientific data and evidence depending on context, world views, beliefs and ideologies. There is also an increasing recognition of the role of emotion in science discourse (Ellerton and Brown, 2018).

Using stories in research in a purposeful, transparent and ethical way

Given their potential power in times when there increasing caution about 'post-truth' discourse, and highly contentious and politicised narratives abound, there is a particular set of requirements for using stories and story-telling within a science and policy context. A recent special issue on the use of stories, narrative and story-telling in energy and climate change research (Moezzi et al., 2017) shows how stories can be used as data objects to gather, analyse and critique; or as a broader approach to an inquiry; narrative analysis to crystallise arguments and assumptions, and story-telling as a way of understanding, communicating and influencing others.

It is imperative to work in ways that are transparent, purposeful, ethical, and safe for all participants. Different types or genres of stories can play a role. For example, some stories may have utility even if fictional or anecdotal whereas others need to be evidence-based in order to achieve their purpose in a considered way. Custodianship of stories is important and needs to be respected, and there is a critical need to ensure that the stories represent a range of voices, perspectives, or groups. There is real danger in only providing space and I for existing dominant narratives (or for people or organisations who hold the power and therefore can disproportionately influence the narrative). Chimamanda Ngozi Adichie in her TED talk 'The danger of a single story' (Ngozi Adichie, 2009) is particularly eloquent in her arguments:

> *Stories matter. Many stories matter. Stories have been used to dispossess and to malign, but stories can also be used to empower and to humanize. Stories can break the dignity of a people, but stories can also repair that broken dignity … When we reject the single story, when we realize that there is never a single story about any place, we regain a kind of paradise.*
>
> *The single story creates stereotype and the problem with stereotype is not that they are untrue but that they are incomplete, they make one story become the only story.*
>
> *The consequence of the single story is that it robs people of dignity. It makes our recognition of our equal humanity difficult and it emphasises that we are different rather than how we are similar.*

Stories and narrative have always been used in politics and power – power struggles are played out in significant part through arguments about the 'best story' (Fischer, 2003 in (Kern, 2011)), and new problem framings (e.g. through new storylines) can trigger political change (Hajer 1995, in (Kern, 2011)).

Therefore, if used as a research tool beyond a science communications context, it is critical to deploy the use of narrative and story-telling with caution, respect and within an accountable ethics protocol in order to help create a conducive, legitimising environment to have formal conversations about changing or reforming regulations and behaviours that create desirable outcomes for everyone involved.

Characteristics of effective stories

There are well-known 'ingredients' of a good story which can influence in the areas of climate change adaptation or disaster risk and resilience (Coninx et al., 2018). Guidance from literature as well as discussions/interviews with authors and film makers, as well as adherence with ethics protocols (see section 3.2.5) were used to help frame the way that stories were used during the workshops.

3.2.5 Ethics and creating a 'safe space'

The broader ethics protocols for the workshop are discussed in Chapter 2. The workshops provided a safe space for participants to explore some difficult topics and conversations. The workshops and surveys were conducted under CSIRO Human Research Ethics protocols, which required informed consent to be provided by all participants. Informed consent included communicating to participants that the workshops and surveys **were intended to keep all participants within a safe and respectful process for sharing knowledge** and to acknowledge the intellectual contribution that individuals make to the project. As such, participation was voluntary, and participants could withdraw from the process of the workshop.

The workshop and survey processes, and the potential uses of all of the outputs, were explained and commitments provided for maintaining the confidentiality of individual contributors and any data which could be linked back to individuals. The Ethics Information Sheets are provided in Appendix A.1 Ethics Protocols. In addition, during workshops the participants were made aware of potential 'triggers', and arrangements were in place for facilitators with mental health first aid training with back-up arrangements for help to be provided by professional counsellors if required. The government departments and sponsors also required clear caveats in workshop reports in order to clarify their roles and responsibilities. Wording on workshop reports included:

- This work is undertaken under Human Research Ethics guidelines and approval with the CSIRO.
- To ensure that everyone can express their views without undue risk, the Project Team have ensured no views can be directly traced to individual participants.
- While specific wording may change as part of doing post-workshop synthesis and trying to create readable diagrams, the ideas and intent will not be altered and nor will their accuracy be checked.
- A variety of perceptions or misperceptions may themselves be part of the causes of vulnerability.
- Please do not circulate beyond workshop participants.
- Please note the views and opinions expressed in this workshop summary are those of individuals who participated and not a representation of any official organisational or government position.

All of these elements were used to create the innovative workshop process described in section 3.3.

3.2.6 The FlashJam

A one day 'FlashJam' workshop was instigated, designed and delivered by Department of Defence, was held in September 2017 as a direct contribution of expertise to commence the co-design of the Deconstructing Disaster workshops.

Participants were invited from across government and academia, with the aim of eliciting their individual and combined expertise in an interactive and creative group design activity. The activities during the day were designed to capture the diverse thinking of individuals, in a semi-structured process using three very large whiteboard walls:

- Temporal wall – aimed to identify how vulnerabilities and values changed as the participants moved through three time periods related to disaster: before, during and after
- Political, Economic, Social, Technological, Legal and Environmental (PESTLE) wall – aimed to identify values within each of these domains
- Free wall – encouraged participants to record whatever they felt was relevant. Participants independently added another category on this wall – cultural, in addition to recording independent ideas. This is because it was considered to be critically important to the topic of disaster vulnerability and resilience and went beyond the usual interpretation of 'social'.

The raw data posted by participants on the walls was photographed on the day, and was collated and analysed (FlashJam report, internal unpublished). It was used as a critical input to designing the two-day Deconstructing Disaster workshops – particularly with respect to structuring the workshops to discuss the systems perspectives and values in separate phases before, during and after disaster events.

3.3 The workshop process

All of the elements reviewed in Chapter 2 and section 3.2 were incorporated into the workshop design. The workshop was divided into six sessions over two days (Figure 6). Each session had specific learning outcomes and structured activities designed to blend intellectual, emotional and creative aspects of participation. Each table had 6 to 12 participants and an experienced facilitator.

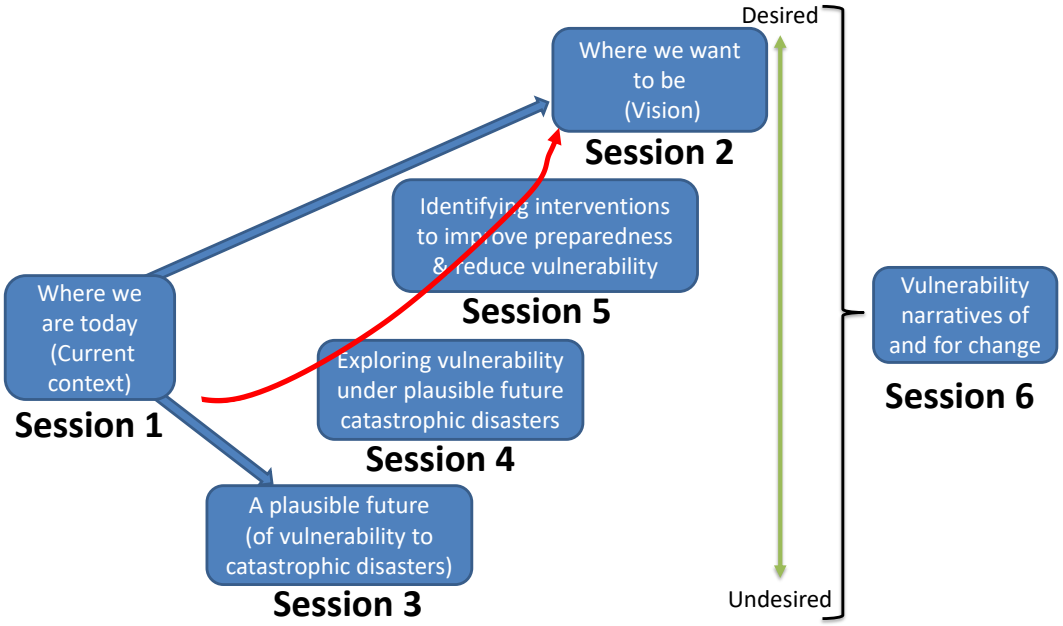


Figure 6 Overview of workshop process

Each of the six sessions was carefully structured and sequenced to build understanding, familiarity with tools, and deepening the discussions and learning outcomes. An overview of these is shown in Table 2 and more detail on each session is provided in the following sections.

Table 2 The workshop sessions with activities and learning outcomes

Workshop session	Activity	Key learning outcome
1 Understanding the current context	Presentation – 'Deconstructing Disaster: Drivers of natural hazards' Activity – Table groups develop cause-effect diagrams of vulnerability to disasters today	Participants have a raised awareness of the drivers of natural hazards and their changing nature, and how this intersects with existing vulnerabilities Participants have developed a greater appreciation and shared understanding of the interactions between the causes and effects of vulnerability in Australia today and the values at stake Important values at stake have been identified
2 Vision for living with natural hazards	Activity – Create a vision for successfully living with natural hazards	Opportunity to share and capture perspectives on what successfully living with extreme natural hazards looks like Raised awareness and understanding of what is important to people, and the desirable attributes (in terms of the values, rules and knowledge) of the 'things of value' to be successfully living with extreme natural hazards
3 Are we prepared for catastrophic disasters?	Presentation – 'Imagining the future: A Story to Deconstruct Disaster' Reflection and discussion Presentation – 'Thinking differently about disaster preparedness'	Changed approach to understanding the implications and consequences of climate and natural hazard risk data
4 Exploring vulnerability under plausible future catastrophic events	Activities – Focus group discussions to explore vulnerabilities in the context of catastrophic disasters	In the context of a plausible catastrophic disaster, participants have developed deeper understanding of: • the causes and effects of vulnerability (incl. the people involved, their motivations for doing things and who benefits or loses) • what this means for the relative importance of the things people value and the attributes of these things
5 Identifying interventions	Activities – Focus groups and plenary discussion to identify interventions to reduce vulnerability to disaster	Participants will have identified priority interventions that: • tackle systemic causes of vulnerability and • reduce impacts and suffering (drawing upon values, knowledge and rules thinking) Participants explore practical and transformational ways of overcoming barriers

Workshop session	Activity	Key learning outcome
		and exploiting opportunities to reduce vulnerability
6 Eliciting narratives	Presentation/discussion – How do we learn? What makes a story impactful? Activity – Create vulnerability narratives	Participants thread together 'stories' of their cause-effect diagrams, including 'vicious cycle' feedbacks, key interventions and changing to a 'virtuous cycle'

3.3.1 Workshop introductory session

Welcomes were made, and the purpose of the workshop was described. Ethics protocols were introduced and discussed, and 'rules of engagement' for the workshop were collectively developed.

3.3.2 Session 1 Understanding the current context

Presentations about climate change and natural hazards were given by Australia's science agencies, the Bureau of Meteorology and Geoscience Australia. The presentations were fairly standard approaches to providing an evidence-based overview of the climate and other natural hazards in Australia, with clear explanation of the changing profile of some of the hazards.

The participants were asked to work as table groups and list the central issues that make Australia vulnerable to these hazards, the causes of these, and the values affected.

The list was prioritised by facilitators and each table group was allocated one of these 'central issues' to work on further. The table group worked with facilitators to create cause-effect diagrams for their central issue (further described in section 3.4). These were then reported back to the whole group at the end of the session.

3.3.3 Session 2 Vision for living with natural hazards

The table groups were asked to draw their vision of what Australia looked like when living successfully with natural hazards. They were asked to draw first, and then when the drawing was completed, to list the values, knowledge and rules (Gorddard et al., 2016) which might underpin such a vision. Visions were presented back to the plenary in two-minute 'pitches'.

3.3.4 Session 3 Are we prepared for catastrophic disasters?

The participants were presented with a catastrophic disaster scenario tailored for their city, presented by the same presenters as in Session 1. The scenarios were presented in narrative form (described further in section 3.5.4).

Participants were asked to reflect, and in one of the workshops were asked to write down their immediate reactions on sticky notes which were collected. The reactions were discussed in table groups or plenary.

The session concluded with a presentation from the Director General of Emergency Management Australia about issues raised in the scenarios.

This session concluded Day 1 of the workshop.

3.3.5 Session 4 What are the causes and effects of vulnerability under scenarios of plausible future extreme natural hazards occurring?

Overnight, the table facilitators reorganised the material in the cause-effect diagrams generated in Session 1.

Upon reconvening and recapping, the table groups returned to these cause-effect diagrams and were given the opportunity to modify, continue, start again on the same central issue, or reframe the central issue. Facilitators invited participants to explore in more depth the root (or indirect) causes as well as more detail on the effects – for example who and which values might be affected. Participants were also asked to start identifying any feedback loops – i.e. things that might be on the 'effect' side of the diagram which in turn become a 'cause'.

Across the many tables and multiple workshops, there was some variation in how this task was conducted as facilitators had to adapt to the needs and capabilities of the group. The discussions were often very deep and detailed and were documented by diagrams produced as well as notes by the facilitators.

3.3.6 Session 5 Identifying interventions

The design of interventions was explicitly out of scope for this Project, but in order to introduce participants to the way that systems thinking could be used to do this, this session gave a very light introduction to the approach. Ideally, this one session would be a two-day workshop in itself conducted after a few weeks' break where the participants would digest the material generated to date. Although there was insufficient time to do this task properly, it gave the participants some idea of how these tools could be used.

The cause-effect diagram and preliminary attempts to show where key feedback loops occur, were combined with the listings of values, knowledge and rules to diagnose vulnerabilities, key points of intervention, and suggestions for what the interventions might be.

This session concluded with each table reporting back on their cause-effect diagrams, and interventions.

3.3.7 Session 6 Using story-telling and developing narratives

The session started with an interactive presentation reflecting on the power of narrative, and why humans connect with story-telling as a basis for engaging hearts as well as minds, as a prelude to changing behaviour.

The participants were given some simple tools (for example a story-telling spine (Rotmann, 2017)) and invited to re-tell the work of their table as a story, which was presented back to the plenary. Stories took the form of plays, skits, picture-stories or written or spoken narratives which were either fictional, anecdotal, or autobiographical.

3.3.8 Workshop concluding session

Workshops concluded with some shared reflections, thanks, and an invitation to participate in a post-workshop survey (section 3.6).

3.4 Describing systems and key points of intervention (cause-effect diagrams)

Cause-effect diagrams (also known as 'influence' or 'causal logic' diagrams) are a specific type of systems diagram designed to capture people's perceptions of cause and effect (Figure 7). This is a simplified, intermediate step towards systems thinking – it maintains some left-to-right linearity that helps people think through connections in a layout that they are more familiar with.

The diagrams are constructed from:

- words and phrases that represent the key variables of a system, and
- arrows that represent processes or mechanisms whereby one variable affects another.

The process of constructing an influence diagram can help reveal and clarify thinking about problem situations:

- What are the key variables?
- How are they connected to each other?
- How do these connections influence the behaviour of the system (the way that it changes over time)?
- How does the problem situation fit into a wider context?

In constructing the diagram and selecting variables, the diagram becomes a 'boundary object' for group discussion – each person sees a problem situation differently and the way that a person frames the situation will determine the variables that he or she selects to describe the system of interest. They have been used in this sort of workshop context in a range of contexts by the CSIRO team (O'Connell et al., 2016, Butler, 2017, Maru et al., 2017). This is not a full systems analysis approach but is a useful entry point or stepping stone for people who are used to more linear thinking.

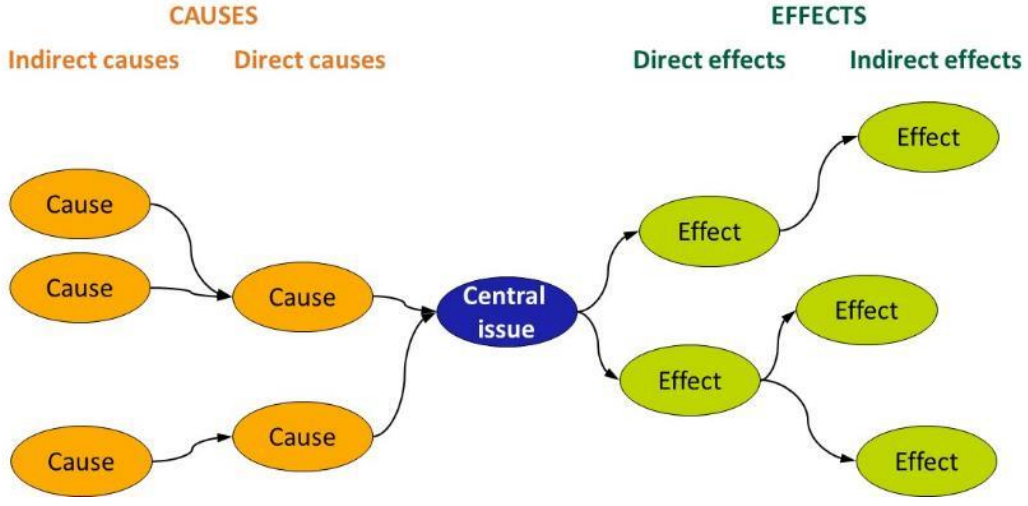


Figure 7 Basic structure of cause-effect diagrams in Session 1

Constructing the diagram started with a focus variable(s) to represent key aspects of the central issue. This variable should be selected to represent what a key aspect of the issue or problem situation of concern. Driver variables and affected variables and their feedbacks are added. There are two types of basic feedback structure – reinforcing (or amplifying) feedback and balancing (or regulating) feedback (Proust and Newell, 2012).

The diagrams became more complex as the sessions continued, and more variables and feedbacks were added. The facilitators managed the diagrams with colour-coded sticky notes, sorted the contributions into like groups, causes, effects, interventions, feedbacks and guided contributions to ensure that variables were measurable in principle (for example a 'level' of something) and contained sufficient detail as to be interpretable by others. In this way, each table group created coherent systems diagrams over the two-day workshop.

3.5 The disaster scenarios presented in the workshops

The disaster scenario presented in Session 3 required a high level of scientific credibility in order to serve the purpose of the workshop, and the Bureau of Meteorology and Geoscience Australia ensured that the scenarios presented were robust and technically defensible.

Severe to catastrophic events which challenge conventional approaches to managing natural hazards sit at the core of the Australian Vulnerability Profile. These events are, by definition, rare and unfamiliar to most workshop participants and not often considered as part of formal risk management approaches. Individuals and institutions often struggle with planning and even imagining the nature of the most extreme events which might be faced, and explicitly or implicitly trade-off event impacts against the low probability of the event occurring.

Severe to catastrophic events often emerge from a confluence of trends and extremes and may involve multiple events at the same time. The enabling trends may include social and economic factors such as shifts in populations in at-risk locations or be associated with trends in natural hazards such as global warming and climate change. While extremes are a way of life in Australia, it is apparent that many of these are changing over time, with heatwaves, dangerous fire weather, intense rainfall and extreme sea level showing increases either locally or globally.

The participants in the workshops were broad ranging, covering households through to large enterprises and government agencies. This required scenarios to have impacts which could be looked at through the lenses of government, institutions, communities and individuals, households and families. Vulnerabilities tested or exposed through the scenarios included loss of access to (or pressure on) food, water, sanitation, shelter, health, communications, energy and transport, for example. The framing for the Profile was an important consideration for the workshop scenarios with EMA identifying six overarching vulnerability domains (natural, physical, human, social, economic and political).

3.5.1 Criteria against which the scenarios were developed

The scenarios for the workshops were developed with a number of criteria or requirements in mind, drawing on the experience of the project team and scientific literature. These requirements included:

- Catastrophic but plausible – the scenarios needed to paint a picture of an event so severe that the usual response mechanisms were severely tested, but remain within the range of what is considered plausible.
- Be relevant to participants – that is, the scenario needed to have clear and obvious impacts across scales and sectors, ranging from households through to state and national government.
- Facilitate discussions around vulnerability – the scenarios needed to trigger discussions around vulnerability and how one might lessen possible future impacts of severe to catastrophic events.
- The scenarios are not forecasts – the scenarios needed to be clearly differentiated from future forecasts which might predict some event anticipated to occur at a later time.

In each jurisdiction (South Australia, Queensland and Western Australian/Northern Territory) a meteorological hazard and a geological hazard were chosen to form the basis for the scenario, with the meteorological hazard occurring shortly before or concurrently with the geological event. While two major natural hazard events happening at a similar time might seem unlikely, it is the unlikely that poses the greatest challenges.

The meteorological hazards were chosen on the basis of past observed events, modified so as to increase the overall impact. The meteorological events at the core of the scenarios were largely drawn from material prepared by the Bureau of Meteorology in the Special Climate Statement series (http://www.bom.gov.au/climate/current/statements/) and/or 'Charts from the Past', the latter carried in the Bulletin of the Australian Meteorological and Oceanographic Society (https://www.amos.org.au/Main/Publications/The_Bulletin__BAMOS/Main/The_Bulletin_BAMOS.aspx). Modifications were made on the basis of recently observed and/or projected future trends to increase the event severity (BINDOFF, 2013, CSIRO and Bureau of Meteorology, 2015) Further modifications were made to the duration or regions affected by the event to increase overall impacts on regions relevant to workshop participants.

The mixed quantitative/qualitative approach to the construction of the meteorological events carries both benefits and drawbacks. It allowed the construction of quite tailored scenarios impacting specifically on the regions of interest, and the use of material and events which might be somewhat familiar to participants. It also differentiates the scenarios from future forecasts, the latter typically drawn from complex atmospheric models. However, the approach does not ensure physical consistency between variables, which is clearly a requirement in the real world. This last point tends to be more an issue when the focus is on the natural hazard, rather than the vulnerability, and when dealing with quantitative impact assessment.

The approach adopted for the geological hazards was somewhat different, as many participants had not experienced an earthquake or a tsunami. Many workshop participants were aware of the Newcastle earthquake in 1989 and the impact it had (13 people dead, more than 160 injured and approximately $4 billion damage) but many were not aware that Australia experiences hundreds of earthquakes every year. Further, participants were largely unaware of the impact that earthquakes have had on the Australian landscape. The 2016 magnitude 6.1 earthquake in the Petermann Ranges (near Uluru) was used to demonstrate that recent large events have been observed in Australia and that this event caused a ~20 km surface rupture. This event was also used to demonstrate the difference between a hazard and a disaster by asking the question: what impact would a similar event have on a major Australian city? Likewise, many participants had little knowledge of tsunami observations in Australia. Notable examples include the 1960 Chile tsunami which impacted the east coast, including Sydney Harbour, the 2004 Indian Ocean Tsunami that caused localised inundation in Geraldton as well as a range of marine impacts (including rescuing people near Perth), and the 2006 Java event which caused the highest recorded run-up in Australia (at 7.9 m) at Steep Point in Western Australia.

Given the frequency of these hazards in Australia, the geological scenarios were selected from national scale, probabilistic hazard assessments (GA's National Seismic Hazard Assessment and the Australian Tsunami Hazard Assessment. Note, updated versions will be available by June 2018). These assessments have been informed by history (i.e. events that have occurred in the past) and the geological and geophysical characteristics of the Australian continent, as well as the surrounding subduction zones which are primary sources for earthquake-generated tsunami. These assessments provide a suite of possible scenarios that could be experienced in the future (with a given probability) and are powerful tools used for planning.

3.5.2 The Workshop Scenarios

Detailed scenarios were prepared for South Australia, Queensland and Western Australia/Northern Territory using the approach described previously. A full description of the scenarios is provided in Appendix Overview of Hazard Scenarios with a summary following. In each case the scenario design incorporates a hydro-meteorological and a geological hazard. While it is obviously rare to have coincident or concurrent events, there have been recent examples that show that this is possible. The first example is with the erupting Indonesian volcano (Mt Agung) with the addition of tropical cyclone in late 2017, with the second being the three major tropical cyclones and devastating wild fires which impacted the USA in the second half of 2017 (resulting in millions of people being displaced).

South Australia scenario

The South Australian meteorological scenario consisted of a record multi-day heatwave affecting most of eastern Australia. The event had temperatures similar to those experienced in January 1939 and January/February 2009, but increased (approaching 50 °C). The high temperatures were consistent with what might occur if the Black Saturday 2009 heatwave peaked earlier in the summer when solar heating is more intense (in combination with the warming trend). The duration and spatial extent of the event more closely matched January 2013, affecting multiple states at the same time.

South Australia is one of the more seismically active areas in Australia. Over the past calendar year alone, over 650 events were detected in South Australia with two over magnitude 5. In the last 50 years, around 1400 earthquakes of magnitude 5 and above were recorded. As described above, impact occurs when the hazard intersects with the community and the 1954 magnitude 5.6 earthquake was used to highlight a (relatively) recent example for South Australia. The plausible scenario selected for the workshop was placed on a known fault that crosses Adelaide with a magnitude selected to generate significant impact.

Queensland scenario

The Queensland meteorological scenario consisted of a prolonged and severe flooding event in the southeast with associated tropical cyclone damage along the entire east coast. Like the 2010/11 flood event, catchments are envisaged to be saturated as a result of a strong La Niña leading to months of above-average rainfall across the state.

The flooding occurs in two stages, first associated with a slow moving tropical low near Brisbane, then reinforced by the passage of a slow moving severe tropical cyclone. The track of the cyclone is similar to a combination of Tropical Cyclone Dinah, Tropical Cyclone Hamish and Tropical Cyclone Debbie, with the system becoming slow moving near the southeast coast. The rainfall totals are similar to 1893, 1974 and 2011 but worse, increased by a slower movement of the lows and the warming of oceans increasing overall rainfall intensity.

The geological event chosen for the Brisbane workshop was a tsunami that had a similar magnitude to the 1960 Chile tsunami, but placed instead on the Kermadec Trench which is east of Brisbane. An estimate of the wave height offshore (in 20 m water depth) was determined for this event from the updated Tsunami Hazard Assessment. No onshore modelling was undertaken; however, scaling was adopted to estimate onshore inundation.

The Western Australia and Northern Territory Scenario

The meteorological scenario for the Northern Territory and Western Australia consisted of a long-track tropical cyclone, initially impacting the Top End, before tracking the full length of the Western Australia coastline as a severe tropical cyclone. Flooding is particularly severe in the Northern Territory (approaching, but greater than January 1998) and near the Gascoyne (approaching, but greater than December 2010). As

the cyclone approaches the southwest it accelerates crossing the coast near Cape Leeuwin. This track brings severe winds and catastrophic fire conditions to areas near and east of Perth with temperatures approaching 46 °C. The final stages of the cyclone passage are similar to Tropical Cyclone Alby, but increased somewhat.

The geological scenario for Northern Territory and Western Australia was a tsunami that had a similar magnitude to the 2004 Indian Ocean Tsunami and placed instead further to the east on the Java component of the subduction zone. This event had already been used extensively within the emergency services agency in Western Australia and formed the basis of multi-year planning efforts following the 2004 event (i.e. what if the 2004 event had instead been directed towards Western Australia?) Detailed inundation modelling had been undertaken for 11 communities in Western Australia. Following this work in WA, similar work was conducted nationally, and the same event was modelled for Darwin.

3.5.3 Managing the risks associated with presenting catastrophic disaster scenarios

Notwithstanding the care taken in developing the scenarios, a number of risks were identified in the workshop preparation which warranted additional actions by the project team. Among the risks identified were of the '*scenarios being interpreted as forecasts*', being used out of context, or impacting participants in ways which might be personally harmful (noting some participants have first-hand experience with disasters).

Steps taken to reduce these risks included:

- Labelling all products as 'Not an official model of scenario. For workshop discussion only.'
- Grounding the scenario in something participants can relate to (lived experience).
- Reinforcing the broader context for the scenarios. For example, that record-breaking conditions are already being observed, or that infrastructure continues to age.
- The terminology of 'worst case' was not used.
- Participants to be appropriately briefed about the use of the hazard scenarios on the day, and made aware the hazard scenarios:
    - are not predictions;
    - are not forecasts;
    - are not defining worst case;
    - are not 'official modelling' of a scenario; and
    - are provided to support workshop discussion purposes only.

3.5.4 Telling the catastrophic disaster scenario as a graphic story

The audience was presented with the context for severe or catastrophic disasters in Australia in workshop Session 1, where key trends in key climate indicators (particularly frequency of heatwave events) as well as key historical events were highlighted. Where possible, relevant historical events were provided to demonstrate that these hazards had been experienced in the relevant jurisdiction (e.g. 1954 earthquake in Adelaide, 2004 tsunami in WA, 2006 tsunami in QLD). This was particularly important for geological events as it is relatively rare that these events have caused impact.

In presenting the scenario, it was important to evoke a sense of time and place to connect the audience as realistically as possible to the event so that a range of emotions could be aroused. The story was placed in

the near future and timed deliberately to exacerbate the impacts to generate severe to catastrophic impact. For example, meteorological events inevitably occur in the summer holidays and combining coastal inundation from a tsunami could significantly increase the potential impact at the coastline.

Maps and images were heavily used where possible to 'fill in the colour' for the picture that was being painted by the presenters. Maps inherently tie us to place where people can directly relate to communities, and importantly, to the people who live in them.

As described earlier, the impact from the meteorological events was not modelled, however, describing the possible impacts was drawn from the vast experiences of these events on the Australian landscape. Mapping out the path of tropical cyclones, naming the communities that the tropical cyclone would pass by, was important to position the scenario in the mind of the participants. Images of previous events could be used to illustrate these impacts, and adding these images offered a different channel to engage with the audience. These images included fallen power lines, washed out roads, etc.

A similar approach was adopted for the geological events, however, in the case of the WA tsunami scenario and SA earthquake scenario, modelled results could be shown to provide to provide a sense of reality (and place) to the story-telling. The modelled results (shown with maps) could also provide a level of credibility to the impact narrative which was perhaps more important for the geological events given the low frequency of these impacts in Australia. These maps could allow the participants to identify features of interest to them in the communities that they know or live in, and to understand the potential impact.

The narrative also sought to describe impact that was thought to be important to the workshop participants. These included:

- Loss of continuous access to utilities such as power and water
- Restricted access for transport, e.g. road and bridge damage (due to rain/flood and earthquake)
- Restrictions to the economy, e.g. impact at ports.

Each of these would, of course, have flow-on impacts to, for example, access to banking facilities and ability to buy food, evacuation and recovery efforts of remote communities, health and safety outcomes of the community, etc.

The catastrophic disaster scenario was delivered in a compelling story-telling style by Geoscience Australia in Session 3, with some visual support in the form of photographs of analogous situations, and maps of impacts of the scenario.

3.6 Participant surveys

The Tracking Systemic Change component of the project is described in more detail in see section 2.6. The participant surveys relate only to one part of the Tracking Systemic Change work – the pre- and post-Deconstructing Disaster workshop surveys.

Participants at the disaster workshops completed the surveys before and after each workshop. This information allowed us to track changes in views and understanding, as well as seek feedback on the process and usefulness of the workshop itself. In addition, the pre- and post-workshop surveys will contribute to the overall evaluation of the Project and tracking systemic change of the Australian Vulnerability Profile.

3.7 Summary of selected workshop outputs

3.7.1 Workshop reports

Workshop reports were circulated to the participants of each workshop with the following explanation:

'Purpose of this workshop summary – to check the raw data on perceptions of systemic vulnerability

This document is intended for participants at the workshop and should not be distributed further.

It is a summary of the *perceptions and views of workshop participants* on systemic issues of vulnerability in the context of natural hazards. This relatively raw data is being shared with workshop participants so they may check that their own contributions are represented appropriately. Summarising the rich and insightful conversations and insights can be challenging, so it is important we check in to confirm these data.

The final Australian Vulnerability Profile product(s) will build on and reshape data gathered in these workshops, but will also engage with data and theories in the scientific literature as well as views and perceptions of the National Advisory Panel and the Partnership Team – a smaller set of people operating at a national scale.

Some of this material informs us about *current* narratives around systemic vulnerability, so may inform but not be directly part of a "new national narrative" (from the AVP Project Plan).

Thus, the final Australian Vulnerability Profile as a product or set of products will be substantially different from this relatively raw material, though the raw material will inform the Profile.'

For these reasons, workshop reports are not publicly available and are not able to be cited. In this results section we will draw from the workshop material to present some illustrative outputs. The partially processed workshop outputs do not answer Research Questions 1 and 2 directly, but show the way that we have analysed the workshop data to address the research questions posed in this chapter about the utility of the workshop itself, as well as the various tools and methods used the workshop (Research Questions 3, 4, and 5). The synthesised results for the overarching Research Questions 1 and 2, are provided in chapters 4, 5 and 6.

3.7.2 Session 1: Central issues covered

In Session 1 of the Deconstructing Disaster workshop, presentations of natural hazards and risks were provided by the Bureau of Meteorology and Geoscience Australia, in a standard science format. Table groups then workshopped the question: what makes Australia vulnerable to disaster? This generated long, unstructured and unprioritised lists of vulnerability issues. For example, typical lists from table groups are given below:

Table A (Adelaide)

Everyone is vulnerable when events happen, but money/power give more choice to avoid or recover

Access to cash, before and after

Reliance on stable government and governance

Hazards related to human nature – greed, incompetence

Table B (Adelaide)

Low population pockets

Foothill suburbs

Morgue space full!

We are ALL vulnerable in some way

Communities interfacing with natural hazards

Changes with time/age/experience

Migrant communities coming into unfamiliar environments

The responses by table groups were reported back to the whole group, synthesised by the facilitation team, and one of these 'central issues' was allocated to each table to discuss. Table groups were able to take different slants on the central issue as the workshop progressed, or move to a different emergent issue if they felt it important. The central issues identified and workshopped at the three Deconstructing Disaster workshops are shown in

Table 3.

Cause-effect diagrams were then constructed for these central issues. Sometimes multiple diagrams emerged for each central issue and/or table group, depending on group size, and interest and expertise of the participants at the table. Some examples of the cause-effect diagrams are presented in section 3.7.5.

Table 3 Central issues identified and cause-effect diagrams produced at the three Deconstructing Disaster workshops

Workshop	Central issues identified and unpacked by table groups during the workshop
Adelaide	Political/governance stability Energy and communication Community preparedness Land-use planning Education and learning practices Community cohesion
Brisbane	Health services Knowledge and communication Legacy decisions Emergency response Land-use planning Critical infrastructure – water
Perth	Single versus redundant sources of supply of critical services Interdependency of critical services Marginalised/disadvantaged people Role of remoteness and diversity of local values in emergency response and recovery Community connectedness Complementary role of business and government

3.7.3 Session 2: Visions, values and illustrative narratives

The vision sessions provided a wealth of creative and informative material that could be used as a basis for eliciting values, as well as potentially worked into future communication products.

A full listing of the vision stories and the values elicited appears in Appendix Summary of Session 2 vision stories and values. A few examples are provided here, as italicised text which was provided in the workshop reports and constructed from the transcripts of presentations.

Figure 8 Visions: Bouncing Back Better Communities

Bouncing Back Better Communities

A community that is prepared to bounce back better from disasters is one which values strength, economic and social capital and is self-reliant and self-organising. It learns together through the sharing of great ideas and innovations, working hand-in-hand it is well connected and co-creates a vision for itself. A community prepared to bounce back better has infrastructure which is adaptive and resilient.

- *Create a system for recognising 'BBB-rated communities'*
- *Learning together through our great ideas and innovations through a community working hand-in-hand, well connected and co-created this vision for itself*
- *Infrastructure that is adaptive and resilient.*

Values elicited:

- *strong, economic and social capital, self-reliant and self-organising.*

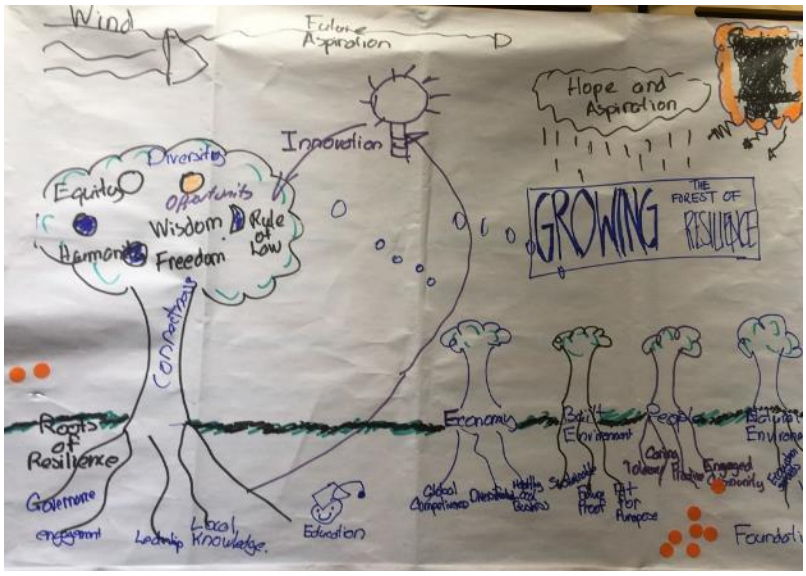


Figure 9 Visions: Growing the forest of resilience

Growing the forest of resilience

Tree of wisdom underpinned by roots of resilience: education, local knowledge, leadership, engagement and community

Grow values through trunk: freedom, diversity, rule of law, wisdom, opportunity

Winds of change blow us to the future. Human innovation is needed: ideas and science

Young saplings grow off sun which comes from this hope and aspiration: economy, built environment, people and natural environment. These need to exist in complex ecosystem of the future

Foundations build future: global competitiveness, sustainable, future-proofed environment, fit for purpose, diversification, healthy local businesses, people who are caring, proactive, tolerant and an engaged community – engaged with natural environment which we value. These foundations help to grow the saplings

The forest survives the storms, storms which will always come.

Values elicited:

- *Education, local knowledge, leadership, engagement and community are necessary agents for freedom, diversity, rule of law, wisdom and opportunity*
- *Innovation fuels their growth.*

Figure 10 Visions: The Pomegranate

The Pomegranate

Australia is a pomegranate; the analogy of many seeds interconnected with other seeds make up a greater whole

Australia's resilience is related to individuals connecting within communities which connect to other communities

Intra-web: adversity within one community can go towards being solved when reaching out to other interconnected communities for support. Inter-web: the community itself is helped by individuals reaching out to others who supply care and promote inclusivity

Common goals and strong infrastructure mean when disasters happen, connected communities bounce back quicker. Spontaneous volunteering and the generosity of others helps quicken recovery

Active communities and physically, mentally, confident communities are strong communities, creating the foundation of resilience. Ensuring they are informed, have good governance, common goals and a bottom-up approach rather than top-down go towards building that resilience.

Values elicited:

- *Interconnection within and between communities*
- *Common goals and strong/resilient infrastructure, volunteers*
- *Healthy communities are strong communities*

- *Being informed, good governance, bottom-up approach to build resilience.*

Figure 11 Visions: Girl Learning

'Girl Learning' Vision for Successfully Living with Natural Hazards

- *Integrate preparedness/personal resilience thinking into the mainstream, such that in one's lifetime learning is a continuum and these things are just part of what we do and how we live our lives*
- *The vision starts with a baby who grows up into a young girl and then a woman, who then has her own family. Her life journey starts when she is a baby who lives in a very disaster-prone area, a flood-prone area. She hears the stories from her family and her forefathers/mothers of what has happened over time, what happened in her geography, what they did to get out of emergencies*
- *At school she is also learning about that history and the culture of resilience, she understands what preparedness means for her family, and planning for bushfire and floods*
- *As she grows up into a young woman she becomes involved in volunteering for her community and helping others. Embedded in this idea is that we can't do this on our own, we have to rely on others in order to become a resilient community*
- *She then buys her own property which is 'green', bushfire resistant and she has a plan for floods. The house complies with legislation around environmental and building requirements. At the same time, she has access to well researched, funded and long-term education on planning and resilience. This education lead to jobs and the creation of future champions*
- *Connectivity is really important in a future (likely digital) world. We have access to others through new technology but we also have back-up through old fashioned radios. We don't lose the communication connection skills from the past*
- *We would like to reach a point where she says 'I know who I am, I know where I live, and I know how to help, both myself and others'.*

Values elicited:

- *Telling stories of lived experiences, history, context, culture. Information about risk preparedness and profiles which are translated to her at different ages*
- *The values needed are cooperation, lifelong learning, long-term planning and resilience building. Addressing vulnerability can't happen overnight, you have to be in there for the long term. Valuing that journey*
- *The rules require legislation for education in order to incorporate it into the curriculum, building codes for land-use planning, community practice around preparedness become the norm*

- *Avenues (research) to expand our knowledge and skills in this area, and potential employment growth in this area.*

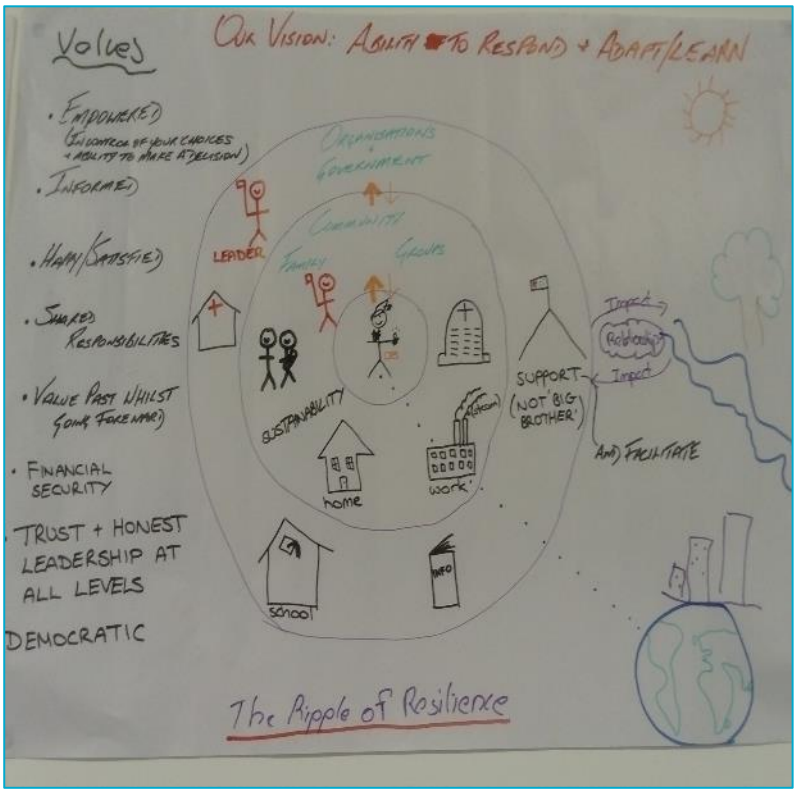


Figure 12 Visions: The Ripples of Resilience

The Ripples of Resilience

Like a stone thrown into a pond the 'Ripple of Resilience' is a concept that catalyses the building of resilience by putting individuals and communities at the centre, and building layers of resilience in depth around them.

The layers of resilience in depth could include:

- *Information layer*
- *Individual preparations layer*
- *Community network layer*
- *Community monument layer*
- *Community leadership layer*
- *Individual financial layer*
- *Emergency Services layer*
- *Resilient critical infrastructure layer*
- *Macroeconomic layer*
- *International assistance and readiness layer*

Each layer could be assessed individually, and the resilience in depth of a community or individual could be assessed holistically.

Values elicited: Empowered (in control of your choices and ability to make a decision), Informed, Happy/satisfied, Shared responsibilities, Value past whilst going forward, Financial security, Trust and honest leadership at all levels, Democratic.

The vision sessions provided an excellent opportunity to harness the creativity and emotion in the room, and release individuals from the constraints of their formal roles in order to elicit some of the held values at play when thinking about the future.

3.7.4 Session 3: Reactions to disaster scenario

The disaster scenarios were told in story form by the Bureau of Meteorology and Geoscience Australia. Reactions varied across workshops, participants from different sectors, and individuals. The session was timed to follow immediately after the fun and uplifting Session 2 on visions, and the contrasting emotion was immediately apparent. A few minutes of silence to digest were provided immediately after the story was told. Responses ranged a lot – facilitator observations in the table discussions afterwards show that responses included questions to probe and make sense of the scenario and gauge its credibility, leading into more vividly imagining impacts and unfolding consequences, including what it would be like for them personally and how they would feel and react; acceptance and going to immediate impacts and logistical responses; as well as very emotional responses and asking the big life questions. In one workshop, participants were asked to write their responses on sticky notes. A small sample is shown below, roughly grouped. The full set of responses is shown in Appendix Reactions to disaster scenario.

Credibility of scenario:

Scenario not unrealistic
Bad but not worst case
Even though tsunami less likely, the impact pattern is similar to what storm surge might be in a big low pressure/TC system. I think something like this will happen within 20 years

Immediate impacts and logistics:

Would anticipate emergency services and health service and other support agencies would be overwhelmed
Most likely require interstate assistance – state emergency, national disaster
Military support needed for tsunami response
Had enough PPR been done? Who has survived?
Response: How? Where? What with? From where?
Resilience of me, family, agency?
Location
Responses/actions for plans
Services affected
Casualties
Family/friends

Emotional responses

Fearful – losses of life
Determined – to start getting into it
Overwhelmed by back-to-back events;
Uncomfortable being pushed beyond the imaginable
Worried about short time frame to act and avoid harm
Feeling of inadequacy to deal with despair
Have we done enough to prepare the country?
Is our potential lack of action increasing their vulnerability?
Really angry, having spent the weekend in <named coastal towns>, that they continue to develop their foreshore areas with dwellings that put more people in harm's way. Irresponsible.
Anxious, worried for those that are so unaware and will suffer.
Hopeful (but cautious) that the process of imagining these things will translate into action to avoid such impacts

Feel lucky it's a scenario.
Concerned
In awe of nature

Longer-term impacts and planning ahead:

Planning regulations: do our building standards and planning laws reflect the models?
Local risk and arrangements: do local risk assessment and arrangements cater for these events?
Plans – coordinated response
Alternative comms
Public informed
Interstate/international assistance
Pre-positioning resources
Pre-impact evacuation
Hurricane Katrina lessons
Decades of recovery
Whole of state economic impact
Insurance may not be possible in the future
How do we get community to visualise these plausible scenarios without being alarmist
We need a national approach
We need to build better infrastructure and make better planning decisions
What it made me think about: the Australian identity and the need for a 'plan B'

The session, and the day, was completed with a talk from the head of Emergency Management Australia focusing on the characteristics of the catastrophic scenario (rather than the actual story), and the plausibility of an event with similar characteristics occurring in Australia. The importance of ethical leadership, and capacity/skills and strategies to deal with the unexpected, were key issues for discussion. There were some table group and plenary discussions, and participants were finished with Day 1.

3.7.5 Sessions 4 and 5: Cause-effect systems diagrams and proposed interventions

Using cause-effect diagrams was new to most participants, and facilitators guided table groups through the process. The many diagrams produced across the workshops were used as source material to develop 'typical systems patterns' in Chapter 5.

In the results of this Chapter we show only two examples of the 60 or so diagrams produced in the three workshops. These examples of first stage processing of the workshop outputs by the CSIRO team show a sample from the work across sessions 1, 4, and 5, and have been selected to demonstrate the utility of systems thinking, and how the before- and after-disaster scenarios changed the thinking of the participants.

Example 1 Interconnected essentials

The central issue was focused on the closeness to losing interconnected essentials for people to function and survive. Interdependencies included:

- Hard infrastructure (housing, water, power, gas, communications, transport)
- Labour required to service hard infrastructure
- Supplies of goods and services (e.g. food, money)
- Social services (e.g. welfare, support)
- Environmental services (e.g. protection from extremes, provision of natural resources, stabilisation of assets)
- Emergency management.

What was considered 'essential' was context-dependent, varying according to who, where/location, and scale (individual, household, community, city, region). The cause-effect diagram from the first day, before the catastrophic disaster scenario was presented, is shown in Figure 13.

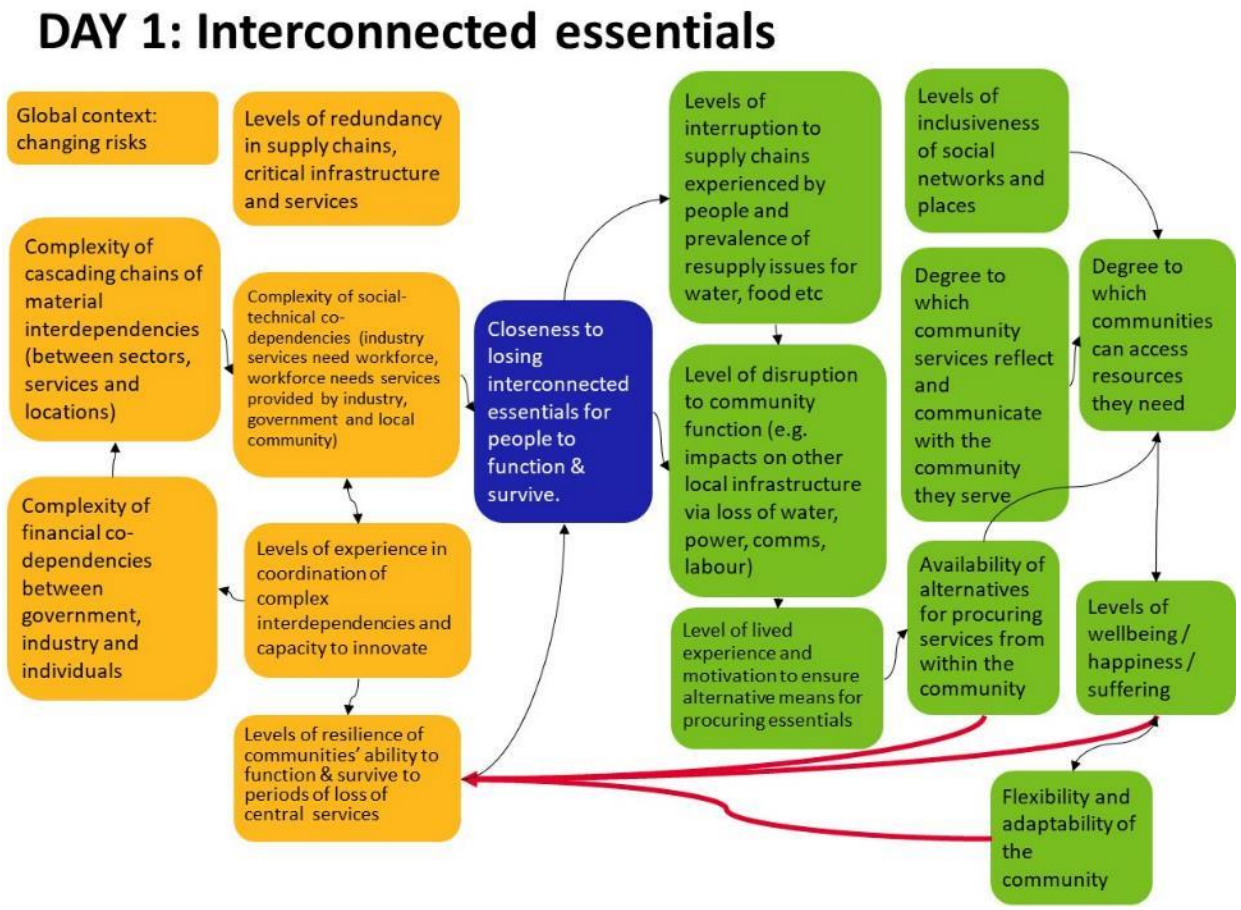


Figure 13 Day 1 Cause-effect diagram for interconnected essentials, before the disaster scenario was presented

The simple 'neutral narrative' for Figure 13 is that given the complexity of financial, material and social co-dependencies across sectors and geographies, the capacity to retain sufficient services for communities to function and survive depends on:

- levels of redundancy (back-up capacity, including awareness of single points of failure and provision of alternatives)
- community resilience to periods of loss of central services
- experience in coordinating complex co-dependencies and capacity to innovate to restore or substitute services when lost.

Ultimately these depend on whether these attributes are recognised and valued in periods of 'peace time'[1] expenditure and decision making. Currently, communities that experience disruptions more frequently

[1] 'Peace time' was sometimes used in workshops as an analogue for what participants consider 'everyday' or 'normal' times. In this report, unless quoting people, we use the term 'in recent times of relative stability' as opposed to 'times of rapid change, and/or major disruption and disaster'.

have more incentive to secure alternative means to procure essentials, which builds desirable flexibility, adaptability and resilience.

The changes to the diagram post-disaster narrative are provided in Figure 14.

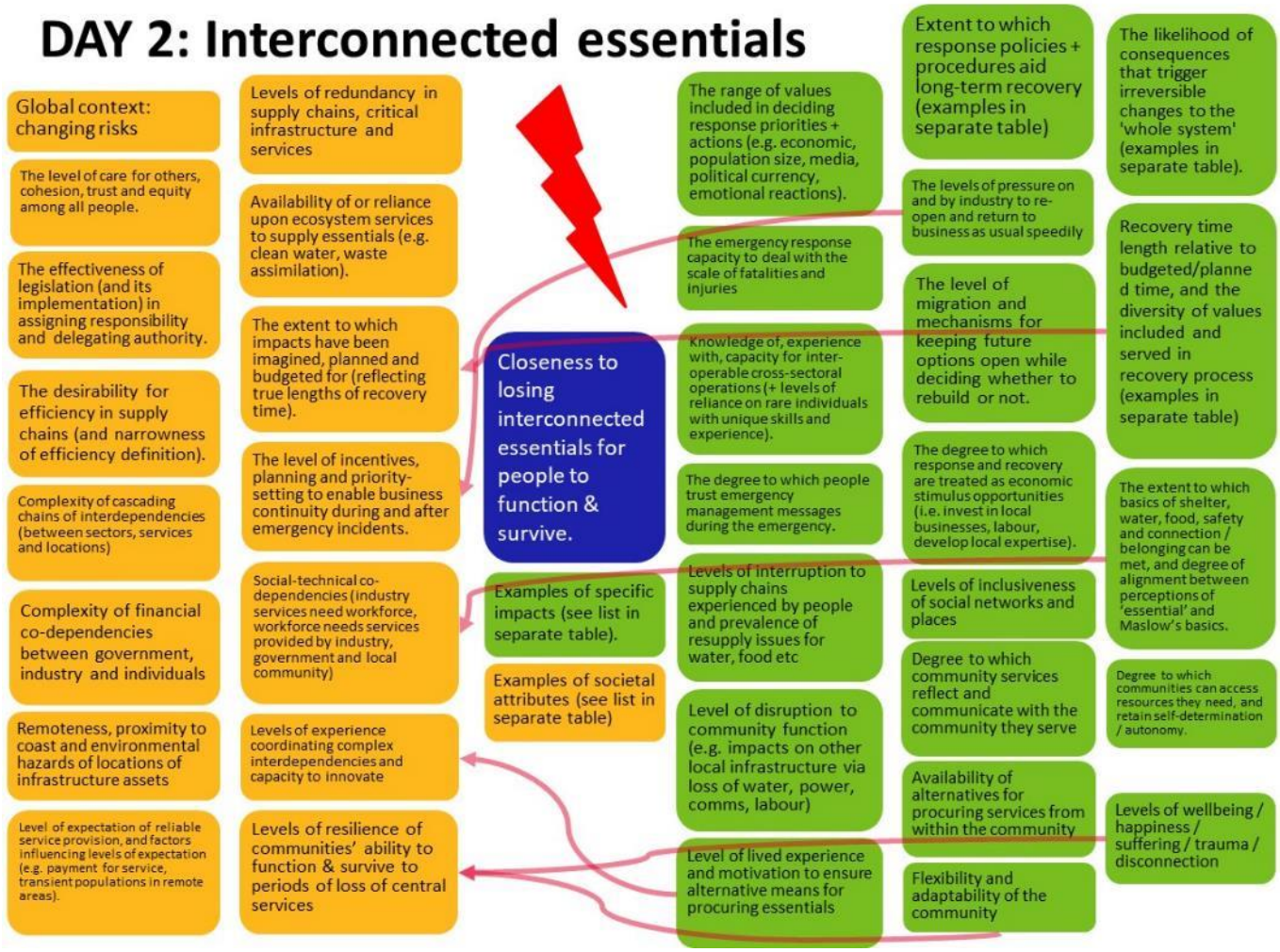


Figure 14 Cause-effect diagram for interconnected essentials, after the disaster scenario was presented

The neutral narrative (post-disaster) is thus. The nature of financial, material and social co-dependencies across sectors and geographies depends on:

- The desirability for efficiency in supply chains (and the narrowness of what is included in assessments of efficiency – usually only economic efficiency but can be widened to reflect other values).
- The level of demand for goods and services, and the imperative to meet these demands in remote, difficult-to-service locations.
- The extent to which people outside emergency management are setting priorities for land-use planning, building codes, rules, and regulations without adequate input from emergency management knowledge and experience.

Given these complex co-dependencies, the capacity to retain sufficient services for communities to function and survive depends on:

- effectiveness of legislation (and its implementation) in assigning responsibility and authority across diverse and interdependent people to take action in response and recovery

- levels of redundancy (including awareness of single points of failure and provision of alternatives)
- community resilience to periods of loss of central services
- experience in coordinating complex co-dependencies and capacity to innovate to restore or substitute services when lost
- the economic, social and political imperative to return to 'normal'.

Ultimately these depend on whether these attributes are recognised and valued in periods of 'peace time' expenditure and decision making. Currently, communities that experience disruptions more frequently have more incentive to secure alternative means to procure essentials, which builds desirable flexibility, adaptability and resilience.

The table groups were then given the opportunity in Session 5 to suggest key points of intervention – taking a systems view and focusing on specific variables especially on the causal side, or on interrupting unwanted amplifying feedbacks (Table 4). The values, knowledge and rules that might help to support such interventions were also listed. The participants almost invariably segued very easily into this task, and many of the suggestions focused on systemic interventions. This task was only allocated one hour as an introduction to the utility of the approach. A second workshop focusing just on design and sequencing of interventions would provide an opportunity for a more considered set of suggestions, and the ones provided here are illustrative examples from the workshop table working on Interconnected Essentials.

Table 4 Interconnected Interventions suggested for Interconnected Essentials, and the values, knowledge and rules that help to underpin them (illustrative only, based on facilitator synthesis of sticky notes)

Interventions	Values	Rules	Knowledge
Assess policies and plans according to long-term system-level implications by developing and using criteria that make benefits of prevention (and prevented costs) more visible, properly recognising true long-term costs of extreme to catastrophic incidents (beyond economic costs). [This can be done at all levels of government, in businesses, organisations and households.]	Long-term priorities. Prevention. Non-economic benefits.	Widespread use of practical criteria for evaluating costs and benefits beyond economic measures.	System knowledge of long-term cross-sectoral costs and benefits.
Develop and use mechanisms for balancing competing values and priorities (e.g. short-term affordability, accessibility and reliability of services in times of emergency, exposure of built assets to hazards, stewardship of environmental assets and ecosystem services). [This can be done at all levels of government, in businesses, organisations and households.]	Inclusiveness. Fairness.	Inclusive decision making and conflict resolution.	Values tensions and trade-offs.
Develop governance structures that prioritise retaining lessons learned and acting upon past recommendations in the face of government and other changes (e.g. a central independent agency). [This can be done at all levels of government, and to a lesser extent by businesses, organisations and	Learning. Independence from short-term political priorities.	Structured to support learning, adaptation and change (rather than blame).	Lived experience with disasters. Strategies for living successfully with natural hazards.

households. Would benefit from Commonwealth government leadership.]			
Use the above mechanisms and governance structures to involve multiple sectors (e.g. emergency management, insurance, land-use planning, health, social services) and support a whole-of-government, business and community approach to planning decisions, setting standards and regulations that are internally consistent, and all informed by emergency management experience, risk profiles etc. [This can be done at all levels of government, and to a lesser extent by businesses, organisations and households. Would benefit from Commonwealth government leadership.]	Cohesion and consistency. Risk awareness.	Cross-sectoral. Whole-of-government (at all levels).	Location-specific knowledge of possible extreme/ catastrophic events and impacts, and strategies for being prepared for them.
Support and invest in creating high levels of location-relevant hazard awareness (including awareness of critical interdependencies) and levels of preparedness that go beyond 'likely' events to include more extreme/catastrophic. [This requires local-level efforts (local government, businesses and organisations) but would benefit from support from other levels.]	Location-specific awareness and preparedness.	Support and investment in awareness raising.	Location-specific knowledge of possible extreme/ catastrophic events and impacts, and strategies for being prepared for them.

Example 2 Interactions between public-private, remote-central cities, and cross-scale economies

A second example of the depth of analysis and change in the perspectives of participants on the analysis is provided here. The central issue was a complex interaction between:

- Nature and efficacy of public-private partnerships
- Level of reliance of state on central city (seat of government and business, main inputs/outputs)
- Health of economy at local to national levels.

These three aspects were seen as inextricably linked, especially in states and territories such as Western Australia and the Northern Territory where the capital cities of Perth and Darwin are the main point of input and output for most goods and services for the state, as well as being the seat of government and big business. This heavy concentration of resources in the state/territory was seen to be compounded by the level of dependence, and single 'just in time' supply lines for goods and services affecting a whole range of groups.

The cause-effect diagram and 'neutral narrative' for Day 1 pre-disaster exposed various root causes such as the 'model of risk liability and risk transfer between business, government and individuals', and the closely related 'level of clear and formal agreements and ownership of responsibility and cost-bearing between state agencies and the private sector'. The 'level of sharing of risk knowledge (specifically on hazard AND vulnerability)' was seen as a major influence on the outcomes for the economy at all levels from local to national levels – and the potential to have international implications as well for some industries such as insurance (and re-insurance) and the LNG industry for WA.

The 'cost of planning and implementing risk mitigation as well as recovery, and the issue of WHO PAYS' were seen as critical influencers of the outcomes. Longer-term drivers were seen as 'trend/pressure/

incentives for profit maximising, smaller role for government, deregulation and economic efficiency', and the 'timeframe for planning (short vs long term)'. There were many illustrative examples provided. For example, in the NT there are existing formal service agreements between different levels of government and private enterprise about disaster preparedness such as for food supply and storage for remote communities. These work effectively but are not in place for WA.

The 'neutral narrative' after the catastrophic disaster scenario exposed a range of impacts and values that were not made explicit during the 'everyday' pre-disaster version of the diagram (Figure 15).

Figure 15 Post-disaster scenario cause-effect diagram for cross-interactions between public-private partnerships, level of reliance on central cities, and cross-scale economies

In the post-disaster Session 4, the table groups explored the potential impacts of a disaster on the 'level of loss of access to essential needs', 'level of self-reliance (for individuals, urban and remote communities, organisations, vulnerable groups, business, governments)', 'level of investment and long-term business health', 'level of adequate governance and leadership', and the 'level of law and order, social conflict, presence of armed soldiers and citizens'. This exploration led to thought-provoking discussions revealing values (expressed as root causes) on the far left hand of the diagram, which had not been previously manifest in the earlier discussions. For example, participants thought that Australia does value (and rely on, even if it doesn't realise it) things such as the 'quality of relationships and levels of mutual trust with regional neighbours – cooperative foreign policy', and 'levels of peace (regional and domestic) and law and order in Australia'. These values were implicit, but not expressed in the pre-disaster discussions; they emerged into the discussion when contemplating what the consequences of the catastrophic disaster scenario might be. For example, if it was widely realised in pre-disaster times how important foreign

assistance from immediate neighbours might be, there might be more explicit value placed on maintaining cooperative and mutually supportive regional relationships in the Asia-Pacific region.

The underlying latent 'level of inequality, racism, misogyny in community' was also seen to have an important interplay with peace, good relationships with neighbours, and domestic law and order. These issues were seen as present in the community already, perhaps being exacerbated by the increasing inequality and rising global tension between globalisation and nationalism. Participants thought that a catastrophic disaster could bring out the cooperative, caring-for-community, Aussie 'mateship' aspects of society or just as easily swing the other way into conflict.

These small samples of the discussion and outputs, taken from workshop outputs and detailed session notes from three workshops, are provided to exemplify the way that the catastrophic disaster narrative, a boundary object such as a cause-effect diagram, and a well-designed and facilitated process can help to create step changes in the understanding, dialogue, and expression of values and system dynamics in a group.

Presentation of cause-effect diagrams and proposed interventions

At the end of Session 5, all of the table groups presented their diagrams. The various views of the system analyses, causes, effects, and proposed interventions were provided by a person nominated from the table group. This was usually done in a fairly standard workshop manner.

The full analysis for the questions of the system diagrams, elicited values, and what makes Australia vulnerable to disasters are presented in a more processed and synthesised form in subsequent chapters.

3.7.6 Session 6: Presenting the system analysis as stories

The final session provided the participants with some simple discussion and tools for story-telling, and the facilitation team challenged the table groups to re-tell their main messages as stories.

The stories were created and told in many different ways – including plays or prose in fairy-tale form (using a familiar story spine), various other styles of plays and skits, advertisements, as well as stories which were fictional, anecdotal or autobiographical. This provided a creative outlet and emotional high point on which to finish the workshop. A summary of the stories is provided in Appendix Summary of session 6 stories.

Example story: SBS Insight Skit, Post Catastrophic Disaster in WA

One of the table groups acted out a skit of an SBS Insight program, set six months after Tropical Cyclone Bad and a tsunami. The panel comprised the state premier, commissioner of a state emergency management authority and an industry leader, 'Mr Neoliberal Moneybags' (representing the Export Only Gas Company). There is one token marginalised person on the panel, however she is seated on the floor while others have a seat. The panel members use the opportunity to advocate their own interests and pat themselves on the back, while casting blame and aspersions on others to score political points and seek more resources for their own activities. Mr Moneybags is celebrated for resuming gas exports to other countries within seven days of the disaster, and he is heckled by disaffected rural shire presidents in the audience who ask why gas exports were prioritised over meeting the needs of the local community post-disaster. The shire presidents also squabble among themselves and complain about the Lord Mayor who has recently returned from a 'fact finding mission' in some very exotic locations around the world where he learned about SPF 50 sunscreen. Every time the token vulnerable person tries to talk, she is told to wait until she is asked and given space to speak – which never happens. At some point, other disenfranchised and marginalised people/protestors try to enter the studio where there is a live audience – hands are

visible, trying to push the door to the workshop room open and security is called to move them out of the building.

It is important to view this story, and all of those told in the workshops, within the context of the 'job of work' done by the narratives. This piece was performed as a chaotic comedy skit, and caused hilarity while mimicking and exaggerating familiar political dynamics. It was a powerful piece of satire even as a quickly scripted spontaneous performance, and had the effect of being able to use humour and fiction to draw attention to societal tensions and vulnerabilities in times of crisis. This style of communication allowed participants to explore tensions and taboo issues in a way that they could not otherwise, recognising social divides and power imbalances in a way which used humour rather than blame and acrimony. Many of the stories and performances had these qualities. The workshops therefore ended on an emotionally uplifting note.

3.7.7 Participant surveys – workshop reflections and feedback

Initial lessons are drawn from responses to a post-workshop questionnaire. Twenty-four responses were received from the workshop in Adelaide, 25 from Brisbane and 39 from the workshop in Perth, which also included participants from the Northern Territory.

Participant visions regarding how society could better live and prosper with disasters

The central themes elicited from participants across the three workshops are:

- The desire to strengthen communities which are cohesive, connected, equitable and self-reliant
- Learning and education for all (community, organisations, government) – awareness, understanding, preparation, recovery and adaptability of living with hazards
- Leadership and collaboration with government – cross-scale collaboration.

In Adelaide the most common vision attributes focused on creating a cohesive community, with people who were self-reliant and who helped their neighbours. Other themes included the need for education and communication, focused on resilience and preparedness.

In Brisbane the main vision was centred on education and communication for awareness and preparedness, with sub-themes of resilience and community.

In Perth the visions also centred on building a resilient community and education for awareness, preparation and recovery. Other themes included collaboration across scales, and between government, non-government and communities and that there needs to be a shared responsibility and understanding of what it is to live with disasters. The Perth visions noted the need for equity, not only in how impacts are addressed, but also considering the systemic roots of inequality.

Barriers or challenges identified for society to be prepared for disasters

Barriers or challenges were perceived to be very similar across the three workshops, with 'a lack of knowledge/understanding or awareness' and 'politics or a lack of political will' mentioned in all three workshops. The next most frequent items were government structures, money, complacency and a decline in the sense of community or its cohesion.

In answering what would most help Australians be better prepared, workshop participants suggested the need for community cohesion and engagement. These two ideas came out strongly in the visions as well as in the potential interventions suggested by participants. This was paired with increasing awareness, education and knowledge. Only Brisbane participants suggested regulation and resourcing as priority interventions.

Workshop expectations

Participant expectations were largely met by the workshops. Where expectations were not met, the responses mostly indicated that they had hoped for 'more on the outcomes'. Others wanted more focus on people and experiences, with one respondent just wanting more of everything. Some examples of the feedback are provided below.

> *The workshop was truly excellent but more time would have been helpful for turning some of the conceptual thinking into practical examples, particularly looking at the causes and effects of vulnerability (Adelaide)*
>
> *Exceeded my expectations a lot of great ideas and issues identified I got a new perspective on risk and vulnerability (Adelaide)*
>
> *Was not sure of what to expect but was excited to witness and participate in the process. I want to learn more about the process and underpinning theories. Also keen to know what you'll do with what we've generated (Brisbane)*
>
> *Very well constructed and thought through process. Really brings the participants along for the journey. Open's one's eyes. Good having professional table facilitation because it can keep us on track within a very complex system (Brisbane)*
>
> *And then some. Fantastic use of systems mapping to understand how extreme disasters impact upon already vulnerable systems and the often-implicit values put at risk (Perth)*
>
> *Was not sure what to expect?! Exceeded any expectations. Congrats on the process, looking forward to the outcome (Perth)*

Most important thing gained from the workshop

Across the three workshops participants viewed 'innovative ideas' as the most important thing they had gained from attending. This was followed by a 'shift in thinking' and 'new information' in Adelaide and Perth. All workshop participants also valued the opportunity to make 'new contacts'.

Enhancing knowledge, skills and awareness

The majority of participants felt that they had enhanced their knowledge, skills and awareness. The most common responses suggested the workshops widened perspectives on the issues and raised awareness of the importance of working with and enabling communities.

Process strengthened or built trust and networks

Workshop participants felt that the process built trust; 100% in Adelaide and Brisbane and 92% in Perth. While some felt the trust was already there, others suggested that it was a respectful, inclusive, sharing, open and flexible process, which enabled difficult conversations and provided a great face-to-face networking opportunity. Most participants suggested that they had formed new connections as a result of the workshops.

Workshop participants' lessons learnt

Participants reflected that one of the most important lessons elicited by the workshop process was the need to include and work with communities, which linked to the need for a different type of leadership which was less 'command and control'.

While there was a mixed response to whether the workshops changed participant views, individuals felt that they had a better, more comprehensive understanding of the context. This was also reflected in what participants said they were going to do differently, including increasing their own awareness, listening more, engaging with communities and practising their communication and story-telling skills.

Participants suggested that they would like to have a better understanding of what the Australian Vulnerability Profile will look like. Participants also identified groups that were missing from the workshop process, including more community members, commercial and business representatives, and other departments such as health and education.

Utility of tools – systems thinking, values, knowledge and rules, and story-telling

Of the tools used during the workshop, story-telling was the one that participants responded to the most (9), finding the approach a novel, powerful one that they could see themselves adopting.

> *Power of the story*
>
> *I didn't appreciate how effective story-telling can be. We need to use it more. People can identify with the personal experience.*

Story-telling was seen as a strategy that would be useful in planning, education and to improve engagement within their project teams and with stakeholders and the community. Participants found creating stories enabled collaboration where participants had a voice and were free to participate.

> *Story-telling concept was new to me. High level of collaboration – level playing field respecting all inputs.*

There were fewer comments on the other tools. Two participants anticipated that they would use the 4MAT approach in their own work. There was only one reflection on values, rules and knowledge, but the full comment is included here as it provides food for thought.

> *If we were to take a shared responsibility approach, this also requires sharing information, values and rules. But from whose perspective? So it may be that information may be directed in multiple directions: from emergency responders to community; from health to emergency responders and so on. With regard to values, there must be no assumption that these are shared, but they should at very least be understood, recognised and respected. Rules should maybe be co-constructed, recognising and respecting experts in the field: experts in emergency response and experts in community. This all takes time, effort and goodwill. But I see this as the only way society will not only live but also prosper in the face of increasing challenges.*

Some of the participants were familiar with the use of scenarios in workshops and already used them in their own work. Only one participant commented specifically on the use of cause-effect diagrams, finding them a useful way to tease out the key issues and potential pathways. Six participants commented that they found systems thinking a useful tool for unpacking complex issues.

> *Can wrestle with the beast that is complex and interdependent systems. Faith that we can map the system and its vulnerabilities and by doing so will end up with options to explore*
>
> *Fantastic use of systems mapping to understand how extreme disasters impact … systems and the often-implicit values that are put at risk*

Stated intentions of what would do differently after the workshop

Of the participants who responded to the question on what they will do differently after the workshop (85), most responded that they would make changes (69), either in their work practices or in their personal lives. The responses fall into several themes:

- Using tools and approaches that were used in the workshop (systems thinking, 4MAT, story-telling, scenarios) (8)
- Preparing personal disaster plans (6)
- Sharing learnings from the workshop with others (e.g. colleagues, community groups) (3)

- Reprioritising planning and projects to elevate emergency issues (4)
- Developing broader partnerships and networks and fostering engagement (5)
- Developing a deeper understanding about issues that underpin policy, planning, resilience, vulnerability and preparedness (15)
- Raising awareness and encouraging inclusion of vulnerable and diverse groups (8)
- Reflecting and acting on own behaviour both at work and personally (listen more, empower others, act with confidence, engage the emotions, and be more inclusive, positive and mindful) (13)

Nine participants did not respond at all to the question. A further nine participants indicated that they were unlikely to change the way they did things; however this did include responses where people indicated that they already used similar techniques. A further five participants responded that it was too soon to tell whether the workshop would change the way they did things.

Summary of participant feedback

Overall, most participants felt that their expectations of the workshop were met and that trust had been built through the process. The most important things they acquired from the workshops were innovative ideas and a shift in their thinking and most felt that they had acquired enhanced knowledge, skills and awareness as well as made new contacts. A key insight for participants was the need to include, and work with, communities.

Discussion, conclusions and key messages

3.8 Addressing the research questions

The discussion focuses on interpretation of the summary of selected workshop results with respect to the key research questions being explored.

3.8.1 Research Question 1: What makes Australia vulnerable to catastrophic disaster?

The more synthesised responses to this question, from the project as a whole, are covered in subsequent chapters. In this chapter, samples of the lightly processed 'raw' data from the workshop processes were presented.

It is clear from the workshop results that some central premises of the Australian Vulnerability Profile were well accepted – i.e. that it is not natural hazards alone that make Australia vulnerable; that disasters only occur when the natural hazards intersect with people and assets; and that the latter features are relatively unexplored dimensions of vulnerability. The workshops enabled a much deeper unpacking of the causes of vulnerability – as shown from the difference in the quality and content of analysis from the Session 1 discussions responding to the question 'What makes Australia vulnerable?' (which is where most workshop or consultative processes would leave the discussion), and the discussions, emotions and analysis which followed using the tools of cause-effect diagrams to do participatory systems analysis, and use of powerful narratives to evoke a different understanding of, and response to, disaster scenarios.

The sorts of issues explored by the three Deconstructing Disaster workshops, and the Partnership Team (who reviewed and contributed through separate workshops), show a depth of analysis and revealed new insights into the social and human elements of vulnerability (for example ethical leadership, community

cohesion, approaches to anticipatory and reflective learning practice) as well as those more 'material' aspects (such as access to essential goods and services). This is further explored in chapters 4, 5 and 6.

3.8.2 Research Question 2: What do we value, and what do we stand to lose in disaster?

The workshops provided multiple ways of eliciting values. Some of these were explicit – for example the participants were asked to list the values in their Session 2 vision stories, and the values, rules and knowledge tool elicited explicit consideration and naming of values. Values were also implicit in some of the activities and discussions, and were extracted post-workshop by the team combing through notes, diagrams, and transcripts from the workshops.

The samples of workshop material provided in the results are a small part of what was captured during the workshop table discussions, and are provided to show that there was a high level of recognition of tension or dissonance in values, and different priorities in before-disaster compared to after-disaster situations (for example, a 'she'll be right' value was seen as quintessentially Australian and widely appreciated as such – but the flip side was that it could also be considered as 'complacency' in the context of disaster preparedness). Discussions, stories and diagrams revealed that such tensions and trade-offs had implications in the choices made by individuals, or by different groups of stakeholders, and between certain contexts (especially the 'normal' or 'peace time' everyday context compared to the during-disaster or post-disaster contexts). There was a deepening level of understanding that emerged over the course of each workshop that some of these trade-offs could drive the system and societal dynamics in very different directions and that this too was highly context-dependent.

The explicit and implicit values, contexts and trade-offs were expressed in myriad ways during the workshops, and in order to make sense of them, a values framework was used to organise the analysis. This goes beyond the workshop results *per se*, and is presented in Chapter 4.

3.8.3 Research Question 3a: Does bringing the disaster experience closer to lived experience through the use of narrative and imagined scenarios lead to different understandings, conversations, and analysis of values and vulnerability?

Narrative, stories and story-telling methods were used in multiple ways throughout the workshop as explained in the methods, including:

- A standard 'science presentation' style narrative was presented in the first natural hazards and risks talk by the Bureau of Meteorology and Geoscience Australia (Session 1).
- The science presentation narrative was turned into an illustrative and experiential story of a catastrophic disaster in Session 6. The concepts and data of the catastrophic story were based on the information presented in the first talk – a direct consequence illustrating the hazards and risk. The second narrative was based on a detailed analysis of data, with plausibility and credibility of both story and storyteller.
- The structure of the whole workshop was run along a narrative arc – this was revealed to the participants only in Session 6.
- The visions in Session 2 and Session 6 were presented by the participants as stories in a range of styles and genres.

Some of these uses of narrative devices were visible to participants, while others were not.

Of particular prominence was the difference in narrative style, and participant response to a standard science presentation compared to the catastrophic disaster scenario story. The story about this anticipated/imagined future required a deeply technical piece of work to translate the data and information about risk and projections and data in the first talk, to a tale with visual supports which was locally relevant, had a sense of immediacy, and had credibility for an audience largely highly skilled in the areas of natural hazards, disaster and emergency response. The catastrophic disaster scenario stories were well constructed and this helped participants to visualise, imagine, and extrapolate the impacts to their own world.

The reactions as shown from facilitation team observations, participant feedback surveys, and also the sticky notes on immediate responses from Perth (see Appendix Reactions to disaster stories) show that translating the usual technical talks about climate change and natural hazards into a story-based catastrophic scenario is highly effective.

Using the story-telling devices in sessions 2 and 6 was also very effective because it validated the use of emotion, creativity and imagination – all of which will be very necessary ingredients to address the overwhelming challenges faced in the sorts of scenarios posed during the workshop. In addition, use of fiction and fairy-tale structures allowed individuals to visibly step out of the constraints of their formal organisational roles, which in some cases included senior leadership roles, and allow their knowledge and experience to be translated into anecdote or humour via a story which did not implicate themselves, their organisations or anyone else.

Many participants in the workshops shared – in table groups and in plenary – stories that were non-fiction. Some were organisational experiences and anecdotes that became very effective ways of transmitting information and lessons learned. Other participants shared personal stories of trauma and survival or of the complexities of managing emergencies in disaster situations, and this helped to share different perspectives and develop trust and empathy in the workshop participants.

The difference in depth of conversations as noted by facilitators and recorded in the cause-effect diagrams, the different sorts of root causes identified (for example in the examples provided in the results) show that there was a significant leap for most table groups on Day 2, but it is hard to ascribe all of this to the utility of the disaster narrative *per se*. It was also the use of emotion, the building of trust on the first day, the timing of an overnight break which typically allows the unconscious processing of learnings from the first day. All of these elements would have contributed and our evaluation method does not enable us to unpack this in more detail.

There is evidence from the workshop activities and outputs, as well as the post-workshop surveys, that the participants responded very positively to the use of narrative methods in the workshops. Participants responded positively to the challenge of creating stories as a form of communication, and their awareness of story-telling increased as was very evident in post-workshop surveys. Their ability to use story-telling devices effectively may not be developed deeply in a two-day workshop so the capacity building for this skill may only be at low levels.

3.8.4 Research Question 3b: Were particular workshop tools and approaches useful – for example, did taking a systems view, a cause-and-effect approach, use of the values, rules and knowledge tool change the way the workshop participants frame the problem and ways forward?

The post-workshop survey data shows that many participants found the systems approach as well as various specific tools to be useful. For some, a deeply nuanced understanding of the use of approaches such as values, knowledge and rules was evident (see comment in section 3.7.7).

Examination of the full set of workshop outputs including notes of discussions, diagrams and narratives shows that there was a depth and complexity in understanding which evolved over the two days. The two examples of cause-effect diagrams and system narratives provided in the results are some of the many that clearly illustrated that taking a cause-effect approach to understanding system dynamics, combined with the power of a narrative about the impacts of catastrophic disaster, did effectively change the way the participants viewed the system, and in many cases substantially changed the nature of the conversation about what makes Australia vulnerable. Much more depth and nuance are brought out by the process and tools of conducting the exploration, as seen from the evolution of the simple list of 'central issues' listed in Session 1 of the workshops, to the diagrams and narratives on root causes produced by the end of Session 5.

The sequence of activities as well as the use of specific tools helped to 'prime' and develop the thinking and analysis over the two days. By Session 5, most participants were looking way beyond the default interventions that they had come to workshop with, or suggested in Session 1 (where some tables did already start skipping forward to simple interventions). During the course of the workshop, many participants realised and were introduced to different networks that they could tap into and different ways to solve some of the problems that they previously thought were unsolvable. This shows that there is some development of efficacy and networks towards agency. Observations and notes from table facilitators show that most thought that the interventions from table groups evolved towards making the system work better – i.e. they were system-oriented, more relational interventions rather than piecemeal (see section 3.7.5 and Table 4). By the time Session 5 was reached, facilitators observed that it was much easier to elicit and for participants to express the more systemic interventions in the context of the systems view built in the workshop.

Similarly to Research Question 3, it is difficult to provide a clear answer because although analysis of the outputs, facilitator notes and observations as well as post-workshop survey comments show that the workshops were highly effective, it is difficult to evaluate the individual utility of specific tools and approaches which were embedded into the broader workshop process.

3.8.5 Research Question 3c: Did the workshop activities help the participants to update their understanding of how disasters play out and what might be done to reduce the potential impacts? Did the participants carry these ideas and possible actions through from the workshop into the day to day work and networks of the participants?

Eight-five participants responded that they might do things differently after the workshop, with many focusing on changes they would make in their work or personal lives. Section 3.7.7 shows that this covers a range of themes including using tools and approaches that were used in the workshop, preparing personal disaster plans, sharing learnings, reprioritising planning and projects to elevate emergency issues, developing broader partnerships and networks and fostering engagement, developing a deeper understanding about issues that underpin policy, raising awareness and encouraging inclusion of vulnerable and diverse groups, and being more reflective in their own behaviours. Although these respondents indicated immediately post-workshop that they were thinking about how they would use these approaches in the future, it will be necessary to conduct further surveys to check how these intentions may have played out. There are generally many challenges to carrying workshop learnings back into daily busy work and personal lives, and sharing insights with others who have not shared the experience.

The workshop may have had a good role in building capacity in a more general sense – for example changing the ways individuals frame the challenges and solutions to natural hazards, disaster risk, planning

interventions in a systemic manner. It is hoped that the Tracking Systemic Change module of this project will be able to capture the capacity development.

3.8.6 Successful factors in the workshops

Factors leading to workshop success included:

- Convening power of the Commonwealth and active participation of the States, and a broad range of participants who engaged with enthusiasm and authenticity, allowing them to create networks they hadn't had before. Active participation and sponsorship by senior and executive leadership of organisations provided an authorising environment for participation by all.
- Credibility of science underpinning workshop design, and scenario development (especially for catastrophic disaster to stretch the imagination).
- Use of multiple methodological approaches around psychology, education and effective learning, systems analysis and use of narrative. The use of narrative methods to move from a standard science presentation on risk, to a storyline with the key features of impactful stories (e.g. sense of immediacy, tapping into sense of place, stimulating emotions and imagination, working to a story arc etc.) was a particularly important feature.
- Creation of a safe space and working under clear ethics protocols, and a legitimate environment for dialogue between people with different perspectives. This included providing a structured way of listening and holding space for multiple perspectives without judgement and without having to resolve them.
- Acknowledging and actively managing emotions through workshops (balancing highs and lows), especially when dealing with confronting material.
- Space for use of imagination and creativity, essential for the generated creative material that can be further developed to carry key messages.
- Ways to include multiple knowledges including different levels of government, industry, experts, and community (Brown, 2008) (section 3.2.2). Different people contributed in different ways to the different parts of the workshop – some in general discussion, some in creative narratives. People could express themselves in ways that were true to them.
- Use of integrated, interdisciplinary science to design the workshop, and expertise of design and facilitation team.

3.9 Key concluding messages

Key message 1: Three 'Deconstructing Disaster' workshops were held in Adelaide, Brisbane and Perth, based on a design to elicit data about what people value and what is vulnerable, and also to stimulate systems thinking, structured learning, and networks for social change.

In line with the co-design principles underpinning the Project, the design of the workshop was informed by several bodies of literature about:

- Individual and group learning that considers or addresses:
    - the psychology of learning and the importance of engaging the mind and the heart
    - the existence of different knowledge types/cultures and the need to try integrate these

    - the presence of power imbalances, in levels of authority and between knowledge types, and the need to try to promote a level playing field
    - the need to complement experiential learning (i.e. learning from observations and the past) with future-oriented learning (or learning from the future as it emerges) due to increasingly novel/unprecedented nature of change
- Systems theory/thinking (including resilience thinking and sustainability science)
- Transformational adaptation to overcome the systemic constraints and barriers to effective climate adaptation and disaster risk mitigation
- Creating an effective storyline – literature and interviews of professional storytellers and storymakers
- Ethics and creating a 'safe space'.

The science and facilitation expertise underpinning workshop design and delivery methods enabled selection and use of appropriate tools and approaches to enhance the learning experience, as well as providing rapid synthesis across the complexity of the many perspectives of different sectors, scales and different constructs or framings.

Key message 2: The workshops achieved the two goals of providing a source of raw and semi-processed data for answering the overarching questions of the Australian Vulnerability Profile, as well as a range of other outputs and interactions that will help to inform it. It provided an effective forum for dialogue and influencing the current problem framings, narratives and ways forward around disaster resilience and vulnerability.

The data sourced from the workshops are further analysed and described in subsequent chapters. The workshops were clearly successful as standalone activities in terms of:

- providing a forum for dialogue between levels of government, sectors, organisations, scales of operation, different disciplines and perspectives
- introducing stakeholders to a different set of ideas and approaches
- helping to build capacity, trust and networks which will hopefully persist beyond the workshop
- raising 'expert' awareness of the importance of involving and working with communities (this came out strongly in the Adelaide and Brisbane workshops, while the message from the Perth workshop was less clear)
- contributing to a step change in the way many participants frame the challenge, and potential ways forward in addressing systemic, cross-sector and cross-scale issues. There is clear evidence that the nature and depth of conversations, analysis of the problem, and types of interventions suggested, changed over the course of the two days.

Key message 3: The convening power of the Commonwealth and States; the participation of senior and executive leadership was critical to gaining the participation of key stakeholders, and the legitimacy of sharing multiple perspectives across sectors, levels of government, private industry and civil society.

There was a strong representation of people from emergency services, particularly from the executive leadership in the Australian Government as well as State and Territory governments. Along with the workshop design, this created an environment for the workshop in which difficult topics could be discussed and trust could be built.

Key message 4: There is an ongoing opportunity to use the successful elements of the workshop design and find ways to amplify the experiential learning process in other ways beyond this Project.

These workshops had a key purpose of eliciting data for the Australian Vulnerability Profile and start to answer the key research questions. The design of the workshops was also intended to test whether the workshops could be an 'intervention' in their own right by creating forums for discussion, building capacity and networks to stimulate the model for social change introduced in section 2.4. As such, they can be considered as 'pilots', and early feedback shows that they had some success in building capacity – for example changing the ways individuals frame the challenges and solutions to natural hazards, disaster risk, and planning interventions in a systemic manner. It is hoped that the Tracking Systemic Change module of this project will be able to capture the capacity development over the longer term. The way that such workshops could be used to stimulate systemic change is further discussed in Chapter 6.

4 Exploring the values dimensions of vulnerability

Russell Wise, Rachel Williams, Michael Dunlop, Deborah O'Connell, Veronica Doerr, Nicky Grigg, Seona Meharg

4.1 Introduction

In this section, a values framework is presented and applied, based on the outputs from the Deconstructing Disaster workshops, in order to respond to the first research question:

> *Research question 1: What do we value, and what do we stand to lose in disaster?*

4.1.1 What is a values-based approach and why use one?

Values are what people consider important in life. Values are articulated as desirable goals, moral principles or preferences about what is important in life (e.g. 'people should be treated with respect and dignity'). Sometimes values are expressed in terms of the things that are valued (e.g. house or family). Values clearly underpin people's attitudes, motivations and beliefs, and societal norms, and therefore influence the choices and actions of people. Understanding the diverse notions of values and how these interact to influence policy, planning and decision-making processes, therefore, is helpful because:

- People's decisions and behaviours are influenced by what is important or valuable to them. Put another way, it is the individual and shared values of people that determine how they relate to each other and to their material and non-material worlds. This is because:
    - values provide motivations for action (Schwartz, 1994, Schwartz, 2012)
    - values influence, and are influenced by, the formal and informal rules that structure human interactions in pursuit of valued outcomes (i.e. rules for decision making embody and reflect particular values) (Ostrom, 1990, Ostrom et al., 1994)
    - values and knowledge interact to influence the beliefs, attitudes, identities, cultural practices and worldviews (mental models) of the people involved in decision-making processes, which influences the choices they make (Stern et al., 1999, Stern, 2000, Jones et al., 2011).
- The framing and discourse about problems and solutions are influenced by the values (and interests) of the people involved depending on their relative levels of authority and power (Leach et al., 2010). To get support for a new framing of a problem or proposed solutions requires developing narratives that appeal to the identities and values of the people involved (Kern, 2011).
- Values are conditional on the historical and prevailing states and dynamics of knowledge, regulations, and the natural, economic, socio-cultural and technological environments, and will change in response to changes in these variables (Gorddard et al., 2017). For example, new knowledge, regulations or technologies can lead to gradual or rapid shifts in people's values, preferences and attitudes. Understanding these relationships and dynamics can help inform engagement strategies and interventions that reveal and promote desired futures.

- In any particular situation, people have multiple, often contested, values for how resources ought to be allocated and used, which leads to unavoidable trade-offs needing to be made. These trade-offs are best informed by understanding the values at play. Values provide an important lens for understanding the trade-offs, damage and loss associated with disasters, and how to reduce this through preparation, response and recovery. Most damage and loss (e.g. memories, sense of place, social cohesion, and identity) cannot be expressed or measured in monetary terms but instead needs to reflect the nature of people's lives as determined by values, place and experiences (Tschakert et al., 2017).

Understanding values requires an approach that specifically accounts for the different dimensions and concepts of value and the factors that determine which values are relevant and are prioritised in different situations. This requires fit-for-purpose conceptual frameworks to guide analyses, build understanding and inform interventions. Values-based approaches[2] may therefore be usefully defined as:

> *the coordinated and structured operation/management of "things" with the purpose of maintaining the significance of the "thing" as determined through an analysis of the totality of values (where a value is "a set of desirable attributes") that society (consisting of various stakeholder groups with legitimate interest in the "thing") attributes to the "things*" (adapted from Poulios, 2010).

In essence, 'values-based' approaches emphasise and guide the structured exploration of: what people value most about their everyday lives; how these values are likely to be affected by environmental changes such as disasters and the policies developed to respond to such changes (Persson et al., 2015); and how these values are articulated and accounted for in decision-making processes.

4.1.2 Value concepts and values-based approaches

Values encompass what people consider important in life. Values therefore refer to desirable goals that motivate action and serve as standards that reflect a person's sense of right and wrong or what 'ought' to be and tend to influence attitudes, norms and behaviours. Values also inform the standards for assessing and choosing what actions are best to do, what way is best to live, or how to manage, use and allocate resources. In this way, values are not only articulated but enacted.

Individuals and groups hold numerous values ('held values'), but how they affect preferences or actions varies. A particular held value might be important to one person or group but unimportant to another. And priorities change with time and context. Additionally, some values are complementary and others are in conflict. Where values are in conflict, they cannot be held or realised simultaneously without creating tensions between (or within) the individuals or groups involved. For example, pursuing novelty and change to fulfil 'stimulation values' is likely to undermine preserving time-honoured customs or values of tradition (Figure 16) (Schwartz, 2012). In such situations, choices and trade-offs are unavoidable. The trade-off among relevant, competing values guides attitudes and behaviours and influences actions when they are relevant to the context (Schwartz, 1992). Such trade-offs are a normal part of everyday life.

[2] The term 'values-based approach' is also used in business management where it refers to maximising shareholder value (http://www.valuebasedmanagement.net).

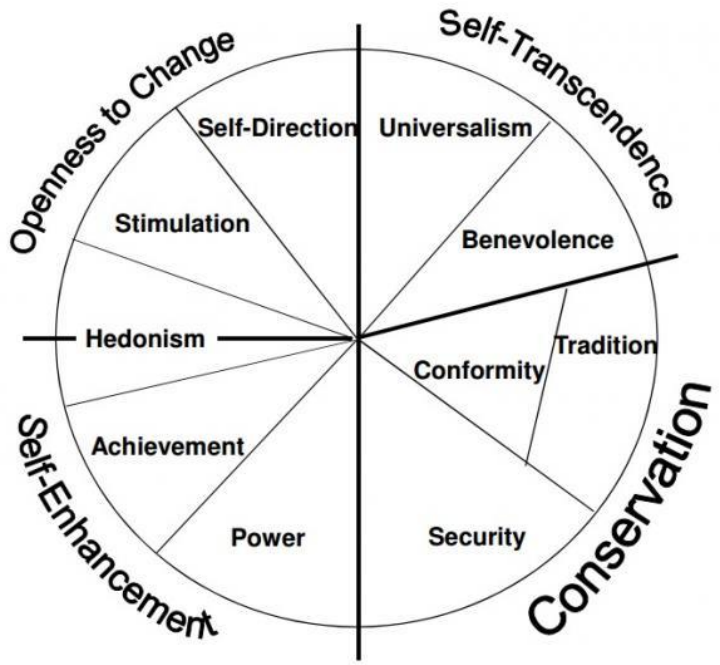


Figure 16 The Schwartz theory of basic values identifying ten basic personal values that motivate people in different ways and are evident across cultures, clustered into two axes reflecting competing motivations (Schwartz, 2012)

There are numerous concepts and terms used to describe values. This diversity can create confusion and impede a shared understanding of problems such as the causes and effects of vulnerability, or working collaboratively on solutions. To overcome this, an attempt has been made here to collate, categorise and define the various concepts of value (Table 5). A framework is then presented (Section 4.1.3) that seeks to clarify how the main concepts of value relate to each other and illustrate how, collectively, they can help reveal some of the drivers of various disaster risk management responses and the root causes of vulnerability.

The framework is based on the idea that value is associated with how 'people' relate to 'things', where people includes individuals and groups, and things include objects, places, goods, services, relationships and even ideas. Building on that, four broad categories of values can be identified: **held** values, **assigned** values, **derived** values and **relational** values. These are defined as follows (and elaborated in Table 5):

- Held values are the fundamental beliefs and desirable goals that motivate the way people select actions and evaluate events. These may manifest as guiding principles for how one ought to live and how to decide between right and wrong;
- Assigned values are the descriptors used to convey the importance of things of value so that they can be legitimately considered in choices between alternative decisions;
- Derived values are the benefits received from the fulfilment of held values by the relationship with the thing; and
- Relational values (or value relationships) are the relationships between people and things of value that realise benefits, help to reveal the values that people have for things and shape how they assign value to them.

Relating these key concepts of value to each other and to the people and processes involved in making trade-offs between them in a comprehensive, integrated values framework can be helpful for building shared understanding about the causes of vulnerability and the nature of the losses and suffering from disasters. This framework is presented in the next sub-section.

Table 5 Different concepts of values and their definitions. Note, these concepts are not exclusive of each other, nor necessarily ontologically compatible

Type of value	Definition
Held values	These are deeply held first-order values that underpin the relationships people have with things and how they derive value from things and assign value to them (Brown, 1984). They are ethical beliefs that determine the way people select actions and evaluate events (Schwartz, 1994, Schwartz, 2012); Stern & Dietz, 1994). Schwartz (1994, 2012) identified ten universal **values according to the motivation or goal that underlies each:** power, achievement, hedonism, stimulation, self-direction, universalism, benevolence, tradition, conformity, and security. These are related in conflicting or congruent ways and are often assigned different priorities according to the individual or societal grouping, and the context (Schwartz, 2012, Gorddard et al., 2016). A complementary 'deontological' view on held values sees values in terms of rules and principles. Examples of **values as principles** include: accountability, sharing, caring, obedience, honesty, helpfulness, sustainability, self-reliance, improved resource/environmental management, gender equity, family focus, genuine need, justice towards nature and people, full participation, freedom, training, education, communication, and spirituality (https://www.heifer.org/ending-hunger/our-approach/values-based-development/index.html). **Shared values**, also known as **social values**, is a term or concept often used to refer to guiding principles and cultural values that are shared by groups (Kenter et al., 2015).
Assigned values	Assigned values are second-order preferences, generally associated with goods or services to which individuals are prepared to ascribe relative values (Brown, 1984). Assigned values are the stories or measures used to describe, quantify, or articulate the diverse and complex values inherent in the relationships that people have with material and non-material things, so that these can be legitimately considered in decision-making processes (Chan et al., 2016, Gorddard et al., 2017). Examples of assigned values include: **Landscape values**, which are the specific values assigned to particular physical places, geographic spaces, or landscape features (Brown, 2006, Ramm et al., 2017). **Market (monetary) value ('price')**, which is the value of a good or service when exchanged in a market. This can also be applied to non-marketed goods as a 'shadow price' referring to the price a good might have if a market existed for it, derived from observation of human behaviours that reflect its usefulness or scarcity (Krutilla, 1967). **Environmental values** are environmental features or things valued by society (e.g. a threatened species or habitat). A sub-category of environmental values are 'functional values' which Brown (1984) argues are features of natural environments that have 'non-preference-based values', derived from the biological or physical relation of one entity to another, for example, the value of nesting habitats for birds. **Intrinsic values,** which reflect the belief that an object may have value in itself. This can stem from people valuing a thing for its own sake and from the ethical position that some things have value independently from people's values for them expressed as 'culturally embedded moral truths' (Zimmerman, 2001); (Sandel, 2012). Intrinsic values are reflected in many and diverse cultural and religious worldviews (Millennium Ecosystem Assessment, 2006). The philosophical position that some things have value independently of any individual valuing them often holds that the intrinsic values of things are non-substitutable (i.e. they cannot be traded off with other values).
Derived values	These are the benefits to an individual or group derived from material or non-material things of value (such as friendship, knowledge, beauty and so on). These values are recognised and measured in diverse ways including acknowledgment, self-fulfilment, reputation, or financial reward.

Type of value	Definition
	Lived values are a form of derived values. Lived values are valuations that individuals make, in isolation or as part of a group, about what is important in their lives and the places they live. These valuations may be articulated verbally (espoused) or expressed through everyday activities (enacted). (Graham et al., 2013) identified five different categories of lived values: health, safety, belonging, esteem and self-actualisation.
Relational values or value relationships	The relationships between humans and between nonhuman actors and humans in dealing with nature, collective wellbeing, struggles over a good life, and caring for nature as a shared value (Chan et al., 2016). The meaning people derive from their relationships with places they live in, even if the places people value are not always local, e.g. 'the relationships people have or used to have [with land] through its use and knowledge about it, and through the freedom and pleasure as well as lifestyle and identity in it…' (Tschakert et al., 2017). The value or importance of a thing derives from how people relate to and experience the thing. The relationship between people and a thing determines the values that people have for and assign to the thing and the benefits they derive from the thing. Value relationships often take the form of formal and informal rules about how individuals or groups are allowed or expected to interact with the thing and how the values are articulated (Gorddard et al., 2016).

4.1.3 A framework for eliciting values to inform the Australian Vulnerability Profile

The starting point for understanding how values influence vulnerability to loss and damage involves recognising that people interact with material and non-material things of value in order to fulfil their needs and desires. These things include physical objects such as buildings, roads, nature, animals and people; non-physical things such as rules, information/knowledge; and 'critical services' such as communications, health, transport, and energy.

People's relationships to things are determined by interactions between relevant knowledge, values and rules: the knowledge people have about the functioning of the things; the held value satisfied by the relationships that people have with the things; and the formal and informal rules governing how people are allowed to interact with the things (Gorddard et al., 2016; 2017) (Figure 17). Furthermore, the value of things depends on:

- the presence or absence of certain features or attributes of the thing (e.g. health, scarcity, substitutability)
- people's ethical, moral, ideological or political preferences
- the benefits or dis-benefits derived from the thing being in a particular state.

Values are enacted through people's willingness and ability to take action to ensure the thing exists, is accessible and is looked after, which in many cases includes their ability to assess, evaluate and articulate importance of a thing in a way that can inform trade-offs in decision making. To summarise, it is the values of people as individuals or groups, based on what they know and what they are allowed to do, that affect the trade-offs they make when deciding where and how to invest their resources and time. It is these choices that determine levels of vulnerability to natural hazards.

Some implications of this relational view on values include:

- The value of a thing derives from how people relate to and experience the thing relative to other things of value and relative to the 'costs' (time, resources, effort) incurred in trying to realise or maintain these relationships.

- The relationships between people and things depend on the values they have for things, how they assign value to the things, and the benefits they derive from the things. Understanding these value relationships can then reveal the various types of values at play (i.e. the held, assigned and derived values) and their relationships.
- Value relationships often give impetus to the creation of formal or informal rules enabling and constraining how individuals or groups can interact with the thing and how values for the thing are articulated and accounted for in decision making (Ostrom, 1990, Leach et al., 1997, Chan et al., 2016, Gorddard et al., 2016).
- It is relationships between people and things of value that are affected by natural hazards. Understanding these relationships can reveal both the proximate and systemic causes of vulnerability in society.

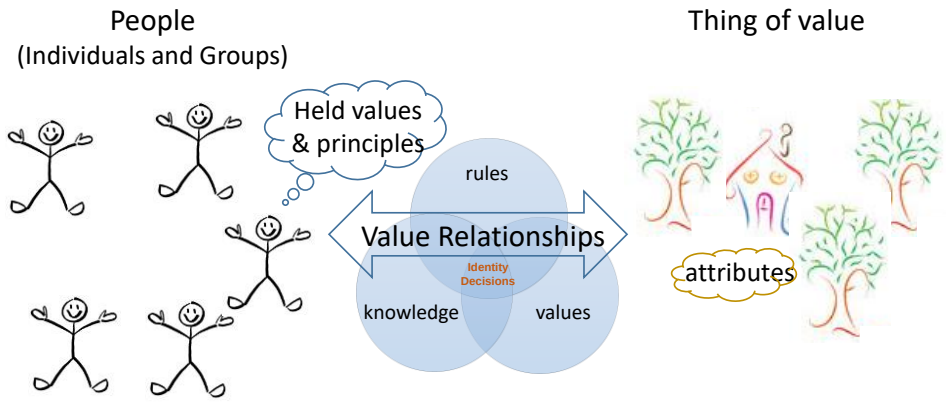


Figure 17 A relational perspective on values highlighting that values depend on the relationships between people and things of value, which are influenced by the held values of the individuals and groups and the attributes of the things important to them

These values relationships affect the actions and wellbeing of people through different channels:

- Positively and proactively, through the role that values play in providing motivation for people to take action to realise goals.
- Reactively, through experiencing feelings of dissonance, despair or suffering caused by either a discrepancy between the current and desired reality or a vivid consideration of the potential damage and losses from a catastrophic disaster.
- Passively, through cultural practices and identities, which provide security to individuals by alleviating the tensions inherent in the daily-life trade-offs between values and the ambiguities of a complex world.

From the discussion above the key elements that ought to be included in a framework to guide a values-based approach can therefore be summarised as:

- The stakeholders identified to be relevant to the focal issue, from the individual to the group to society as a whole;
- The things or entities of value to people;
- The motivations behind the ways people relate to, or engage with the things of value (i.e. their held values that motivate choices);
- The ways in which people assign value to things and prioritise them in decision-making:

    - A diversity of ways exist for assigning and prioritising values. In some contexts these are determined by the rules governing the decision-making processes, such as markets where value is expressed in terms of the exchange value (price) of things; deliberative or democratic processes where value is negotiated within agreed processes; and formalised processes where value is encapsulated in the way a thing is described (a threatened species or carats of a diamond)

- Ways of making explicit the congruency in values across individuals and groups and how interests and asymmetries in knowledge, power or authority influence whose values and what types of values are prioritised in choices;
- The contingency of values on the state and dynamics of the physical system, on the level of *knowledge* about the system, and the formal and informal *rules* governing what people are allowed and not allowed to do.

These dimensions of value are conceptualised in a holistic values framework in Figure 18.

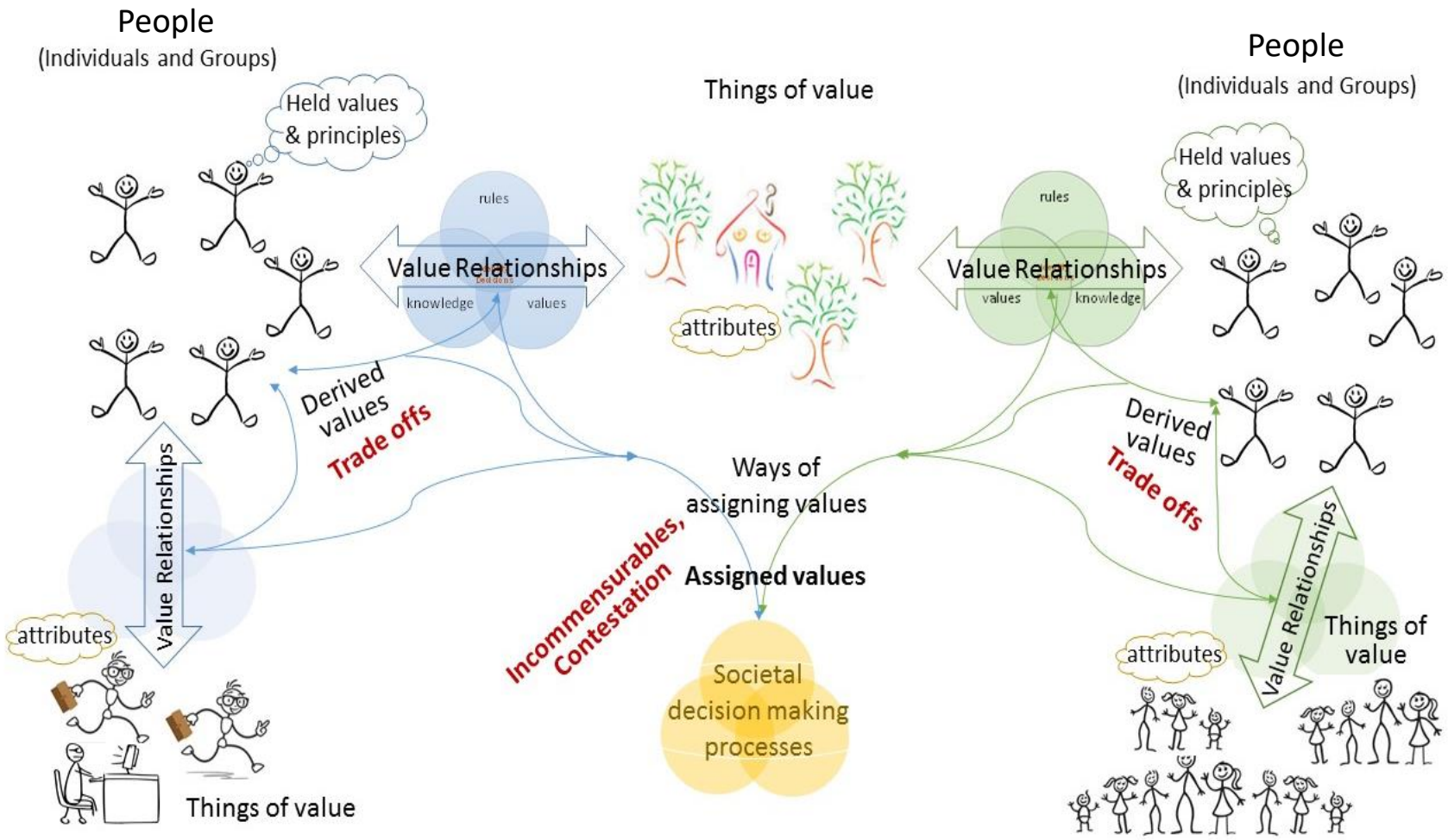


Figure 18 Conceptual approach to understanding and framing values.
'*Held values*' are the values that people hold within themselves, e.g. their moral compass, that fundamentally shape their views about, and the ways they interact with and relate to 'things' (entities). '*Value relationships*' are the relationship between people and things which determine and reveal the values that people have for, and assign to, things. The *values derived* from the things and '*ways of assigning values*' include the stories or measures used to articulate the values that people have for things so these can be legitimately considered in particular decision-making processes. The figure also highlights the trade-offs that people face and the difficulties assigning and evaluating values associated with things that do not have dollar values or cannot be readily compared (incommensurables)

4.2 Methods

A series of questions was developed from the conceptual framework to guide a values analysis of the data from the 'Deconstructing Disaster' workshop reports, including the FlashJam workshop (described in Chapter 3), and relevant published reports and papers (Table 6).

Table 6 Questions to guide the eliciting of information on values from workshop reports and other sources

Questions to guide values analysis	Additional directions and guidance	Reason for the question (i.e. what useful information about values is this question trying to elicit?)
Q1. What are the things of value (identify and describe)?	Distinguish and separately list pre- and post-disaster things of value.	This question attempts to identify what things people and groups value before and after a disaster.
Q2. Who values the thing?	Which people or groups value the thing identified? List these separately and disaggregate the 'who' as much as possible (i.e. try not to use generic high-level categories like 'government' or 'business' but specify the sub-groups within these).	This question highlights that value (the things of value and their relative importance/value) depends on the people involved. The answer to this question, combined with the answers to Q1 provide the basis for identifying the different attributes of things valued by diverse people and helps understand why certain things and certain attributes get prioritised over others in decision-making processes.
Q3. Describe the current state of the important (desirable) attributes of the thing of value?	This is about describing the current state of the thing of value, focusing on the specific attributes that make the thing important or valuable. The aspirational desired attributes are addressed in Q4. The answer here may be the same for Q4 if the current state is in its desired state.	This question requires identifying the attributes of things that are important to different people. It also requires baseline information on the current state of the thing, which when combined with answers to Q2 indicates which people are benefiting and which are not, and which people potentially have more influence than others in terms of being able to ensure their desired attributes of the thing of value are represented.
Q4. Is the thing currently in a desired state or not? If not, describe the desirable attributes?	The desirable attributes of things are often described by people in terms of their aspirational, moral or ideological values for a thing.	This question reveals people's aspirational values for things of value. By identifying and listing the desirable attributes of things (i.e. the aspiration values) these can be compared with the current state of the attributes to reveal discrepancies; these could then inform interventions to address the discrepancies.
Q5. What benefits does each person derive from the thing, when it is in a desired state?	What material and non-material benefits do people receive when the thing is in a desired state? Consider the held or motivational values being satisfied.	This question attempts to reveal the distributional dimensions of the benefits being realised across the many people. It is also an indirect, but transparent way, of revealing the motivations (linked to held values) of people from explicitly stated 'assigned values'.
Q6. What have people done (or are they doing) to secure the flow of benefits from the thing of value?	If the thing of value is not in a desired state then it would seem to imply that people would do something to change this. If so, what has been done and by	This question reveals and explores the potential trade-offs and constraints that people face in what they can and cannot do. People may value certain attributes of a particularly important thing, but there are

Questions to guide values analysis	Additional directions and guidance	Reason for the question (i.e. what useful information about values is this question trying to elicit?)
What have people NOT done and why (red text)?	whom? This also reveals the value of the thing in terms of what people have given up or invested to get the desired attributes of the thing. If nothing has been done, then understanding why not reveals the other things of value that people are investing time into, which implies these other things are deemed or perceived to be more important.	other things that are more important, and only limited time or resources are available. So here we want to capture these relativities in values and importance and potential conflicts.
Q7. What are the impacts, costs, loss, suffering (and to whom) caused by the thing not having the desired attributes (i.e. in times of stability)?	What emotional, psychological, physical, financial costs are people incurring from the damage to, or loss of, the attributes and things of value, due to the way the current socio-economic system operates?	This question starts to focus on the essence of vulnerability.
Q8. What are the impacts, costs, loss, suffering (and to whom) caused by the disaster?	What emotional, psychological, physical, financial costs are people incurring from the damage to, or loss of, the attributes and things of value, due to disaster?	This question reveals more about vulnerability.
Q9. What are the newly emphasised or recognised things of value during or after a disaster?	Have workshop participants mentioned things of value that were not mentioned in the pre-disaster situation? If this is the case, please list these and provide explanations for this, where given by participants.	Disruptions can highlight or reveal things of value that were previously unknown, unrecognised or taken for granted during periods of normalcy.
Q10. What are the emphasised or newly recognised attributes of things of value when affected by disaster (during or after)?	Have workshop participants mentioned attributes of things of value that were not mentioned in the pre-disaster situation? If this is the case, please list these valued attributes and provide explanations (if given) for why these were previously not mentioned or why they are now being mentioned.	While the things of value may be the same, different attributes of them may be revealed as more important during disruptions compared to periods of normalcy.

The questions and associated explanations in Table 6 were entered into an MS Excel spreadsheet by seven different analysts based on the workshop outputs. The data were colour coded to distinguish between pre- and post-disaster situations (Figure 19). Instructions were included for users of the Framework to distinguish or highlight (using different colours of text or in bold):

- when the answers were directly from the workshop outputs;
- when the answers had been supplemented by the user with their own interpretation or speculation; and
- when conflicts or trade-offs between values were identified.

Before analysts applied the framework, they were guided through the process of how to capture the information in response to the questions of the framework. Each analyst methodically went through the relevant information from the workshops to capture the answers to the questions about values and record them in the Excel spreadsheet. The questions in the framework provided a structured process for users to filter out relevant information on values. Each analyst's assessment and synthesis of the values information was reviewed by another analyst from the CSIRO team to cross-check and promote consistency between analysts in their interpretation of the framework.

This analysis was done after the workshops, drawing on outputs from a range of workshop sessions; the questions were not asked directly of participants. As outlined in section 3.1.1, the workshop participants were mainly professionals from government emergency management and emergency services agencies, but also from private and non-government organisations that have a role in disaster preparation, response and recovery across a wide range of sectors. Most participants had extensive experience working with disaster victims, and many had first- or second-hand personal experience with disasters (including some disaster survivors).

Data Source	Thing of value?	Value to who?	Describe the current state of the important attributes of the thing of value?	What benefits does each actor derive from the thing, when it is in a desired state?	Is the thing currently in a desired state or not? If not, describe the desirable attributes?	What have actors done (or do) to secure the flow of benefits from the thing of value? What have actors NOT done and why (red text)?	What are the impacts, costs, loss, suffering (and to whom) caused by the thing not having the desired attributes?	What are the priority (or newly recognised / emphasised) attributes of the thing of value when affected by disaster (during and after)?	What are the impacts, costs, loss, suffering (and to whom) caused by the disaster?
	Newly recognised or emphasised 'thing of value'								

Figure 19 Matrix structure of the values framework in MS Excel.
Analysts were prompted by questions (column titles) to fill in information on the values at play in the cause-effect dynamics of each central issue. The pre-disaster information was inserted in the blue cells and during- and post-disaster values were inserted in yellow cells

4.3 Results

The results from applying the values framework (Figure 19) to the outputs of the Deconstructing Disaster and FlashJam workshops are presented below. The results present an integrated synthesis of the information gathered in the workshops: visions, encompassing aspirational and goal-oriented values and principles; descriptions of causes of vulnerability that shed light on values, beliefs, norms and cultural practices that motivate the choices, behaviours and actions of people; and the consequences of vulnerability, which reveal the things of value impacted or at threat of being lost due to the prioritisation of some values over others by the system and potential disruptions to the system.

The results are presented in sections that represent components of the values framework (Figure 19) including: what people value and why they value these things, i.e. the relationships people have with things of value and the desirable attributes of valued things; what people are willing and able to do or give up in order to ensure the things of value exist and have their desirable attributes; and whether these values change between periods of stability or normalcy and disaster.

Interpretations and discussion of the results are presented in section 4.4.

4.3.1 What do Australians value?

A. Principles to live by

A summary of the key aspirational 'principles for successfully living with natural hazards and catastrophic disasters' articulated by participants of the Deconstructing Disaster workshop is presented below.

- Societal goals and decision-making processes are inclusive, transparent and promote shared accountability and learning.
- Societal goals promote wellbeing (prosperity, happiness, contentment and financial security) based on equity, efficiency (non-wasteful) and sustainability criteria.
- Adaptability in disaster preparedness and response efforts is promoted, drawing on continual lifelong learning, self-reliance and self-agency, and supportive institutions.
- Knowledge, innovation and information sharing about risks, trade-offs, and returns are promoted and enabled.
- Healthy natural environments are protected to promote connectivity between people and between people and nature.
- Diverse cultural identities and world views are respected and nurtured.
- Authentic and ethically based leadership is rewarded and practised across all sectors of Australian society.

These 'vision statements' reflect some of the held values and ethical beliefs of people about how the world ought to be or how one ought to live. It is these principles that influence subsequent assigned values and the ways in which trade-offs are evaluated and actions or choices prioritised.

B. The material and non-material things of value

The identified 'things of value' fall into four categories which are summarised in Table 7. Most, if not all, of the things identified as valuable in the pre-disaster situation, irrespective of the category, were also identified as valuable in the post-disaster situation. The workshop participants did,

however, recognise and emphasise that some of the things of value were relatively more important than others in the context of catastrophic disasters (these have been highlighted in blue text in Table 7). These were emphasised either because they confer more resilience or because their damage or loss in a disaster was recognised to be difficult or impossible to replace or would lead to immense suffering.

It is noteworthy that many personal things of value such as memories, mementos and other lived values, which are often emphasised as important by affected individuals and emergency services during disaster response, did not get emphasised over other things of value. This might be because the focus on 'factors affecting vulnerability' shaped the things considered in the values analysis with the effect of reducing the emphasis on the immediate consequences of the disaster for individuals. This does not mean these personal things of value were not considered important; it merely reflects that the workshop process directed the focus to exploring the limits to emergency response and recovery and to discussions on understanding systemic causes of vulnerability to inform disaster mitigation efforts.

Table 7 General categories of 'things of value' with examples of each, identified from the three 'Deconstructing disaster' workshops and the FlashJam workshop*

Non-living physical things	Living things	Services	Processes/rules
Critical infrastructure	Individuals	Water	Learning practices
Houses	Family and friends	Health	Regulations
Roads	Pets or livestock	Emergency	Standards
Place	Community	Energy	Land-use planning
Money (income)	Leadership	Wastewater	Economy
Mementos	Nature	Communications	Governance
	Networks	Transportation	Law and order
	Organisations	Social safety nets	Risk sharing
	Food	Value chains	Cost-benefit and risk analysis
		Employment	Democracy
		Education	Sovereignty (freedom)
		Information	Emergency planning

* Note: items in black text were identified before, during and after a disaster whereas blue text indicates those things of value that were more heavily emphasised or acknowledged in the workshops as important during and after a disaster.

The people that were consistently identified by workshop participants to be contributing to or affected by vulnerability were: individuals, households/families, friends, local and special-interest communities, government agencies at different levels, private sector organisations, international participants (e.g. neighbouring countries), and leaders (mostly referenced via discussion of 'leadership'), (Table 8). Stakeholders were generally referred to in these broad categories and only rarely did workshop participants specify particular organisations or people, even when prompted to do so. The exceptions were emergency services agencies; when distinguishing between individuals or communities in urban or rural settings; drawing particular attention to marginalised or disadvantaged individuals or communities, including those in remote regions; Aboriginal and Torres Strait Islander peoples; the elderly; and people with disabilities. The absence of explicit references to women or youth is noteworthy, although the younger generation was acknowledged as being relatively disadvantaged by the prevailing rules compared with older generations.

Table 8 Summary of the categories of people and organisations identified by workshop participants

Categories of people	Examples of disaggregations of people and organisations		
Individuals	Disadvantaged/ marginalised*	As consumers	As citizens
Family and friends	Households	families	friends
Community	Urban, rural	Community groups (local, special interest)	
Government	Federal, State and local	Political parties	Agencies (EMA)
International groups	Neighbouring countries		
Business	Corporations	Industry groups	SMEs
Leadership**	Government	Business	Formal and informal

* Disadvantaged or marginalised individuals refers to people with disability, the elderly, the youth, lower socio-economic groups, traditional peoples, and those in rural or remote regions who, because of their location, socio-economic standing, age or physical ability are not treated fairly/equitably.
**Leadership was more often discussed than leaders specifically.

It was almost always the case that there were three or more distinct groups or individuals associated with any particular thing of value. And, in many of these instances, there were differences between the groups in how the value relationships were identified. In other words, it is clear that different people have different expectations and priorities regarding the desirable attributes of the things of value and have different preferences for ways in which the things of value ought to be managed. For example, many land-use planning and development decisions, such as zoning low-lying flood-prone areas for development, are influenced and made by many people with diverse motives and objectives. Land developers tend to be influenced by shorter-term, economic imperatives due to market forces (demand for housing, roads etc.) and their need to generate financial returns (e.g. to shareholders), and have incentives to rapidly develop land largely irrespective of the longer-term implications. Local governments need to generate revenue to provide effective services to their communities and therefore have incentives to develop land for financial returns. Individuals want affordable housing in aesthetically pleasing locations and are generally trusting of the system (or of those 'responsible') to ensure that the buildings are safe and secure. Many of these objectives or values are in tension. The values of some people will prevail over those of others depending on the relative levels of influence or authority, the prevailing rules that incentivise or constrain what can legitimately be done by each person, and the knowledge held by people at the time they make decisions. These types of value tensions and conflicting behaviours and choices are pervasive in society. Examples of these 'value relationships between actors and things of value', identified in the workshops, are described in Table 9 .

Table 9 Summary examples of value relationships that people have with 'things of value'. Note: As mentioned in Table 8, the categories of person listed here are not homogeneous, but the data are not sufficiently detailed to warrant further breakdown of the categories

People	Non-living physical things	Living things	Services	Processes and rules		
				Land-use planning	Learning practices	Assessment approaches e.g. cost-benefit, risk
Individuals, communities and households	People have value relationships with work (for income to afford essentials and lifestyle choices), home and place (to fulfil values of safety and security), and community (values of connectedness). These relationships are often in tension due to competition for the limited available time people have to invest in realising them and because of differences in the rewards or benefits received from pursuing each. People are generally described to have high expectations and growing dependencies on reliable, affordable and safe critical infrastructure.	People are reliant on Government for the provision of many services and on business to provide goods and services and as a source of employment and shareholder returns. Relationships between individuals and community and nature were emphasised to be important for fulfilling needs of inclusion, identity, safety and security. **Disadvantaged and marginalised people*** are particularly dependent on communities.	Critical services provide the basic requirements for living e.g. food, potable water, electricity, heating and cooling etc. Workshop participants described people's relationships with critical services as being highly and increasingly dependent. **Disadvantaged and marginalised people*** are particularly dependent on community services.	Land-use planning governs where and how people can live. People expect to be able to live where they want and that renting or purchasing homes is affordable.	Learning practices and lifelong learning were highlighted as critical for disaster preparedness and to guide action to reduce the impacts of future severe natural hazard events.	Not applicable **Disadvantaged and marginalised people*** are particularly dependent on social safety nets.
Government	Arbiter of fate: steward or custodian of nature; granter of natural resource exploitation rights.	Governments have carriage of decision-making about how society should operate and be able to interact	Provision of sustained, affordable, reliable and efficient services	A means for governments to house a growing population and a source of revenue, via land sales and land taxes. Also a source	A means of promoting and achieving efficiency goals (i.e. learn to do better or cheaper).	Used to assess, prioritise and justify expenditure or regulation.

People	Non-living physical things	Living things	Services	Processes and rules		
				Land-use planning	Learning practices	Assessment approaches e.g. cost-benefit, risk
		with the natural world, while also relying on the political support of citizens.	is the core business of government, either as owner, partner or regulator.	of political tension as debates around development versus sustainable management of biodiversity and other natural resources play out in the land-use planning sphere.	Government invests in the innovation system to promote opportunities for economic growth and to learn how to better cope with emerging threats.	
Business	Source of profit and influence, and a means for generating products wanted by people.	Source of profit and influence.	Source of profit and influence.	A source of profit for developers and a source of constraint on where and what they can do. Provides the rules for where and how businesses can establish operations.	Seek efficiency (learn to do better or cheaper). Some invest in innovation. 'The market' seen as a key form of learning feedback.	Used to assess, prioritise and justify expenditure

* Disadvantaged or marginalised individuals refers to people with disability, the elderly, the youth, lower socio-economic groups, traditional peoples, and those in rural or remote regions who, because of their location, socio-economic standing, age or physical ability are not treated fairly/equitably.

4.3.2 What are the desirable attributes of the things valued by people?

A range of desirable attributes of things of value were identified (Table 10). Not all of the attributes apply to all the 'things of value' in each category. Some attributes were relevant to fulfilling people's goals in stable conditions, often based on assumptions of normality and being able to understand and control the system. Some attributes contribute to people realising their objective to successfully live with extreme natural hazards and disasters.

It is hypothesised that:

- Many of the preferred attributes of things of value in times of stability will be different and likely in tension with the desirable attributes of these same things in situations of severe to catastrophic disasters.
- The priority of some of the things of value to people and organisations during times of stability will change when they recognise the changing nature of natural hazards and their increasingly catastrophic consequences.

Table 10 Desirable attributes of the 'things of value'.
Desirable attributes common to 'times of stability' and 'successfully living with disasters' are in black text, those specific to 'times of stability' in red text and those emphasised for 'successfully living with disasters' are in blue text. Terms with similar meaning have been grouped under a common heading

Physical things (non-living)	Living things	Services	Processes and rules	Leadership (Government, Business, Citizen)
• Accessible • Affordable • Amenity • Productive • Reliable • Resilient and robust; diversity • Safe	• Accountability • Agency (self-efficacy, autonomy, empowered) • Accessibility of nature as a source of refuge and for reflection • Capacity (learning, receptive to learning) critical thinking (discernment, information literacy), self-reliance, emotional coping, preparedness, knowledgeable (warned in advance, across sectors, vulnerability aware, Emergency Management plans, realistic and informed expectations, about what people value, situational awareness, prioritisation, role clarity, to help with Disaster Management) • Connectedness at multiple scales, with EMS, with nature, across sectors and scales (local community cohesion), (special interest community cohesion) • Dignity • Economic diversity • Equity (distribution of wealth and power, and of cost-bearing) • Inclusion (diversity) • Individual sovereignty	• Accessible (available, affordable), equitably • Cooperative – between agencies • Ethical • Human-centred (personalised, choice, local autonomy and self-determination, efficiency and access balanced with privacy) • Interdependencies managed • Preventative vs cure focus e.g. health • Reliable • Resilient and robust (diversity, responsive to change, ability to improvise, resourced adequately) • Safe (including water quality) • Tailored • Trusted (credible, independent, balanced) • Useful	• Accessible (affordable) • Accepted • Adaptable (flexibility, tailored, responsive to change e.g. changing risks, demographics, environment, location, phase of event) • Accountability built in (compliance) • Balanced • Capacity building (for problem-solving, decision-making, conflict resolution) • Consistency • Continuity • Community-led • Evidence-based (experience-based, informed by worst case scenarios, disaster resilient, risk aware, plan for the long term, relevant) • Honesty (integrity) in use • Inclusive (equitable, consultative, compassionate, shared, multiple diverse views, silo-spanning, tailored, receptive, open, known	• Accountable • Adaptive (think outside the square) • Authentic • Collaborative (bipartisan when needed, cross-level coordination, knowledge sharing) • Courageous (confident) • Ethical (socially responsible) • Humble • Respected • Trusted • Representative (decisions made in public interest) • Visionary

Physical things (non-living)	Living things	Services	Processes and rules	Leadership (Government, Business, Citizen)
	• Living with nature – not fighting it • Productive • Resilient (adaptability, incl. of nature) • Responsibility for self and to others (shared responsibility) • Trust • Wellbeing, mentally and physically healthy		about, local k, beyond academic, balanced, includes non-local, safe, relationship building) • Interoperable across sectors, jurisdictions and scales. (governance principles built in e.g. governance subsidiarity) • Protecting • Resourced adequately • Stable (certainty) • Transparency in use (unambiguous)	

4.3.3 What are the current states of the 'things of value' and what does this mean for people?

Almost all things of value were described as having some attributes in desirable states and some attributes in undesirable states. It was also often the case that workshop participants made generalised statements about the state of things, the causes of these states and their consequences, drawing upon specific examples or their own perceptions or experiences. As much as possible, the authors have tried to acknowledge that descriptions of the states of things do vary across Australia and what is being described is from the perspective of the participants; it may not necessarily be as widely applicable or generalisable as indicated by the statements of the participants. The relationships as described are used to gain a broad understanding of the types of value relationships that are important to Australians, rather than a comprehensive understanding the details or current states of those relationships. Examples of the current state of 'things of value' and the benefits and costs from these are summarised in Table 11.

Table 11 Illustrative examples, with brief descriptions, of the current states of the 'things of value' (listed in Table 10) compared with the desirable attributes of these things, reasons for the current state and who is benefiting or losing out from the current state.
Attributes common to living in times of relative stability and 'successfully living with disaster' are in black text, those specific to living without disaster are in red text and those emphasised for 'successfully living with disaster' are in blue text

Things of value	Desirable attributes	Current state	Reasons for current state (i.e. reveal the systemic causes)	Who benefits or loses (reveal any conflicts)
Local community	Cohesive Connectedness (including beyond community) Commitment Economic diversity Efficacious (ability to self-organise) Equity Inclusion Learning Live with nature (don't fight it) Preparedness Productive Resilient Sense of identity Self-sufficient Shared responsibility Trust Wellbeing	Varies, but workshops consistently identified widespread declines in connectedness and ability to self-organise within communities, between communities and government, and between communities and nature. Virtual (specific interest) communities believed to be getting stronger at the expense of local communities.	Increasing individualism Increasing population mobility and changing nature of work leading to more non-locals in remote areas. Market and cultural pressures (lifestyle, rising living costs, pressure to succeed, materialism). Individuals' work and family demands means little time available to invest in community. Decline in understanding of the benefits of a cohesive local community. Declining capacity and willingness to put time and effort into sustaining local community as the benefits are less realised or can be achieved in other ways. Local leaders often lack authority to make the decision needed to be self-sufficient. Internet enabling greater connection with non-local communities. See Typical system pattern #8**: Communities of place, interest, identity and necessity.	**Benefits**: Increased sense of autonomy for otherwise self-sufficient individuals **Costs:** Disadvantaged or marginalised individuals and groups more isolated than is ideal or necessary. Regional/remote communities have unplanned interventions imposed upon them.

Things of value	Desirable attributes	Current state	Reasons for current state (i.e. reveal the systemic causes)	Who benefits or loses (reveal any conflicts)
Critical services (Utilities, food, transport, communication)	Centralised Efficient (low redundancy and interconnected) High reliability Back-up capacity Realistic expectations Self-reliance	Relationships of individuals with business (especially leaders) were described as declining in trust. There is a perception that many critical services are under supplied and becoming increasingly unreliable and unaffordable to greater numbers of people. High dependence and expectations on single sources of critical services.	Government and business are seen to prioritise efficiency and profit. Lack of awareness of interdependencies and the consequence of that. Perception of community unwillingness to pay what is needed for better and more reliable services. See Typical system pattern #1**: Essential goods and services.	Benefits: Government and business keep their costs down. Costs: Regional/remote communities experience price gouging and low service quality. Prolonged services failure to all sectors in a catastrophic event. Cascading failure of interdependent services when one is damaged is a cost to everyone.
Government services (e.g. Health, Education, Emergency, Social Services)	Accessible Equity of access Efficient Holistic Shared responsibility Strategic	Siloed/fragmented. Top-down, controlling and paternalistic. Widespread decline in capability of agencies to engage with the needs of communities. Widespread inequity of access to services. Relationships of individuals with Government (especially leaders) were described as declining in trust.	Pursuit of efficiencies coupled with increased reporting requirements means fewer resources and capabilities are available which leads to declines in understanding or capacity to engage with communities. See Typical system pattern #2**: Health and capacity to care	Benefits: lower financial costs incurred by government in the short term. Costs: increased community suffering and financial burden; declining trust in government; reinforcing dependencies; decline in mental health of all individuals involved.
Land-Use Planning	Adaptive (responsive, flexible, tailored) 'Building back better' Consultative Enables equitable societal resilience in the long term 'Harm minimisation' Informed by worst case scenarios (e.g. dealing with	Not widely consultative. Uncertainty, lack of common national codes, misinterpretations of regulations and conflicting laws, and inconsistent enforcement particularly at the local council level. Allows unsafe development in areas with high exposure to extreme natural hazards, e.g. flooding.	Legal precedents in the implementation of planning laws that favour development over risk reduction or environmental protection. Changing emphasis between market-based vs level of regulation. See Typical system pattern #4**: Placement of communities, infrastructure, assets.	Benefits: Developers and housing purchasers derive benefits from low land prices. Governments meet their need to accommodate a growing population. Costs: Risks are transferred to the future and to those who are unaware or powerless to manage the risks. High mortality and injury rates. Lasting disruptions to the economy.

Things of value	Desirable attributes	Current state	Reasons for current state (i.e. reveal the systemic causes)	Who benefits or loses (reveal any conflicts)
	high mortality, safe places of retreat) Interoperable across sectors, jurisdictions, scales	Impedes effective emergency management.		
Governance	Capacity Consistency Continuity Cooperation Disaster resilient Inclusive Integrity Stability	Relatively strong compared to some other countries, but good governance was thought to be weakening, and the public trust in it was also eroding.	Root causes of decline not understood by the general public and key decision makers. Priority given to governance of efficiency, reduced regulation and economic growth. Popularisation of governance, discounting long term or less likely outcomes. See Typical system pattern #11**: Governance and Organised Decision-Making	Benefits: In the short term, people in positions of leadership (political, government agencies and business) benefit from maintaining the power and resources in the current system. Costs: lower confidence in investing in business; lower employment; lower level of functioning markets; lower levels of trust in government.
Leadership	Accountable Adaptive 'Think outside the square' Authentic Collaborative (bipartisan when needed, cross-level coordination, knowledge sharing) Courageous Confident Ethical Socially responsible Humble Respected Trusted Representative	Currently seen as better than some countries but declining. Variable and in political arena generally low. Big business corporate responsibility is improving in some industries 'social licence to operate'; SMEs have more direct connection to community and more direct trust feedback loop.	Short-term political cycle undermines incentives to tackle difficult problems See Typical system pattern #12: Leadership**	Benefits: In the short term, people in positions of leadership (political, government agencies and business) benefit from maintaining the power and resources in the current system. Costs: lower confidence in investing in business; lower employment; lower level of functioning markets; lower levels of trust in government.

Things of value	Desirable attributes	Current state	Reasons for current state (i.e. reveal the systemic causes)	Who benefits or loses (reveal any conflicts)
	Visionary			
Information about risks and suitable responses	Accessible Affordable Credible Reliable Independent Relevant and usable	Availability of information about risk is limited. Overload, with limited capacity to derive intelligence and actionable advice. Trade-offs made between quality and timeliness. Equitable access problems. Variability in media credibility and independence.	Information not being released/delayed because of institutional risk aversion; funding problems (issue prioritisation, silo culture); coordination difficulty because of multiple sources and siloing; vulnerabilities from privatisation and dependencies on technology. Level of complacency – preparedness is a low priority and people have previously been bailed out. Politics of climate change. See Typical system pattern #3**: Information and communication	Benefits: In the short term, organisations avoid being held liable or having the value of their assets drop if information about risks to assets in which they have a stake isn't made public. Costs: Low levels of community self-reliance, low trust in themselves and in their intuition for decision-making (feelings of shame and blame).
Risk sharing processes	Accessible Equitable Harmonised Transparent Trusted Address life-cycle costs Incorporate rare, extreme risks.	Existing building codes and standards for development accommodate some current levels of risk, but also embed rare extreme risks. Limited trust in institutions and developers, lack of rules and knowledge. Not harmonised at state, local and National. Risks are transferred to those who are either unaware or powerless to manage the risks.	Regulations abandoned due to need for speedy reconstruction after disasters. Timely action is prohibited by risk-averse processes. Short-term profit is incentivised over long-term reduction of risk to things valued by society. See Typical system pattern #6**: Risk assessment, ownership and transfer.	Benefits: Avoided short-term cost and inconvenience to developers, builders, consumers. Costs: Long-term/future costs increase to business, negative media, poor understanding of policies and their impact. Developments in high-risk locations, loss of productive agricultural land, loss of land for nature and recreation, loss of trust in government and developers, risk transferral to householders, Increased suffering during rare extreme events. Increased cost of recovery including a lack of clarity as to who bears the cost of recovery, exposure to and the level of impact of hazards, various levels of economic impact, loss of productive land. Infrastructure and social lock-in to hazardous locations. Establishment of

Things of value	Desirable attributes	Current state	Reasons for current state (i.e. reveal the systemic causes)	Who benefits or loses (reveal any conflicts)
				norms around low cost higher risk infrastructure.
Learning practices for emergency preparedness	Accessible Adaptive Beyond academic education Capacity building for problem-solving, decision-making, conflict resolution, preparedness, acceptance Collective Experience-based Inclusive (incl. non-local) Known about Lifelong Trusted Safe	Variable. Little emphasis on lifelong and experience-based learning practices in schools. Unequal access. Low participation. Where learning is valued this materialises in informal and formal personal and community networks and raised levels of disaster preparedness.	Low awareness. Few incentives and low motivation. Being overwhelmed by the pressures of daily life (earning income). Weak local networks. Siloed knowledge and teaching. Low sense of community. Low awareness of safe gathering places. Complacency 'she'll be right'. See Typical system pattern #10**: Lifelong learning practices, mindset and expectations	Benefits: Time and effort can be used for other activities of interest. Costs: Poor communication and low levels of understanding and trust, propagation of false information. Low levels of agency, capacity or preparedness in: working together, knowing what to do in adverse situations, e.g. gather information, care for others, distribute resources, etc.
Nature*	Accessibility Adaptability Aesthetic Continuity Diversity Healthy Liveability Live with nature, don't fight it Predictability Productive (usefulness) Source of refuge Source of/for reflection	At risk from other land-use values.	Increasing disconnection from and low awareness of nature. Limited understanding of risks. Failure to learn from Aboriginal and Torres Strait Islander peoples. Low levels of social connectedness. See Typical system pattern #14**: Nature and people	Benefits: To those who benefit from other land uses, e.g. agriculture, urban development, resource extraction. Costs: loss of land for nature and recreation.

Things of value	Desirable attributes	Current state	Reasons for current state (i.e. reveal the systemic causes)	Who benefits or loses (reveal any conflicts)
	Transformability			

* Nature was a prominent feature of the vision statements and drawings but it was largely overshadowed in the discussions by issues that were more salient to the agency representatives present in the workshops. The Partnership Team workshops put extra emphasis on nature and environment when reviewing and building on the Deconstructing Disaster workshop data.

** Typical system patterns are described in Table 16 and Appendix Typical System Patterns.

4.3.4 What is and isn't being done to secure the flow of benefits from things of value? Why?

Since many of the things of value were reported to be in an undesirable state or missing many desirable attributes, the analysis sought to understand the extent to which people seek to actively manage the things of value. This helps reveal the potential trade-offs, constraints and conflicts that people experience in their daily lives in relation to these things of value. For example, when time and financial resources are limited people may invest in stewarding only those things that are most important, rather than all the things that are important to them. Or, people may not have the agency to manage some of the things that are important to them, for example, managing the desirable attributes of public infrastructure or lands is beyond the skills, resources or legal remit of most people. These issues are summarised in Table 12.

Table 12 Illustrative examples, with brief descriptions, of the current states of the 'things of value' (Table 11) and the value tensions and relative value priorities that are placing things of value at risk

Thing of value not in desired state	Actions or lack of action by specific groups of people to improve the state of the thing of value	Value tensions and interactions between values, rules and knowledge (v-r-k) that underpin these actions or lack of them in times of stability, with some examples of how value priorities shifted in response to the disaster scenarios
Local communities have declining levels of collective cohesion, connectedness at the wider scale, capacity to self-organise.	Declining individual participation in local groups and events. Cross-sector disaster committees exist with variable community participation. Businesses are beginning to invest in community building activities.	**v tensions:** Virtual communities may be an easier and more effective means of experiencing community cohesion, for those who desire it **(v)**. This also satisfies a desire for individual autonomy **(v)** through engaging with 'communities' of one's own choosing, including distant family. **v tensions:** For businesses, investment in community building **(v)** can be hard to justify from a financial perspective **(v)** as it's a long-term investment with indirect benefits. Fly-in-fly out or short-term postings are cost effective **(v)**. **v tensions:** In the disaster scenarios however, the value of local community cohesion **(v)** in enabling self-organisation and resilience was prioritised over net economic activity **(v)** and individual prosperity **(v)**.
Many **critical services** are under supplied and becoming increasingly unreliable and unaffordable to greater numbers of people. High dependence and expectations on single sources of critical services.	Some individuals are investing in self-supply e.g. water tanks, solar. Businesses may not regionally stockpile for emergencies. There is a perception that governments follow the business lead on least-cost supply models. Some businesses have established effective relationships with government providers to ensure priority of critical service provision during extreme events. Lack of preparedness by community, service providers and government	**v tensions:** Businesses are operating on least-cost **(v)**, just-in-time provisioning models which discount the need for community self-sufficiency **(v)** if supply chains are cut. **v tensions:** Decisions about the location and construction of infrastructure (which supplies services) **(v)** are often driven by short term political imperatives **(v)** which may outweigh considerations of service reliability and continuity **(v)** under extreme events. **v-k:** Decreasing emphasis on local community connectedness **(v)** reduces sharing of local knowledge of risks **(k)**. **k-v:** Widespread lack of awareness **(k)** of critical services **(v)** interdependencies and the vulnerabilities they present.

Thing of value not in desired state	Actions or lack of action by specific groups of people to improve the state of the thing of value	Value tensions and interactions between values, rules and knowledge (v-r-k) that underpin these actions or lack of them in times of stability, with some examples of how value priorities shifted in response to the disaster scenarios
Government Services siloed and fragmented. Top-down, controlling and paternalistic. Widespread decline in capabilities and (equity of) access.	Individuals pay taxes. Those who can afford it pay private health insurance. Service providers and government agencies have focused on increasing efficiency.	**v tensions:** Efficiency in service provision **(v)** is prioritised over equity of access to services **(v)**. **v tensions:** Governments and businesses were seen to prioritise efficiency, economic growth and profits **(v)** while individuals and communities emphasised income security, equity and connectedness with nature and people **(v)** as critical for their wellbeing.
Land-Use Planning allows unsafe development in areas with high exposure to extreme natural hazards e.g. flooding and impedes effective emergency management.	Households stay in places that are at risk. Governments have not increased standards/regulations.	**k-v, v tensions:** Home owners/communities are largely unaware that risks to property are changing **(k)**. They make trade-offs between cost, amenity and the disruption of moving (change) **(v)**. **k-r-v:** People have high expectations **(k)** and reliance **(r)** on the elected authorities and the rules governing development and how resources are used (i.e. safety, fairness) and generally lack awareness **(k)** of shortcomings in the system for delivering on these. **v tensions:** Governments have short term needs for economic development and affordable housing **(v)**. However, maximising financial returns **(v)** while providing affordable housing to a growing population **(v)** puts human lives at risk **(v)**. **r-v, v tensions:** There is little incentive **(r)** for developers to avoid developing high risk areas **(v)** as these risks are transferred to the owners of homes and infrastructure **(v)**.
Good **Governance** was thought to be weakening, and the public trust in it was also eroding **Leadership**	The general public participates in processes to maintain fundamentals of democracy e.g. voting but many have not demanded more of their political and corporate leadership People in positions of leadership (political, government agencies and business) – often work hard to maintain current structures of governance	**v tensions:** Time and effort are applied elsewhere. **k-v:** The consequences of current societal vulnerabilities are not yet widely enough recognised **(k)** for more people to prioritise **(v)** improved governance. **v tensions:** Current incumbents benefit from maintaining the power and resources in the current system.

Thing of value not in desired state	Actions or lack of action by specific groups of people to improve the state of the thing of value	Value tensions and interactions between values, rules and knowledge (v-r-k) that underpin these actions or lack of them in times of stability, with some examples of how value priorities shifted in response to the disaster scenarios
Availability of usable **information** about risk is limited. Information overload, with limited capacity to derive intelligence and actionable advice. Trade-offs are made between quality and timeliness. Equitable access problems Variability in media credibility and independence.	Not much being done	**k-v:** The difficulty for most people in imagining how the future will unfold **(k)** means the relative value **(v)** placed on disaster risk information is low; **v tensions:** 'being prepared' takes low priority relative to day-to-day life demands; **k-v-r:** Information is valued **(v)** but high expectations **(k)** that information and help will be there when needed lowers self-expectations about seeking it out **(r)** **r-v:** Legacy of being reactive and declining self-reliance **(r)**; **k-v:** Inconsistency in messaging **(k)** reduces value of information **(v)**; **v-k:** Lost connection to landscape **(v)** means risk awareness **(k)** is absent **v tensions:** diversity in community needs and preferences; **v tensions:** corporate objectives vs utility of information;
Risk sharing processes Existing building codes and standards for development accommodate some current levels of risk, but also embed rare extreme risks. Limited trust in institutions and developers, lack of rules and knowledge. Not harmonised at state, local and National. Risks are transferred to those who are either unaware or powerless to manage the risks	Processes exist to accommodate a level of risk, but these have not been used to address rare extreme events. Regulations abandoned due to need for speedy reconstruction. Building regulations, zoning enforce reduction of risk, where applied. Disclosure rules, publically available hazard maps make some embedded risks transparent.	**v tensions:** Cost and inconvenience to developers, builders, consumers **(v)** may prevent this. Further actions would increase up-front costs to consumers and/or reduce profitability to businesses, and/or require process design and enforce new standards, zoning, disclosure systems. **k-v, r-v:** Other barriers may be: lack of information about events that have not been experienced **(k)**; regulatory guidance **(r)**. **v tensions:** Increased individualism **(v)** over community cohesion/connectedness **(v)** reduces interest and capacity for collective action in the event of a disaster.
Extent/quality of **Learning practices for emergency preparedness** are variable. Little emphasis on life-long and experience-based learning practices. Unequal access.	Emergency preparedness training for school children, and ways for parents to learn via their children.	**k-v:** Complacency, 'she'll be right' mentality. **Value tensions, v-r:** The prevalence of centralised, siloed systems **(v-v)** leads to dependence on them **(r)**, which creates vulnerability in a disaster.

Thing of value not in desired state	Actions or lack of action by specific groups of people to improve the state of the thing of value	Value tensions and interactions between values, rules and knowledge (v-r-k) that underpin these actions or lack of them in times of stability, with some examples of how value priorities shifted in response to the disaster scenarios
Low participation	Informal personal networks are making cross-sectoral connections possible (example of emergency services and aged care provider link thanks to informal connections)	**Value tensions:** People are too busy & prioritise paid work **(v)** over community activities **(v).**
Nature*	Very little people can do to steward nature at the scale it is valued. Individuals have little ability to manage extensive nature on public lands. Owners of large areas with nature often have conflicting primary production incentives. People do manage nature in their back yards, donate to conservation agencies, volunteer, seek to minimise their impacts when in nature, and lobby and vote.	**Value tensions:** for those who want to live close to nature **(v)** and yet also value the safety and security of home and family **(v)**, which can be lost in a disaster. **Value tensions:** between valuing nature, in diverse ways **(v)** and perceiving nature as a threat **(v)**. **Value tensions:** between valuing nature intrinsically or for aesthetic or amenity reasons **(v)** and valuing nature for utilitarian reasons (recreation, source of harvestable resources) **(v)**. **Value tensions:** between valuing nature **(v)** and valuing other land uses **(v)**. v-r-k: individuals have few rights **(r)** to manage public lands, and little ability to do scale **(v, k)** Public land and water managers have some but marginal ability to manage for nature, due to resource, imposed priorities and difficulty **(v, r, k)**

* Nature was a prominent feature of the vision statements and drawings but it was largely overshadowed in the discussions by issues that were more salient to the agency representatives present in the workshops. The Partnership Team workshops put extra emphasis on nature when reviewing and building on the Deconstructing Disaster workshop data.

4.4 Discussion and Conclusion

4.4.1 Value tensions affecting Australia's ability to successfully live with catastrophic disasters

The differences between the aspirational principles for living with disasters (Section 4.3.1) and the actual state of things of value and how people choose to manage them (Table 11 and Table 12), give insights into the value tensions associated with the choices people make that, possibly inadvertently, increase or decrease vulnerability. These differences between the aspirational values of people and the actual states of these values are revealed by comparing the synthesised information in the first two columns of Table 13. The key value tensions that these differences highlight are listed in the third column of Table 13. These value tensions provide focal points for further analysis in order to understand how and why choices are being made that are leading to discrepancies between what people desire or aspire towards and what is actually manifesting in reality. Understanding these choices can then inform potential points to intervene to promote a rebalancing of values that shift the actual state of the things of value closer to their desired or aspirational states, and thus reduce vulnerability.

Table 13 Value tensions associated with vulnerability illuminated by the difference between the ideal aspirational principles for successfully living with disasters and the actual current state of the things of value

Aspirational principles for successfully living with disasters	Current states and dynamics of things of value and ways people choose to manage them	Illustrated value tensions
Strong local communities with clear goals, roles and responsibilities, and decision-making processes that are inclusive, adaptable, relevant, transparent and promote shared accountability and learning.	Special-interest communities, including dispersed and virtual ones are believed to be getting stronger at the expense of local communities. Declining capacity and willingness to put time and effort into sustaining local community as the benefits are less and less realised. Land-use planning is not widely consultative and transfers risks to those who are least able to manage it. Government services are experienced as top-down, controlling, paternalistic and unable to adapt to local and sectoral needs. Widespread decline in equity of access to services. Declining reliability of service provision due to increased vulnerability and susceptibility to disruption. Good governance is thought to be weakening, and the public trust in it is also perceived to be eroding. Low awareness and practice of continual, collective learning.	Individual interest – collective interests. Self(s) interest – interests of different other(s). Efficiency – equity, underpinned by prioritising short-term financial returns. Centralised control – distributed control (agency). Short-term considerations – long-term considerations (present – future), underpinned by low awareness of future risk. Efficiency prioritised over resilience in service provision leading to less reliable and more costly services in highly variable contexts. Central control prioritised over distributed management.

Aspirational principles for successfully living with disasters	Current states and dynamics of things of value and ways people choose to manage them	Illustrated value tensions
Societal goals promote wellbeing (prosperity, happiness, contentment and financial security) based on equity, efficiency (non-wasteful) and sustainability criteria.	Many critical services are under supplied and becoming increasingly unreliable and unaffordable to greater numbers of people. Government and business are seen to prioritise efficiency and short-term profit which reduces resilience to disruption. Government services are experienced as top-down, controlling and paternalistic. Widespread decline in equity of access to these services. Pursuit of efficiencies coupled with increased reporting requirements means fewer resources and capabilities are available which leads to declines in understanding or capacity to engage with communities. Short-term political cycle undermines incentives to tackle difficult problems. Current land-use planning practices transfer risks to those who are least able to manage it.	Efficiency – equity, underpinned by prioritising short-term financial and/or political gain for some over long-term benefit to society. Efficiency prioritised over resilience (which was often viewed in simple terms as wasteful over-capacity or 'gold plating' during times of stability) in service provision leading to less reliable and more costly services in the event of more frequent disruptions.

Aspirational principles for successfully living with disasters	Current states and dynamics of things of value and ways people choose to manage them	Illustrated value tensions
Adaptability in disaster preparedness and response efforts is promoted based on (informed by) continual lifelong learning, self-reliance and self-agency, and supportive institutions.	Preparedness is a low priority and people have previously been bailed out. Declining capacity and willingness to put time and effort into sustaining local community as the benefits are less and less realised and individuals have more demands on their time or money leaving less for investing in community. Many critical services are under supplied and becoming increasingly unreliable and unaffordable to greater numbers of people. Government services are experienced as top-down, controlling and paternalistic. Pursuit of efficiencies coupled with increased reporting requirements means fewer resources and capabilities are available which leads to declines in understanding or capacity to engage with communities. Land-use planning and building practices allow unsafe development in areas with high exposure to extreme natural hazards e.g. flooding, bushfire. Information is not being released or being delayed because of institutional risk aversion, leading to inequitable access to information. Low awareness and practice of continual, collective learning.	Present – future. Self(s) – other(s). Centralised control – distributed control (agency). Efficiency – equity, mediated by prioritising short-term financial returns. Ideal of cohesive community is sacrificed as limited time and money is invested in other priorities. Information as an enabler of adaptability – as a source of liability or a lower priority use of time. Doing to achieve an outcome – enabling learning about the doing process or world.

Aspirational principles for successfully living with disasters	Current states and dynamics of things of value and ways people choose to manage them	Illustrated value tensions
Knowledge, innovation and information sharing about risks, trade-offs, and returns are promoted and enabled.	Declining capacity and willingness to put time and effort into sustaining local community as the benefits are less and less realised reduces local collective learning. Information overload, with limited capacity to derive intelligence and actionable advice. Information is not being released or being delayed because of institutional risk aversion, leading to inequitable access to information. Trade-offs are made between information quality and timeliness. Politics of climate change. Variability in media credibility and independence.	Information and knowledge sharing as enablers of adaptability – as a source of liability or a lower priority use of time.
Healthy natural environments are protected to promote connectivity between people and between people and nature.	Declining capacity and willingness to put time and effort into sustaining local community as the benefits are less and less realised reduces local collective learning about living safely with nature. Increasing disconnection from and low awareness of nature. Failure to learn from Aboriginal and Torres Strait Islander peoples. Land-use planning and building practices allow unsafe development in areas with high exposure to extreme natural hazards e.g. flooding, bushfire.	Value tensions for those who want to live close to nature and yet also value the safety and security of home and family. Ideal of healthy environment and people-nature connections is sacrificed as people's limited time and money are invested in other priorities Tension between valuing nature and perceiving nature as a threat. Tension between valuing nature for its aesthetic and amenity values and for the services it provides and valuing nature as a source of resources. Tension between valuing nature and valuing other land uses.
Diverse cultural identities and world views are respected and nurtured.	Special-interest communities, including dispersed and virtual ones, are believed to be getting stronger at the expense of local communities. Declining capacity and willingness to put time and effort into sustaining local community as the benefits are less and less realised. Variability in media credibility and independence.	Individual interest – collective interests. Self(s) interest – interests of different other(s).

Aspirational principles for successfully living with disasters	Current states and dynamics of things of value and ways people choose to manage them	Illustrated value tensions
Authentic and ethical leadership is practised and rewarded across all sectors of Australian society.	Good governance was thought to be weakening, and the public trust in it was also eroding. Quality of leadership is variable and in political arena generally low. People in positions of leadership (political, government agencies and business) often work hard to maintain current structures of governance as current incumbents benefit from maintaining the power and resources in the current system. Short-term political cycle undermines incentives to tackle difficult problems.	Leadership is valued for different ends by those in power and those who are dependent on it. Individual interest – collective interests. Self(s) interest – interests of different other(s)

A key finding clearly illustrated in Table 13 is that in times of disaster people come to value things differently, by changing how they value familiar things or seeing value in things they had not previously recognised. This is particularly well demonstrated where the effectiveness of community responses and recovery depends on community connectedness (which underpins a community's capacity to self-organise and be temporarily self-sufficient) but which isn't invested in sufficiently during periods of stability. Another example of this is the need for multiple sources of critical services and supplies that provide back-up capacity and resilience (self-sufficiency) in the face of disruption (sometimes referred to as 'redundancy') rather than a single centralised source. Urban development of land in flood-prone areas in times of stability is another example where the future uncertain risks and costs of disaster are given less attention or priority compared with fulfilling other 'more urgent' values of affordable housing. The more the values considered important for successfully living with disasters are overlooked or deprioritised, the greater the risk these things face in disaster and the more vulnerable society is to catastrophe.

Thus, there are tensions between the attributes of things people value in times of stability and those that underpin resilience in the face of disaster. This suggests that the way we currently make choices based on the things we value in stable times is the root cause of society's vulnerability to disaster. These choices are made across the whole of society, reflecting broadly shared values. However, the ways people value things and make decisions are shaped disproportionately by certain segments of society with more influence and decision-making power, such as planners, people setting standards, design professionals, the media, corporations and their marketers and politicians. In addition, the impacts of vulnerability are not evenly felt; the greatest impacts are on people directly in harm's way and especially those who are already disadvantaged. Notably, in many situations there is a decoupling between those with who are disproportionately affected and those with greater influence of the societal decisions shaping vulnerability.

Nine value tensions, in various combinations, consistently differentiate the aspirational principles for living with disaster from the current behaviours and states of things of value (

Table 13; Figure 20).

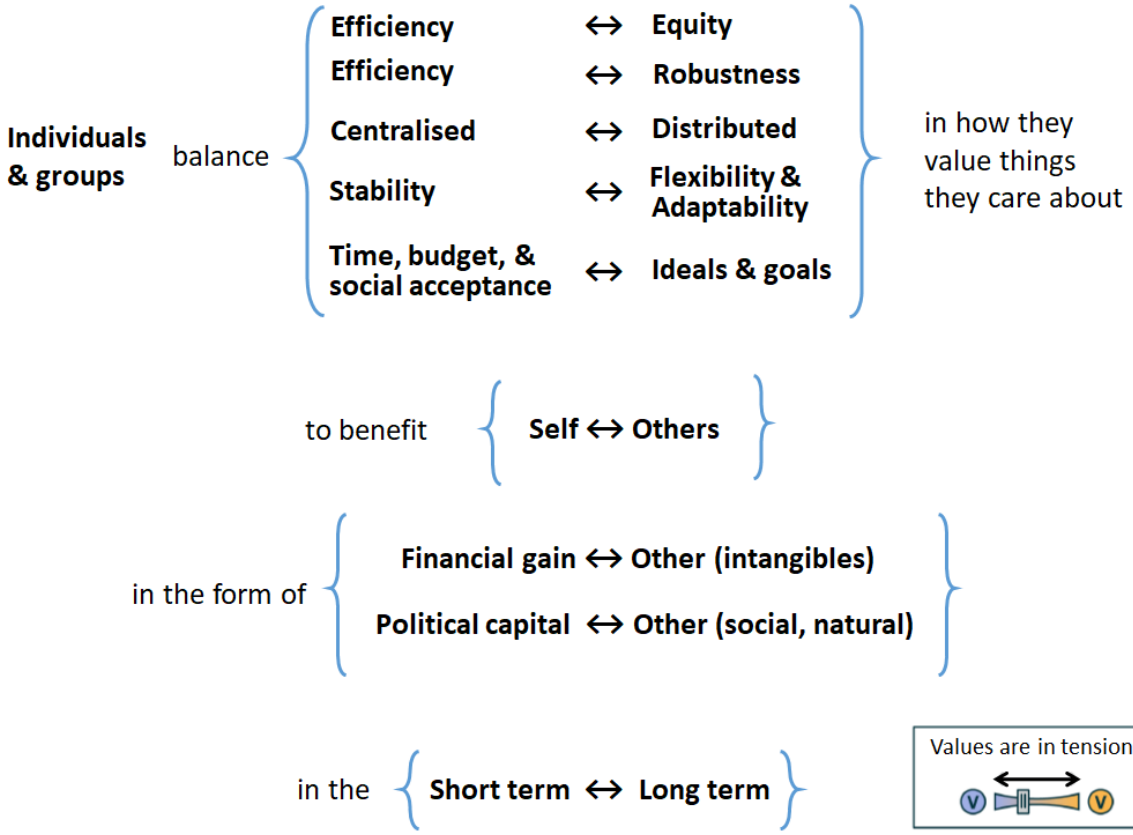


Figure 20 Value tensions that exist within and between individuals and groups that play out in every day decision but fundamentally shape the vulnerability of society to natural hazard events.
Broadly speaking, values on the left are favoured in times of stability and lead to decisions that create vulnerability, the ones on the right would lead to decisions that confer resilience in the face of disaster

These tensions manifest in how:

- a particular thing is valued
- different things are valued
- different individuals or groups value things (Figure 17).

Efficiency – Equity: When efficiency is a predominant criterion for valuing services, they tend to be centralised, which prioritises reduced cost over tailoring of the service, disadvantaging those with specific needs. When the thing is damaged, those who are best resourced are most able to fend for themselves while the already disadvantaged suffer more.

Efficiency – Robustness: Costs can be lowered by optimising process for the current conditions. However, in the face of uncertainty continuity of service requires processes that perform satisfactorily across the full spectrum of possible futures (i.e. robust strategies). Robust strategies are often less efficient.

Centralised – Distributed: Applies in particular to management of critical infrastructure and the services it provides, as well as government services and the rules governing their provision. Centralisation enables standardisation, efficiency, upwards accountability and control, whereas distributed delivery enables tailoring to local requirements, accountability to users.

Stability – Flexibility and Adaptability: Stability of the states of many things and systems that people rely on is highly desirable in the short term. However, adaptability is highly desirable in times of disaster.

Time, budget and social acceptance – Goals and Ideals: Most people are constrained by limited amounts of time or money and therefore prioritise a subset of their goals and ideals to pursue. Cultural practices and expectations also need to be considered when balancing which goals to pursue.

Financial and Political capital – Other (social, natural capital) outcomes: This tension plays out in everyday decisions, but it also reflects the pervasive influences of power in society where financial and political returns to select groups are prioritised over widespread enjoyment of social and environmental outcomes.

Self – Others: reflects the tension between taking care of oneself or one's group or considering other individuals and different groups. It embodies the tension between individualism and collectivism, and between 'tribes'.

Short term – Long term: reflects the tension between capturing a benefit in the short term and acting to improve a longer-term outcome. Focus on the short term is underpinned by lack of awareness of increasing risks of natural hazards, and discounts any awareness of such risks. In particular, it enables profit from activities that create future risk to be transferred to others.

As noted previously, the detailed workshop deliberations mainly focused on the professional interests of the workshop participants, and relatively little attention was given to how individuals and society value nature, hence it does not feature strongly in the tensions. However, if one considers nature as representing one instance of how people value land or places, then it can be read into the 'syntax of tensions' in Figure 20. For example, people who want to live close to nature might play out the tensions of **Stability – Flexibility, Short term – Long term** and **Financial – Other;** and people choosing between stewarding nature and other extractive land uses may play out tensions of **Financial – Other**, **Self – Others** and **Short term – Long term.**

4.5 Key messages

The first four key messages relate to Research Question 1: *What do we value, and what do we stand to lose in disaster?*

Key message 1: What people value, and might lose, can be understood by systematically analysing the relationships that people have with things of value.

People value a vast array of things including physical things, other people and experiences. The value of these things is realised through the diversity of relationships people, individually and collectively, have with them. The relationships often depend on specific attributes of the things, and the relationships satisfy a diversity of motivations or held values within people. The relationships people have with different things are dependent on context; in different situations different things or attributes are important, and different motivations come into play. An important aspect of context is the degree to which things are the subject of everyday consideration, visibly changing or under immediate threat. Furthermore, people are different, both in their held values and their context, and so can value things in different ways and vary in the attributes they find important. The community, government and the private sector represent three broad classes of people with quite different motivations and relationships to things; those who are disadvantaged or marginalised and those with more economic or decision-making power are other categories of people who are important in the story of loss, vulnerability and its causes.

Key message 2: People value things differently in stable times and in the face of disaster.

The workshops identified that, while many of the things people value are important both in times of relative stability and in the face of disaster, there are a range of things that are possibly taken for granted most of the time but whose value is revealed in times of disaster. These include things that are directly damaged or lost during disaster such as houses, mementos, capital, people and services, and amenity

associated with these things, but also sense of security, safety, harmony (lack of trauma), normalcy and self-efficacy. Losses may be to the individual or shared through personal or community connections. Understanding how the relative importance of things of value changes can help inform preparation and response actions to more effectively reduce losses and suffering.

Key message 3: People value the processes in society that keep them safe, and prospering.

There is another class of things whose value is revealed during disaster: those processes and capacities that have the ability to reduce vulnerability during stable times and to enable coping and recovery during and after disaster. An example is the diffuse system of processes that govern the location and construction of housing and infrastructure, and specifically the ability of that system to reduce known vulnerabilities. Another example is the ability of service providers, public, community and private, to deliver tailored responses that address the specific needs of affected people, as opposed to focusing on aggregated economic costs. More fundamental examples include societal norms, business practices and economic policies that could reduce the extent to which the burden of vulnerability is borne by individuals and communities separate from those who profit economically or politically through the processes that create and transfer risk. Recognition that these systems have failed to reduce vulnerability leads to loss of trust and confidence in governments, businesses and even society.

Key message 4: People value resilience, and believe that it has been declining.

Resilience in the face of floods, fire or cyclones is often held as a defining Australian characteristic. However, the workshops clearly revealed it is not a given, especially in a rapidly changing Australia. It can readily be eroded by greater focus on cost reduction, near-term outcomes, and increased mobility placing people in unfamiliar situations and communities. At an individual or community level, the capacity to cope, be self-sufficient and self-organise recovery efforts is a thing to be recognised, understood and fostered; there are clear roles for individuals, communities, businesses and government. Lack of these capacities is a loss in itself, but cascades to other losses such as a broader undermining of community cohesion, confidence, hope and agency. Although resilience in communities to anticipatable events was recognised as being important (and requires effort from government, non-government and industry sectors as well as community to build), an additional insight from the workshops was that even in well-prepared communities there are limits to this resilience in the face of severe to catastrophic disasters. In these circumstances, business, governments and non-government organisations play a critical role in providing a level of resilience to unexpected or unprecedented events.

The next three key messages provide partial responses to Research Question 2: *What makes Australia vulnerable to catastrophic disaster?*

Key message 5: Vulnerability to disaster is created by the choices, decisions and trade-offs people make in times of relative stability.

When choices are made based on the things people value in stable times without due consideration for the things that people value in times of disaster, future loss and suffering during and after a disaster are locked in. Most people are unaware of these considerations and have little agency to make decisions to change things should they wish to. Some of these decisions are relatively clear, such as choosing cheaper housing that is on a floodplain, choosing to live in the bush despite the fire risk, or choosing to live right on the sea front despite the risk from storms. In these cases, a household favouring cost and amenity leads to increased vulnerability for themselves. This may be a conscious choice (even gamble) for some, but for many, particularly the less well off, their only choice is the least-cost option which may well be more exposed to natural hazard events. In other cases the trade-offs are less direct. For example, the pervasive demand for lower prices, higher near-term profits and streamlined regulatory processes trades off against

the resilience of supply chains and service delivery. These trade-offs, however, are far from clear to consumers in supermarkets or government procurement officers.

Key message 6: The decisions that create vulnerability, and the trade-offs they embody, are made throughout the system, making it hard for individuals to readily reduce their vulnerability.

In the cases above, and in most cases, there are numerous decisions made by other people that shape an individual's decisions and strongly influence vulnerability. These decisions and the value trade-offs they embody are largely hidden from consumers and citizens, and most individuals have almost no capacity to interact with these decisions in a way that would reduce their vulnerability. For example, home purchasers or builders might be ignorant of vulnerability to natural hazard events, or they could legitimately assume that processes of zoning, building design, building approval, construction standards, construction, due diligence of their lender and insurer, and the sensibility of their neighbours have conservatively factored in consideration of possible disaster. Even if these other processes had considered possible disaster risks, the home purchaser would not be cognisant that the risks (to them) had been balanced (by others) against a range of powerful competing values that are immediate, familiar and lauded by society (e.g. large, cheap housing; economic returns from land development). And any such consideration is very unlikely to have included natural hazard events that are unprecedented in magnitude or type. This systematic nature of the creation and transfer of vulnerability, in multiple sectors of the economy and society, is explored in detail in the following chapter.

Key message 7: Some groups in society have disproportionate power to increase or reduce vulnerability to disaster, while others are disproportionately vulnerable.

The choices made across society affecting vulnerability often reflect broadly shared values and the constraints of prevailing rules and knowledge. However, some groups in society have disproportionate influence over the trade-offs between enjoying life in stable times and being resilient to disasters, and between who might benefit and who bears the risks of disaster. This results directly from the nature of the highly influential decisions they make with the priorities they embed. For example, the choices between maximum returns and equity, or between efficiency and robustness in the design, location and pricing of critical infrastructure and community services fundamentally determine the distribution of benefits and vulnerabilities across individuals and between the present and future.

The disproportionate influence over the trade-offs driving vulnerability also results more subtly but more pervasively through the rules and processes, created by those with authority and influence, that shape the trade-offs inherent in the everyday decisions made throughout Australia, such as financial policy, land-use planning, building codes, taxation policy, and the information that they provide, for example marketing by businesses and suasion by governments.

While disasters can cause suffering and loss for anyone in their path, some groups in society are particularly vulnerable. Multiple forms of disadvantage can lead people to be more likely to be in harm's way, less aware of disasters, less prepared and able to respond in ways that reduce loss, less able to access emergency services, less able to recover independently, and less able to access recovery services, especially services that meet their specific needs. Again, the choices made every day in Australia, by those with political and financial power, and by everyone, shape the distribution of disadvantage that causes vulnerability.

5 ‘Typical system patterns’ to diagnose vulnerabilities and key points of intervention, and generalise the learning

Authorship: Deborah O’Connell, Nicky Grigg, Seona Meharg, Jacqui Meyers, Michael Dunlop, Rachel Williams, Russell Wise, Veronica Doerr, Jill Edwards.

5.1 Introduction

A major objective of the Australian Vulnerability Profile (‘the Profile’) was to take a more systemic view of disasters, vulnerability and resilience, moving beyond the siloed approaches that currently prevail.

The systems-based methodology introduced in the Deconstructing Disaster workshops (Chapter 3) was used to elicit and explore the many perspectives of the system held among workshop participants. The diagrams themselves are not useful as a communication device or as comprehensive descriptions of the system. Rather, they are useful as representations of complexity, and ways to distil this down to a boundary object which people are able to interact with. They are also useful as a diagnostic for communicated postulated cause-effect links and system feedbacks and therefore for identifying key points of intervention in a highly dynamic system. The structure of the cause-effect diagrams used in the workshop lends itself to taking the next steps in interpreting system dynamics with a view to designing and testing system interventions.

System dynamics uses the concept of ‘system archetypes’ to show typical patterns of behaviour, including positive (reinforcing or amplifying) and negative (balancing or dampening) feedback loops, which are universal across different systems (Kim, 1992). Each systems archetype has a specific identifiable structure, patterns of behaviour over time, intervention points and story lines. They are quite simple diagrams with few variables, and have simple labels such as ‘Fixes that Fail’, ‘Limits to Success’, and ‘Tragedy of the Commons’. Once someone is familiar with these archetypes, it makes it easier to spot these recurring patterns and intervention points in ways which are applicable across a wide range of organisations or situations.

The concept of system archetypes was used in a slightly different application in this project to distil the many diagrams developed at the workshops, into a finite set of ‘typical systems patterns’. These are more complicated, and not as well tested as what is commonly considered to be a true system archetype.

In this context, typical system patterns (of cause, effect, feedbacks and dynamics) are those that may occur regardless of:

- Type of disaster
- Location or timing of disaster.

These typical system patterns help to highlight the systemic structures that lead to common, highly likely or inevitable outcomes independent of the type of disaster or the geographic location. Therefore, they describe system dynamics in a way in which the learnings can be transferred to other places or contexts. This is the basis for the typical system pattern being judged to be of ‘national-level significance’.

5.2 Methods

5.2.1 Criteria for typical system patterns

Potential typical system patterns were selected based on the following criteria:

- Applicable across multiple types of systems, disaster types, locations
- Provide:
  - recognition and diagnosis of key feedbacks
  - insight into vulnerabilities and intervention points
- Could be drawn from the workshop process, or from literature or other types of experiential knowledge
  - May include those that are specific to hazards that are in the 'knowable' realm, where there is plenty of experience, knowledge, evidence and data about the biophysical basis (e.g. food supply chains, energy, etc.)
  - May include those that draw attention to human emotional and ethical qualities, and their role in disaster preparedness, response and recovery (e.g. capacities for forgiveness, truthfulness, humility, compassion, learning, and acceptance of limitations).

The data and evidence for these narratives were drawn from workshops, follow-up discussions, literature reviews and synthesis by the authors.

5.2.2 Generating the typical systems patterns from workshops and literature

Approximately 60 individual systems diagrams were developed during the Deconstructing Disaster workshops with stakeholders and the Partnership Team. These diagrams, and the various text narratives and discussions associated with them, represented a considerable breadth and depth of knowledge and experience of the workshop participants and Partnership Team. As discussed in Chapter 3, the full set of diagrams and the rich descriptions are not provided in this report, but many of them were provided back to workshop participants in order to check the capture and synthesis of discussions by table facilitators. This set of 'raw' data represented the views of the participants, was not cross-checked with peer-reviewed literature, and did not represent the views of any particular organisation.

The outputs from the Deconstructing Disaster workshops were distilled into a subset of diagrams, which were put to two separate face-to-face Partnership Team workshops at different stages of the project. The Partnership Team reviewed, critiqued and supplemented the workshop outputs and the first round of analyses and synthesis that had been done by the Co-Design Team. The set of diagrams with an intermediate level of processing (see Figure 21) and their lineage that was put to the Partnership Team is shown in

Table 14. Their critique, comments, additions and modification of this set went into the final round of delineation of typical systems patterns.

Table 14 Provenance of the central issues and workshop diagrams as source material for typical system patterns

Workshop	Central issues addressed in Deconstructing Disaster workshops	Diagrams
Adelaide 2–3 Nov 2017	Political/governance stability	Leadership including the media
		Stability and integrity of governance
	Energy and communication	Reliable and affordable energy
		Energy distribution networks
		Effectiveness of communication for people with a disability
	Community preparedness	Level of preparedness – Community
		Access to Information
	Land-use planning	Land-use planning
	Education and learning practices	Learning practices (undesired state)
		Learning practices (desired state)
	Community cohesion	Prevalence of 'Community'
Brisbane 8–9 Nov 2017	Health services	Access to, and demand for, quality health services
		Digital operation of health services (every day)
		Digital operation of health services (during disaster)
	Knowledge and communication	Availability of information
		Capacity to make informed decisions and to act
		Capacity of information providers to analyse and communicate information
		Capacity of communications infrastructure
	Legacy decisions	Built environment risks carried by residents (1) – transfer of risk
		Built environment risks carried by residents (2) – fiscal efficiency makes us brittle
		Legacy built environment, vulnerability and loss – the stories we don't tell
	Emergency response	Emergency management and response [1] – siloing
		Emergency management and response [2]
		Emergency management and response [3] – vulnerability synthesis
	Land-use planning	Where we place communities and infrastructure
	Critical infrastructure – water	Water supply and quality
Perth 27–28 Feb 2018	Single versus redundant (i.e. multiple) sources of supply of critical services	Redundancy (or back-up capacity) in supply routes and sources
	Interdependency of critical services	Interconnected essentials for people to function and survive

Workshop	Central issues addressed in Deconstructing Disaster workshops	Diagrams
	Marginalised/disadvantaged people	Capacity of marginalised or disadvantaged individuals and groups
	Role of remoteness and diversity of local values in emergency response and recovery	Meeting and respecting diverse remote community needs during recovery
	Community connectedness	Ability of community to self-organise to effectively respond to novel events
	Complementary role of business and government	Interconnections: economy, reliance on a central city and public/private
Other	Capacity to care	Capacity to help (vicious cycle)
		Capacity to help (virtuous cycle)
	Cycle of blame	Legalistic and adversarial inquiry processes
	Critical services – food	Availability of fresh food
	Placement of community, infrastructure and assets	Where we place or have placed our communities, infrastructure and assets

The CSIRO team worked with all of the final sets of diagrams from the Deconstructing Disaster workshops and the Partnership Team workshops. A detailed process of pairwise and multiway comparisons between diagrams and their components – adding, subtracting, grouping and regrouping, resetting boundaries and scope and level of detail in order to find the minimum, parsimonious set of diagrams that represented the most important patterns as a synthesised set (Proust and Newell, 2012) was undertaken. As shown in Figure 21, the many diagrams produced during the workshops were gradually reduced to a generalisable set of typical system patterns with clearly articulated central issues, neutral narratives, causes and effects and key feedbacks. The content of each typical system pattern was checked against, and supplemented with, other sources of information, for example expert opinions and scientific literature. The system patterns are not fully comprehensive nor widely tested but form a useful basis from which to explore further (for example see section 5.4.2. for how they could be used to design interventions to address vulnerabilities).

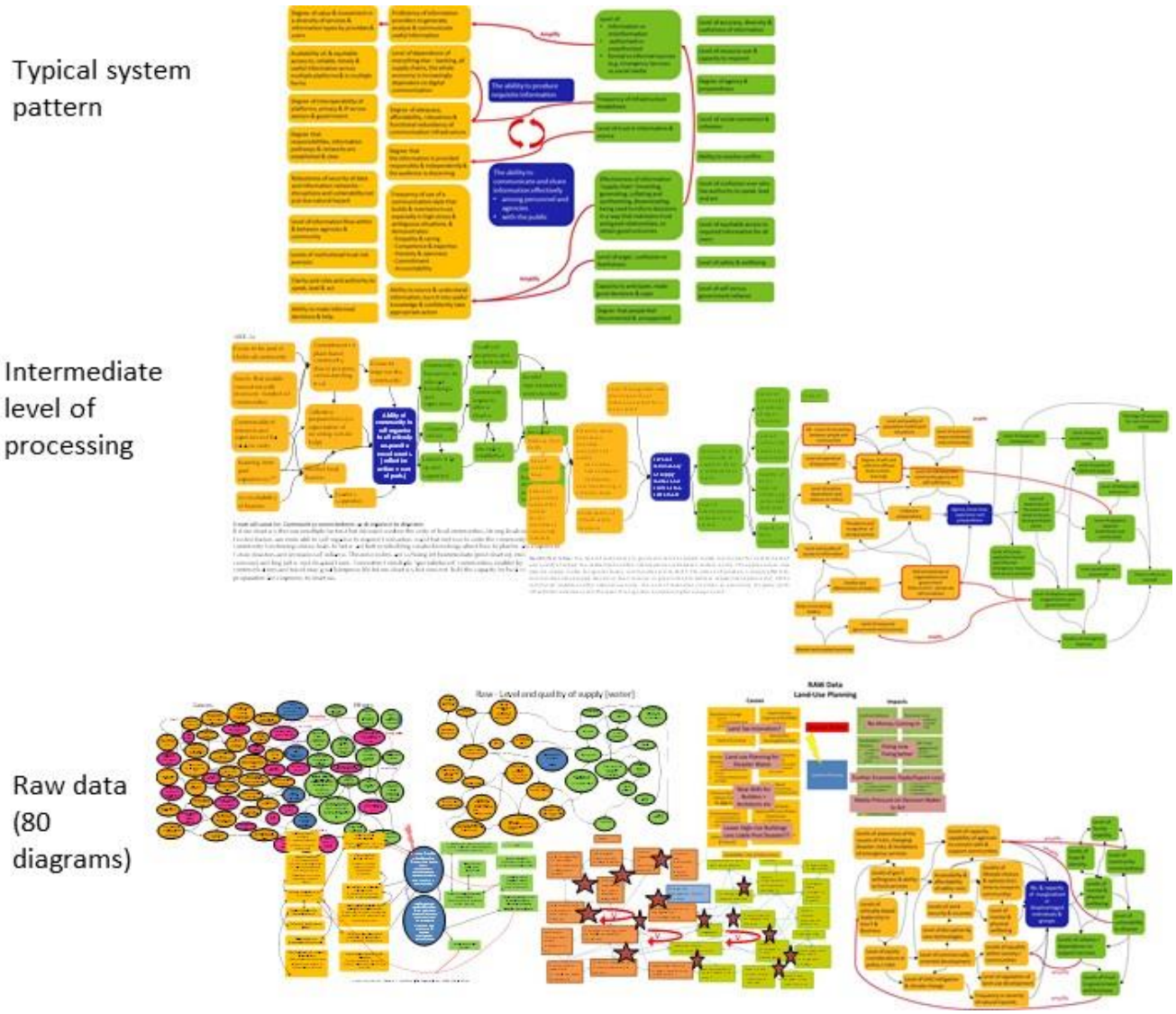


Figure 21 The raw diagrams from workshops were processed iteratively, and discussed by the Partnership Team and Co-Design Team, gradually distilled to typical systems patterns

5.2.3 The role of perceptions and mental models vs testable biophysical models

The typical system patterns are based on qualitative cause-effect models. Some of these chains of cause and effect take place via physical processes that are quantifiable, at least in principle, e.g. material and energy flows interacting with infrastructure. Others are causes and effects of human behaviours and social constructs (e.g. money, principles, communication processes, beliefs and expectations), which are less easy to quantify and measure. The evidence for each of these is shown in

Table 15.

Table 15 Different qualitative and quantitative 'lenses' on important system dynamics

	What does evidence look like, and why is it important?	Models based on the perceptions of how the system works
Provisioning systems which can be measured and quantified as on-ground outcomes	(1) E.g. biophysical models of supply chains for food, water, electricity. • Evidence can include measurable physical and economic data or projections. • Important where possible to base decisions on the best representation of reality where possible.	(2) E.g. people's mental model of how supply chains work • Important for decision makers to understand how people THINK the system works, even if it doesn't match biophysical reality, because the belief about how the system works determines their behaviour which in turn can be a critical system driver.
Behavioural or social processes which determine on-ground outcomes	(3) E.g. models of community cohesion, education and learning practice, dynamics of trust and mutual accountability • Qualitative evidence can be produced through social science methods, application of critical thinking and logic and academic rigour • Sometimes 'surrogate' or proxy indicators • Important to approach in a systematic manner using social science methodologies.	(4) E.g. models of community cohesion, education and learning practice, dynamics of trust and mutual accountability • Important for decision makers to understand how people THINK the system works, even if it doesn't match biophysical reality, because the belief about how the system works determines their behaviour which in turn can be a critical system driver.

In this project, the typical system patterns are developed based on all four of the quadrants, with a mix of:

- those based on distillation of peer-reviewed papers which, in turn, may be based on biophysically rigorous models; or theories in the scientific literature
- those which build on and reshape data gathered in the workshops and are therefore based on the mental models or perceptions of how stakeholders think the system works.

There has been a limited attempt to rigorously compare and check systematically any differences between the mental models i.e. between the categories in (1) and (2), or (3) and (4). This is an area of work which could be usefully expanded in future phases of the project.

Different stakeholders are likely to evaluate the credibility and legitimacy of information according to situational factors like past experience with the individuals and groups generating the information, whether it is conveyed in language they can understand, and who they perceive may win or lose if the information is believed (Cash et al., 2003 cited in Brugnach and Ingram (2012)). As discussed in Chapter 2, different types of knowledge are relevant in co-production processes, and what is known or not known about a system is not limited to scientific facts or expert opinions – experiential knowledge can outweigh scientific understandings in decision making (Brugnach and Ingram, 2012). In contrast to factual scientific knowledge, this knowledge is tacit and it is not explicitly expressed except through practices – as expressed by Brugnach and Ingram (2012):

These differences in how knowledge is produced also influence how knowledge is defined. In contemporary knowledge production processes, knowledge is conceived as an abstract body of statements (e.g. factual scientific data) that objectively represents reality. Other types or forms of knowledge are undermined or only considered when conforming to scientific standards. Differently, in the proposed co-production processes knowledge is rooted in action, procedures, routines, commitments, ideals, values and emotions of people, and as such it is inseparable from social practices. So, in addition to explicit content, there is a tacit element to knowledge that is manifested through relationships. This way of conceiving knowledge also requires a different way of coping with ambiguity, one that can include the diversity of meanings and interpretations that actors can bring.

5.3 Results

5.3.1 Typical systems patterns

For each typical systems pattern, a cause-effect diagram and simple neutral narrative was developed, along with a tabulated description of the cause and effect variables. This diagram was used to diagnose a summary of the key vulnerabilities. One example is provided in this results section (see section 5.3.1) and the full set is described in Appendix Typical System Patterns.

The diagrams represent the foundations of influence diagrams representing the flows of cause and effect in a system. The arrows linking boxes describing causes and effects that were used in workshops have not been added to the typical system patterns. The boxes have multiple connections to one another, making for very complex diagrams that are confusing and difficult to interpret. By providing boxes only, and some key reinforcing or amplifying feedbacks, the intention is to convey the rich set of causes and effects involved, and the reader is encouraged to identify the system connections that are consistent with their knowledge and experience. As a general rule, the boxes are organised approximately so that the flow of cause (orange boxes) to effect (green boxes) is from left to right, however boxes connected in multiple directions.

5.3.2 Typical system pattern example: Health and capacity to care

The central issues

The central issues for health and capacity to care are: access to and quality of health services compared to the demand for health services; and the capacity for informal help and care outside of the formal provision of medical services. Formal medical services are provided by government and the private sector in Australia, with a strong (relative to many other countries) safety net for healthcare in the form of Medicare as well as private health insurance.

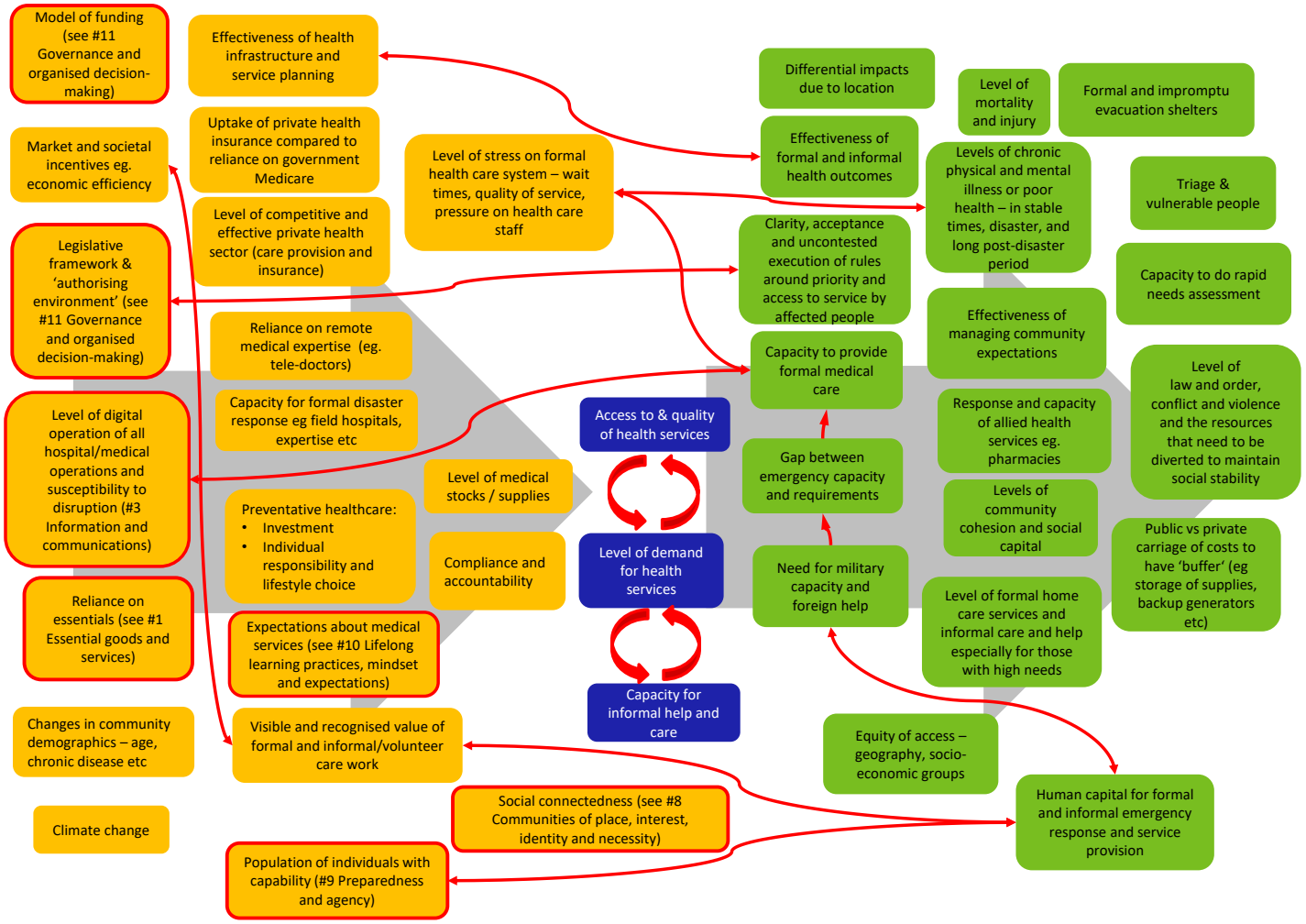


Figure 22 Cause-effect diagram for the typical system pattern 'Health and capacity to care'.
The boxes are all multiply connected to one another (not shown). Some key reinforcing or amplifying feedback links are shown. As a general rule, the boxes are organised so that the flow of cause (orange boxes) to effect (green boxes) is from left to right as shown by the background arrows.

In times of stability

In times of relative stability, the function of the formal health care system is dependent upon elements of many other typical system patterns including funding and decision-making processes, and effective legislative frameworks and authorising environments. The system is dependent on critical goods and services (food, water, waste management, energy) and is increasingly dependent upon digital information and communications which manage almost every aspect of the formal health care system including staffing, facilities, infrastructure and patients.

In times of stability, injury and mortality rates in Australia are relatively low and decreasing (AIHW, 2018b), and life span is generally high and increasing (AIHW, 2018a) – people live longer, with the potential for more diseases. Currently, the health system in Australia can meet most demand, but wait times for surgery are high, with 50% of patients on public hospital waiting lists admitted within 38 days and 90% within 258 days in 2016–17 (AIHW, 2017) The formal system is already stressed and there are many overworked doctors, nurses and other carers.

Changing demographics – especially an ageing population, and one with lifestyles and diets that exacerbate chronic illness such as diabetes – are expected to drive a large change to the overall demand for, and type and cost of health care in its many forms (AIHW, 2016). These characteristics are not evenly distributed across demographic groups – there is a strong influence of geographic location, and socio-economic status – those in poverty have a shorter lifespan, and often higher demand for health services. Climate change is also expected to drive different disease vectors and conditions even outside of disaster scenarios.

Preventative health care is becoming more important in order to take the stress off medical systems, but does not receive the same level of attention or investment of time and resources by government, business or individuals.

Formal and informal care provision of the elderly, or chronically ill or people with special needs by low paid, unpaid or volunteer carers is a critically important and under-recognised component of the system (Deloitte Access Economics, 2015). It is generally less visible and can fall disproportionately to some sections of the population – low paid workers and women.

The choices and trade-offs during stable times

There are many choices and trade-offs throughout the provision of health services and informal care. Increasing demands on the system places budgetary pressure throughout the public and private systems of provision and insurance, and leads towards strong drive for economic efficiency. When combined with new technologies, there is increasing reliance on digital systems for every aspect of formal health care provision, and while this increases efficiency and access, it also creates susceptibility for major disruption from natural hazards, energy or communications interruptions, or malicious interference. There are particular trade-offs relevant to rural and remote Australia where the relatively high cost of provision of local services for low populations means that there is increasing need to travel to capital cities or regional centres to access services, and increasing reliance on remote medical expertise (National Rural Health Alliance, 2016).

Given the long-term stresses which are widening the gap between supply, equitable access to and demand for medical services, there are some strong complementarities in reducing demand on formal health care services by increased preventative health strategies, and by individuals making healthy lifestyle choices. There are benefits as well as trade-offs between increasing capacity of informal mechanisms of providing health care – for example community-based care. Higher levels of community-based care can reduce demand on the formal care system, and can be beneficial for those needing care. Caring for others is a fundamental aspect of being human, but carers also need to care for themselves to be able to care for others. If caring work is not valued highly by the market and falls disproportionally to unpaid or lowly paid people, these carers are at a systemic disadvantage and face disincentives for caring work relative to other

activities. In times of disaster, such carers are doubly vulnerable if they feel bound to continue their caring responsibilities and yet their lower financial security gives them access to fewer options for disaster response and recovery.

Furthermore, the tasks of caring for others, especially unpaid work, are not evenly spread across communities and fall disproportionately to women, setting up gender-specific vulnerabilities to natural hazards. So if the consequences of increasing natural hazards aren't factored into the ways that choices are constrained or enabled, individual self-interest may take precedence at the expense of the capacities to care for one another that will ultimately be needed when natural hazards strike.

In a disaster

A catastrophic disaster (whether caused by natural hazards, a pandemic or other crises) would have immediate impacts on injury and mortality based on proximity to the disaster, cutting across all socio-economic groups. The capacity to provide formal medical care would be vastly exceeded as would the capacity of essential goods and services like energy, food and water. A system of clear rules and appropriate authorising environment around priority and access to medical care would be important.

The chronically ill and disadvantaged would be differentially impacted, and second-order impacts such as infectious disease could rapidly emerge due to impacts on systems for sanitation and waste management. There would be a rapid appearance of features which are not very prominent in the current system, for example formal and impromptu evacuation shelters, field hospitals and possibly the need for military capacity and/or foreign assistance to conduct search and rescues, set up field hospitals and potentially help to maintain law and order.

The capacity to respond with informal help and care would become critically important, and the population of individuals with physical and mental capacity, skills, knowledge and willingness to help would become a vital determinant of overall capacity to cope, and health outcomes.

After a disaster, issues of long-term injury, trauma, loss and ongoing mental health issues, and increases in domestic violence can persist for many years (Norris, 2016) and the health care system would be increasingly called upon to deal with these outcomes.

Key vulnerabilities

There are key vulnerabilities related to slow stresses even in times of stability, for example:

- Level of demand for health services is increasing:
    - Changes in community demographics (e.g. ageing population, higher number of migrants), which will be in the future further exacerbated by shifts in locations of populations due to climate change and associated changes in vectors and disease distributions and type.
    - Levels of chronic illness and poor health are increasing due to lifestyle choices, diet, increasing inequality and families in poverty.
    - There are high expectations about medical services that the general population holds, combined with a relatively low level of government and industry investment in preventative health care, and a low (and socio-economically stratified) level of individual responsibility for preventative health, risk management and lifestyle choices.
- Access to and quality of supply of health services:
    - This is impacted by an increasing emphasis on economic efficiency, high levels of accountability at every level which reduces the time and energy for frontline care-givers (doctors, nurses etc.) to provide hands-on care, and budget stress in public funding.

        - Model of funding – short-term decisions and priorities drive the effectiveness of health service planning. This creates a differential effect on geographic areas and socio-economic groups. This also impacts on the effectiveness of health service planning.
    - Increasing reliance on digital operation for health services for all aspects of hospital operation including all day-to-day operations such as management of food, water, and waste; medical supplies and procedures, and patient care; staffing; budgets; communications and coordination not just in particular facilities, but across the state health care system. This is a benefit in times of stability, but makes the system susceptible to multiple forms of disruption including hacking, interruptions to the communications networks, and disasters.
    - Increasing need for informal care, which is often invisible, undervalued and falls disproportionately to women and low paid workers and volunteers. While volunteers in emergency response are trained and their roles are highly visible, care work for chronic health issues is not.
    - In a catastrophic disaster situation, the capacity to provide formal medical care would be exceeded, and the capacity to respond and provide informal care would be low, but could be strengthened, for example:
- Current lower levels of social capital (connectedness, expertise, time, willingness, and ability to coordinate and manage volunteer workers) could be improved.
- Formal rules around roles in emergencies – people are prepared to step up (e.g. vets or GPs may want to provide care) – but cannot due to existing legal frameworks.

5.3.3 Overview of the set of typical system patterns

Twelve 'typical system patterns' were identified through the processes described in the methods. These fall into two broad categories:

- Provisioning systems (e.g. food, water, energy, ecosystems, health)
- Behaviours, social capacities and social processes (e.g. capacity to care, land-use planning processes).

Simple descriptions of the typical systems patterns are:

Essential goods and services (#1): The drive for efficiency in highly interconnected supply chains can see low levels of diversity and redundancy, and a severe disruption can trigger cascading and amplifying failures, with consequences worsened if people's expectations of uninterrupted services have left them unprepared and inexperienced in coping with the loss of essential goods and services.

Health and capacity to care (#2): An emergency incident with high levels of injury and mortality risks overwhelming a system already stretched to provide routine services, with cascading public health consequences that further erode the capacity for emergency response and recovery.

Information and comms (#3): In times of disaster the pressure to make and share complex, difficult decisions with speed and accuracy drives imperatives for fail-safe, interoperable and broad-reaching communication infrastructure, and trusted, respectful communication practices that foster civil peace and support those who are suffering, however these all need to be established well before incidents occur, when there is less imperative to do so.

Placement of communities, infrastructure and assets (#4): The location and quality of housing and other infrastructure is shaped by innumerable considerations and there can be resistance to the increased costs

and complexity of planning and building practices that better account for risks from natural hazards, even though failure to do so locks in unwanted cascading consequences during emergency incidents.

Risk assessment, ownership and transfer (#6): When there are different owners, managers and insurers at different stages in an asset's life cycle, short term financial interests of transient owners and stakeholders can see a lower emphasis on long term risk awareness and associated anticipatory actions, resulting in impacts of future hazards being borne by those who have not been party to or beneficiaries of past decisions.

Legacy decisions (#7): The cumulative decisions and actions made by individuals, organisations and governments in the past constrains the options available to current and future decision-makers, creating path-dependencies that risk locking in unwanted consequences, however there many barriers to acknowledging and acting upon the deficiencies of legacy decisions.

Communities of place, interest, identity and necessity (#8): In daily life most people have considerable freedom to engage with various networks of people as, when and how they wish, however during emergency events communities of necessity are thrown together and may need to work together to secure essentials of life, care for the injured and share information and decision-making, with varying degrees of preparedness to do so.

Agency and preparedness (#9): The means and motivation to prepare and plan for hazardous events is readily displaced by other pressing demands and expectations of daily life, so eroding awareness, preparedness and agency when faced with emergency incidents.

Lifelong learning practices, mindset and expectations (#10): Formal learning in educational institutions equip students for everyday life, which in itself reflects assumptions and expectations about the future. These formal learning approaches are only a small subset of the lifelong learning practices that would more effectively support preparation for, response to and recovery from hazardous incidents.

Governance and organised decision-making (#11): Governance and decision-making can be a highly formal and structured process, or highly agile, flexible and adaptive with 'rules' that emerge from a given context (protocols developed by a community or business in response to a rapidly changing situation). Both are needed in stable times, and higher agility (or the capacity for it) is even more important in a disaster.

Leadership (#12): In times of stability, leadership structures and models in many domains have been characterised by hierarchical use of power and authority, command and control approaches to decision making and implementation, investment in positional leadership and a stronger focus on 'leading from the top'. In situations where rapid change and innovation are required, different leadership structures, styles, skills and cultures may be more useful, and informal, emergent and diverse leadership may be a more useful approach.

Nature and people (#14): Every person's wellbeing is dependent upon natural systems for the provision of goods, services and income, however nature is also a source of dangerous hazards that put lives at risk, and effective balancing of benefits and risks of our interactions with nature depends on the level of understanding of natural systems and governance processes that use that knowledge, and knowledge of the values at stake, to guide decisions.

The full set of typical system patterns developed are provided in Table 16 and are fully described in Appendix Typical System Patterns.

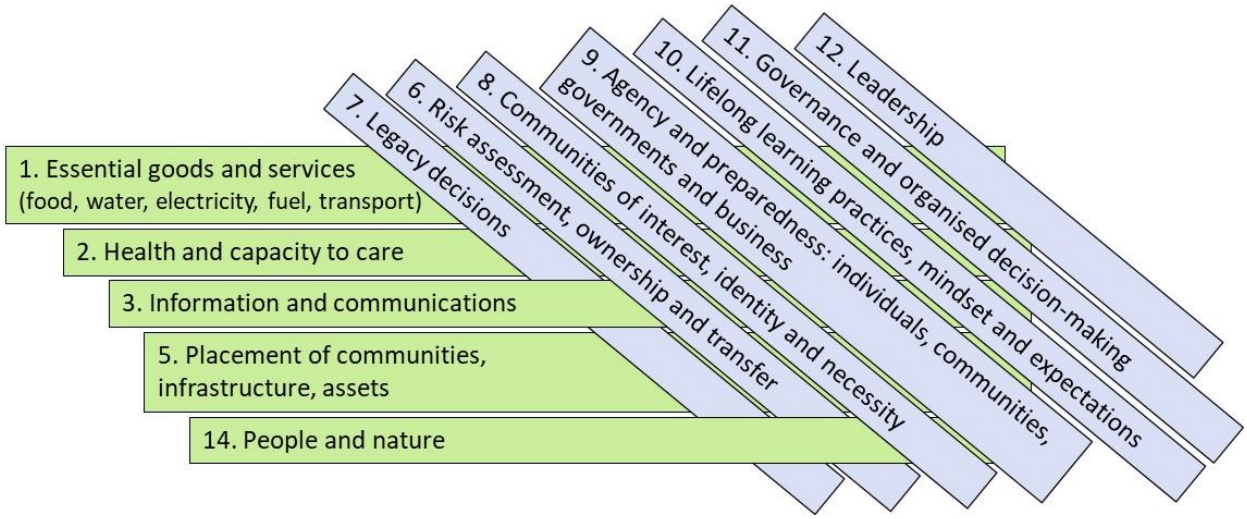


Figure 23 Different types of 'typical system patterns' – social and physical systems intersect (note, numbers were dropped as typical system patterns were merged)

Table 16 Summaries of Typical Systems Patterns. Note that while these diagrams were sufficiently robust for distinguishing different typical patterns and diagnosing vulnerabilities, they would need further development and testing before being used for other purposes

Essential goods and services (food, water, electricity, fuel, transport) (#1)
The central issues in this typical system pattern are focused around supply and demand for essential goods and services such as food, water, electricity, fuel and transport. The characteristics that are universally important across these goods and services include level of availability, affordability, quality, sufficiency, and equity of access. There are complex interdependencies across the various systems providing food, water, electricity, and fuel. These interdependencies are shaped by many influences, including market demands, supply costs, legislative requirements, environmental factors (e.g. remoteness, exposure to natural hazards, natural resource availability), and people's knowledge, values, experience, connections, habits and expectations. In times of stability, the systems in Australia that provide these goods and services are generally very effective and efficient. There are high levels of expectation about access, reliability, quality and affordability of the basics of food, water, electricity, fuel and transport. When there is a major disruption one or more of the supply chains for essential goods and services may be affected and because of the interdependency, the low levels of diversity, substitutability and redundancy (back-up capacity, e.g. stored food or fuel), these disruptions quickly cascade and amplify across all of the systems. There would be strong differential impacts of disruptions based on the location and type of hazard event, and this would be amplified by people's differing ability to cope. Social conflict and breakdown of law and order are possible when people cannot access basics such as food and water for an extended period. Although there are emergency rules for access to liquid fuel during emergencies, these are untested, and there are no rules in place for food and water.
Health and capacity to care (#2)
The central issues for health and capacity to care: access to and quality of health services compared to the demand for health services; and the capacity for informal help and care outside of the formal provision of medical services. Formal medical services are provided by government and the private sector in Australia. In times of stability, the function of the formal health care system is dependent upon elements of many other typical system patterns including funding and decision-making processes, and effective legislative frameworks and authorising environments, goods and services (food, water, waste management, energy) and digital information and communications. Preventative health care is becoming more important to take the stress off medical systems.

Formal and informal care provision of the elderly, or chronically ill or special-needs by low paid, unpaid or volunteer carers is a critically important and under-recognised component of the system.

A catastrophic disaster would have immediate impacts on injury and mortality based on proximity to the disaster, cutting across all socio-economic groups. The capacity to provide formal medical care would be vastly exceeded. A system of clear rules and appropriate authorising environment around priority and access to medical care would be important. The chronically ill and disadvantaged would be differentially impacted, and second-order impacts such as infectious disease could rapidly emerge due to impacts on systems for sanitation and waste management. There would a need for formal and impromptu evacuation shelters, field hospitals and possibly the need for military capacity and/or foreign assistance to conduct search and rescues, set up field hospitals and potentially help to maintain law and order. The capacity to respond with informal help and care would become critically important. After a disaster, issues of long-term injury, trauma, loss and ongoing mental health issues, and increases in domestic violence can persist for many years and the health care system would be increasingly called upon to deal with these outcomes.

Information and communications (#3)

There are three central issues that relate to this typical system pattern; the ability to generate the requisite data and information, the ability to communicate and share it among emergency response personnel and agencies, and the ability to communicate effectively with the public (including listening to citizens, recognising the value of their knowledge and experience). Features across the whole information and communications 'supply and demand' chain create vulnerabilities in times of high demand, high stress, ambiguous and crisis situations – these result from a complex mix of technological and human factors.

In times of stability, this typical system pattern begins with the value placed on, and the investment made by government and the private sector in the resources, people and infrastructure required to create, disseminate and communicate the requisite data and information. It requires clarity around the problems, and the skills and resources to source, generate and analyse the data and turn it into information that is timely and fit-for-purpose. Sharing of data and information among agencies requires the personnel and the systems in place to enable it, but this can be hampered by concerns about privacy, security, competitive advantage, liability, interoperability between systems and a lack of common standards. Effective communication and information flows between emergency services, support agencies and the public are dependent on having adequate communication infrastructure and skilled communicators.

Communicating clear and consistent information to the public is made complex by the diversity of people and abilities in the community, expectations that information will be available on demand, that it suits different purposes and communication preferences, relevance at multiple spatial coverages. Communicators need skills to listen to and understand the context and needs of their target audience, and deliver clear, comprehensive and consistent information about the disaster and relevant actions that people can take. During high stress and ambiguous situations, a communication style that can build trust, is credible, respectful, honest, empathetic, and can share vital knowledge quickly and calmly is beneficial.

During a disaster there is an increased need for resources, skilled personnel and functional redundancy to ensure fail-safe communications with broad coverage including remote areas, and urgent pressure to make complex, difficult decisions with speed and accuracy. This in turn relies on streamlined communication and sharing between public and private organisations. There is a heightened need for fail-safe, broad reaching communication and information technologies and media so that vital information can be passed in all directions between emergency services, support agencies and the public.

Placement of communities, infrastructure, assets (#5)

The central issues regarding communities and the infrastructure and assets upon which they rely, are a consequence of both their locations (exposure) and the standards to which the infrastructure is built (vulnerability). The choices and actions leading to the location of communities and quality standards of buildings and infrastructure are shaped not only by formal land-use planning processes, but other formal and informal planning, decision-making and communication processes reflecting individual and societal values and priorities. There are

different options for dealing with the changing risk profile in terms of forward planning of new infrastructure, buildings and assets, compared to what already exists and therefore has inherited risk from legacy decisions.

In times of stability, there is interaction between the demand for housing and infrastructure, and supply. On the supply side, Australia during recent stable times has had a steadily increasing population, as well as changing demographics – for example changing rural/city populations – and these are basic drivers of demand. The increasing demand for housing has led to high prices in many cities, and there have been recent issues with affordability, which have differential socio-economic impacts. Demand factors drive decisions about where and how communities live, the construction of buildings, assets and infrastructure. People make choices about where they live and build based on numerous considerations including affordability of land and housing, convenience, amenity and lifestyle, cost of construction, availability or proximity of jobs. These are affected by trends in the housing sector, the state of the economy, and a range of different policies of governments, banks and other financial institutions.

Factors around development and planning processes are critical. Economic frameworks in which the future is discounted, and the political will to engage in long-term land-use planning considerations are important to the way housing, assets and infrastructure are supplied. Proximity to and state of natural resources (e.g. water) to support a population is usually a consideration, but there has been insufficient consideration of risks from nature (for example development on floodplains) even in times before the current changing climate risk profile was evident. The inclusion of emergency services planning expertise in the early phases of planning is rare, and when included often there is insufficient information available.

When disasters occur, people and buildings are damaged or destroyed. There can be multiple failures, or failures of multiple assets, leading to cascading impacts, as impact in one aspect of life, sector or service flows on to others. The inherent transfer of risk, and the locked-in consequences in times of disaster, contribute to cascading impacts that worsen already catastrophic outcomes.

Risk assessment, ownership and transfer (#6)

The central issues are around the interplay between risk assessment and management (based around methods, data, information and knowledge); and risk ownership and transfer (based around values, decision-making and the sets of formal 'rules' in business and government). Many standardised approaches for risk assessment have been developed, tested and applied for identifying hazards or threats, estimating the probability of their occurrence, understanding the nature and magnitude of the consequence, designing controls or mitigations to lower the risk, and then assessing the 'residual' risk. The cycle of risk creation, ownership and transfer refers to the processes from designing and proposing, funding and approving, constructing and managing assets. Whether or not risk is formally assessed or addressed, the on-ground outcome is that the elements of risk relating to physical exposure and many aspects of vulnerability are materially created through this cycle of asset planning, approvals, ownership and transfer. It is where the risk is operationalised, and mitigations in a high-quality risk assessment process can be proposed and implemented.

Even during recent times of relative stability, the issue of risk has been given more attention as it increases due to the increasing cost of disasters. Much of the effort to date has been improved characterisation of the natural hazards, including predicting the likelihood of occurrence, the behaviour of phenomena, and the impacts. All levels of government as well as many industries in Australia have progressed to various levels of implementing these approaches in the context of emergency management and disaster resilience. The implementation of local scale, single hazard risk assessment and design of mitigation strategies is widely operational (though focused more on assessment than mitigation). This is necessary, but not sufficient – the aspects of exposure, vulnerability, and how to deal with risk in the context of low probability events with catastrophic consequence; and more complex forms of cumulative risk with non-linear interactions at wider scales and across multiple sectors and stakeholders, are critical gaps in knowledge.

In a disaster, during and in the immediate aftermath of a natural hazard event, the capacity to cope for everyone – individuals, communities, industries and governments – is in part dependent on the level of anticipation and proactive decisions taken by those bearing the risk, the scalability of emergency response capability to deal with the event, general risk awareness, implementation of the risk management and controls, agency and preparedness.

Therefore, the effectiveness of the risk assessment and mitigation processes and the ways they have been implemented through a range of institutional processes are critical.

Legacy decisions (#7)

The central issue of legacy decisions (made in the past, with a current impact) is that no single person or organisation created the situation that now exists – it was created over a long period, with lots of cumulative decisions and actions by many individuals, organisations and governments. The ways forward are constrained by the pathways to this point (called path dependencies). These pathways have locked in more constrained sets of options – which in turn become further constrained and costlier in terms of human suffering, environmental decline and economic costs – the longer necessary changes are deferred.

In times of stability, a range of 'rules' exist to codify, simplify, or provide common 'guidelines' for society at large. These 'rules' can take many forms – from laws and policies and regulations from government, to incentives, consultation processes, business plans, codes of conduct, building and planning codes and processes. In this way, the scope of choices made by individuals is dramatically shaped by the actions of businesses and governments, communities or societies, and by history. There are many, many layers and mechanisms for different rules, and therefore many unintended consequences in terms of choices and actions that are made. These are complex to understand and will be challenging to resolve.

Several barriers prevent unwanted, unintended consequences of past decisions from being acknowledged and acted upon in times of stability. The unintended consequences are not necessarily being felt, and the benefits of past decisions are still being realised. Furthermore, depending on risk governance processes, the beneficiaries of past decisions may or may not have to experience unwanted unintended consequences. The appetite and courage to talk about anticipated unwanted consequences can be low, particularly if accompanied by political risk. The capacity to characterise and act upon long-term risk assessment depends on the level of complexity of analysis that is tolerated within policy and governance discourse, because action can involve understanding and responding to a complex system of past decisions, path dependencies and consequences. The quality of risk governance, particularly processes for bearing sunk costs and overturning precedents, as well as the quality of cross-jurisdictional cooperation and interoperability all affect the degree to which decision making is proactive and the level and nature of risk transfer.

During disaster, historical decisions mean that people can be highly exposed to increasing natural hazards and carrying 'locked-in' risks, resulting in more loss and disruption of services, higher recovery costs, and increased human suffering, all of which risk eroding not only long-term quality of life, but also the social and personal qualities that build the resilience required to live successfully with natural hazards.

Communities of place, interest, identity, and necessity (#8)

The central issues include the level of community cohesion, inclusion and sense of belonging people have for their communities of place, interest, identity and necessity. These elements are related to relationships, values, personal choices, and responsibilities people take upon themselves. People simultaneously belong to multiple communities which can be geographic, 'of interest or practice'. Communities of necessity can spring up whenever there is a specific need such as a temporary power outage or a disaster where people might be stranded in a commute home from work, or in an evacuation shelter with a bunch of strangers – and may be there for an extended period and need to work together. The degree of community cohesion, inclusion and belonging is core to what makes a liveable society in both the good times and the bad.

In times of stability, communities are created by people based on their geography, their interest or willingness, their levels of skills and knowledge, and their capacities to engage with others, shared culture and/or beliefs. This capacity is influenced by both individual and collective levels of economic means, health and the existing social capital and communication within that community. Governments and markets can influence the development of communities through investment in infrastructure (both hard and soft), incentives, and the quality of representation and leadership provided to these communities. There is a trade-off between what may be good or ideal for the individual and what may be good or ideal for the collective or wider society. In these 'stable times',

people can be individualistic, choosing to engage with their communities as, when and how they wish. This individuality allows people to choose to belong to, or not, various networks.

While this level of choice is desired or celebrated, it can also make people vulnerable if the required effort is not put into creating or maintaining nurturing relationships (family, community etc). This vulnerability is exacerbated if insufficient time is spent growing knowledge, capacities, and awareness of others or contributing to communities (place based and other).

When disaster strikes, the amount of harm felt across individuals and the community is in part determined by the level of community preparedness. The level of preparedness is affected by a number of things including, and not limited to, the agency individuals and communities have to access information and maintain awareness, their level of self-sufficiency, the level of connection between people, experience of prior events, dependence on others, and things that can help or hinder this access. This level of preparedness can be high or low. The vulnerability of individuals and communities is increased if there is a new or greater reliance on the support from formal and informal networks, services and capacities at a time when these services and networks are also challenged (greater need, interruption in service, networks broken).

Agency and preparedness: individuals, communities, governments and business (#9)

The central issues focus on those things that grow or weaken agency, know-how, experience and preparedness of individuals, communities, organisations and governments. To have agency is to intentionally enact change by one's actions, and requires forethought, self-reactiveness and self-reflectiveness. For individuals and communities this relates to the degree of self and collective efficacy which influences levels of motivation, self-regulation, learning and achievement. There is also the ability to influence others to direct change, and this type of efficacy is related to levels of connection between people and communities, their economic means and their health and education. Personal or community resilience can be viewed as a product of developing self-efficacy which in turn contributes to agency and self-sufficiency. If all of these are high, especially when combined with prior knowledge or experience of a hazard event, the individual and community will have a high level of collective preparedness, with the know-how and agency to deal with the situation.

In times of stability, strong local communities with trusted leaders are more likely to positively depend on each other and self-organise in order to respond to disaster in ways that continue to unite the community, get the community functioning sooner, enabling faster and more effective return to normal. This reduces loss and suffering in the immediate (post disaster), medium (during recovery) and long (after next disaster) term. Parallel to this is the connection to government and organisations, who are often seen by the community as providers of information, facilities and services. This can be in place of, or complementary to, community organised aspects of preparedness. Community organisation/government partnerships for event preparedness are more effective where there is a self-organised motivated community to provide guidance and leadership and drive responses. This cooperation can reduce loss and suffering during an event, as well as build trust and generate shared learning when preparing for and recovering from future disasters. This then builds the (adaptive) capacity of organisations and governments to work with the community, as well as building self-reliance within the community. The level of adaptive capacity of all players in the system contributes to the quality of the emergency response and lives saved or injuries prevented, and the speed and quality of the return to normal.

In a disaster where a community has low agency and preparedness there is often a low level of awareness of what is happening and how to respond which is exacerbated by a lack of shared trusted information. This leads to a shortfall in human capital for emergency response and a wider event impact and a low quality of emergency response. Access to essential needs is compounded by the individual and community's lack of time, self-sufficiency and just-in-time reliance on facilities and services. Leading to greater injury, suffering and loss of life, and a longer time to return to 'normal'.

Lifelong Learning Practices, mindset and expectations (#10)

The central issues focus on opportunities for experience-based learning that can be created throughout life so that people are better at looking after themselves and others both during emergencies and in times of stability. This system pattern represents learning practices across society, and how they shape societal outcomes in times of

disaster. It considers the whole person, including spiritual and emotional dimensions of mindset, identity (individual and group), level of opportunity (privilege) and how these flow into shaping expectations, and what people feel entitled to. Many of these personal attributes are learned, and also affect how we learn and the expectations we place on others. Lifelong learning, particularly social learning is a vital attribute for adapting to and responding to change. If effective, social learning generates shared ways to gain knowledge that lead to changes in practice. Lifelong learning is more than formal education. It includes experiential learning ('learning by doing'), cultural activities such as art, stories and songs, as well as the acquisition of specialist knowledge in trades and professions, local knowledge of people and places, and social and personal awareness. The capacity to cope with change requires abilities in systems thinking, strategic thinking, anticipatory learning and interpersonal skills for collaborating with others. These skills and lifelong learning practices are as important in business and government as they are at the community level.

In times of stability it is useful to have anticipatory learning i.e. forward looking in order to craft decisions and actions that will shape the future. It involves learning from the past, monitoring current trends, deliberately imagining and preparing for surprises or shocks, building anticipatory capacity and using planning and decision tools that support adaptation and change. In times of stability, most attention to learning is within the formal education system. Learning environments are created deliberately as safe places for people to make mistakes and learn. These learning environments are equipping students for 'normal' life, and also play a role in shaping experiences of what 'normal' is and setting expectations of what to expect in life. Workshop participants pointed to a trade-off between the benefits of avoiding risks in order to create safe learning environments and the benefits of engaging with risks in order to be better familiar with and prepared for them.

In a disaster, everyone feels grief and despair when there is a loss and this can be greatly influenced by prior expectation. For example, if there is an expectation or entitlement to 'safety', it can be a shocking surprise when something unsafe happens. This can be manifest as anger and blame about the unfairness of situations. In contrast, shaping expectations around what events might possibly happen, and mentally preparing for those possibilities as well as physically preparing for improving the likelihood of better outcomes, helps to mitigate post-event trauma and anger. Learning practices for improving personal and social awareness and communication skills give people the experience to work effectively together when responding to emergency situations. Governments and businesses that foster lifelong learning practices are better equipped to connect with and learn from a more diverse range of people and knowledge sources, and grow their adaptive capacity and ability to deal with extreme events. Learning after disasters helps build adaptive capacity and reduce the risks of the same thing happening again.

Governance and organised decision-making (#11)

The central issues of governance and organised decision making describe the processes and 'rules' which are formalised by various groups in society including three levels of government; business; NGOs and other instruments of civil society; and community.

In times of stability, governance and decision-making can be a highly formal and structured process, with static rules that stay in place and can be difficult to change (e.g. the Constitution). Stability in some instruments is an important underpinning of well-functioning societies and economies. Governance and organised decision making can also be highly agile, flexible and adaptive with 'rules' that emerge from a given context (protocols developed by a community or business in response to a rapidly changing situation). This is known as 'fit-for-purpose' or 'adaptive' management or governance. Therefore, the characteristics span consistency, cooperation, continuity; agility and adaptive capacity – there is no right or wrong way, rather it is about having governance and decision-making processes which are fit-for-purpose. In periods of rapid change or crisis, it becomes more important to have adaptive approaches (especially if the established 'rules' contributed to creating the crises).

A declaration of disaster in Australia leads to a change in the governance structure and leadership (separation of powers). There may be varying degrees of clarity or confusion about ownership of decisions and responsibilities, actions and cost-bearing. Governance around immediate emergency planning and rules e.g. access to food, water, fuel and medical supplies, and the authorising environment may be unclear and appears to be a gap in the current Australian planning. In catastrophic disaster, issues of law and order, social conflict, presence of armed soldiers and citizens and respect for the rule of law may be tested. The relationships between media, social media, and

leadership is critically important during and after a disaster. Disaster recovery also requires a different set of governance structures and decision-making processes to come into play.

Leadership (#12)

The central issues of leadership cannot be separated from the context, and the question 'leadership of what or whom?' The formal positional leadership of many different sectors and different types of organisations provide different contexts for leadership and may operate very differently, requiring different skills. For example, the workshop participants discussed the multiple contexts of political leadership at different levels of government, leading a political party or a committee, internal-facing leadership (e.g. of a cabinet) versus external facing leadership (e.g. for the public). Leadership is often viewed as an individual's set of personal attributes and skills – for example ability to provide vision, strategy, make decisions, and communicate effectively. In the corporate context, effectiveness depends less on the traits of any one executive and more on the company's competitive challenges, legacies and shifting forces.

In times of stability, leadership structures and models in many domains have been characterised by hierarchical use of power and authority, command and control approaches to decision making and implementation, investment in positional leadership (rather than informal or emergent leadership), a conflation of leadership and management, and often a stronger focus on 'leading from the top'. This type of leadership model is very well suited to some types of tasks, situations and constituencies. There are different models of leadership which are successful in other contexts. For example, in some situations – non-hierarchical or flat structures – there is recognition that leadership comes at all levels in an organisation (e.g. constructive middle management, innovative early career individuals), and may not come with a formal 'position'. In situations where rapid change and innovation are required, different leadership structures, styles, skills and cultures may be more useful, and informal or emergent leadership may be a more useful approach. Leadership cohorts that include diverse demographics, perspectives, skillsets, and networks have demonstrably better outcomes for solving some sorts of problems, particularly the complex problems that lead to, or are manifest in times of disaster.

In a disaster, modes of formal positional leadership and emergent informal leadership are both required. Matching leadership models and skills with the context of leadership, representing a diversity of demographics, styles, skills and networks, and adequate governance structures to support the leaders is important. Effective, fit-for-purpose interactions and interfaces are needed between the leadership of different domains (e.g. public/private/ community); levels (e.g. executive vs mid-level); sectors (agriculture, energy, manufacturing etc); roles (e.g. politician, bureaucrat, emergency or military, businesses, innovators, public good advocate); situations (times of stability, rapid change, crisis etc.). This would lead to improved outcomes in stable times as well as in disaster.

Nature and People (#14)

The central issue relates to how society and individuals realise the existential dependence of economy and society upon nature; value their connection to nature and the contributions that nature provides; how they mitigate the threat to life and property from disasters; and how they cope with disaster in natural areas. Many Australians have a deep connection with nature, but as the country becomes increasingly urbanised, a disconnection is growing between many people and nature.

In times of stability or disaster, every human's wellbeing is tightly coupled to natural systems for the provision of clean air, water, food and other essential goods, to regulate our climate, assimilate our waste, provide protection from extreme events (e.g. flood protection) and maintain productive land and water resources. Natural resources also underpin much of the national income, whether it be from resource extraction, agricultural production, fisheries or tourism. People value nature for a variety of reasons, including nature values (e.g. biodiversity, trees), social values (e.g. place and space for social interactions), cultural values (e.g. cultural heritage), experiential values (e.g. spirituality, relaxation) and production values (e.g. food production and mining). In terms of putting a monetary value on nature's contributions, there has been limited success owing to the multiple and inter-related benefits, values, and trade-offs that it provides. While nature provides protection from extreme events, it also can pose an increased risk for those living in or near natural landscapes (e.g. bushland – bushfires; floodplain – flooding; coast – storm surges). People who live in high-risk areas may do so by choice, or it may be necessary for cultural,

spiritual, family, community or livelihood reasons. As the climate changes and the risk profile of natural hazards changes rapidly, it means that people who have not previously been 'living amidst nature' are now also increasingly at risk of impact from natural hazards (for example storms, floods, fires or heat waves in cities). They may have much lower levels of awareness than those who live in regional areas or on urban fringes.

In a disaster, the hazards of nature are manifest. Failure to prepare and act on an emergency survival plan can increase the risk of injury and death and the loss of livestock and property. In a disaster, poor access can make it difficult for emergency services to reach residents, increasing the danger and potentially leaving residents stranded for extended periods. In these circumstances, making the decision to leave early is usually the safest option. Extreme events can provide an opportunity to rethink interactions with nature and 'build back better' in recovery. Actively seeking opportunities to use the recovery period to connect with post-trauma activities that are safe, instil confidence and help with reconnecting people with nature and place, can contribute to individual and community healing, as well as building positive relationships across different levels of government and business.

5.3.4 Catastrophic natural hazards and typical system patterns

The full set of typical system patterns and the potential consequences were aggregated into a single view (Figure 24). The consequences listed in various workshop outputs and captured in the system patterns showed a stable and relatively discrete set of consequences.

The explorations of disasters in Australia to date, and the catastrophic disaster scenarios at the Deconstructing Disaster workshops (Chapter 3) were used to compare against the aggregate set of typical system patterns and consequences in Figure 24. This indicated that in previous disasters in Australia, several typical systems patterns had been disrupted and several of the consequences invoked. In comparison, the catastrophic disaster scenarios explored showed that all of the typical system patterns would be affected in a cascading manner, and the full set of the negative versions of the listed consequences could occur.

Some of the things that make Australia vulnerable to disaster are captured on the left-hand side of Figure 24 in the typical system patterns – depending on whether these are in 'vicious' or 'virtuous' cycles, they could generate vulnerability, or resilience. Some of the things that Australians stand to lose are on the right-hand side of Figure 24. They are stated as neutral variables, and could be lost, preserved or gained depending on the state and dynamics of the system.

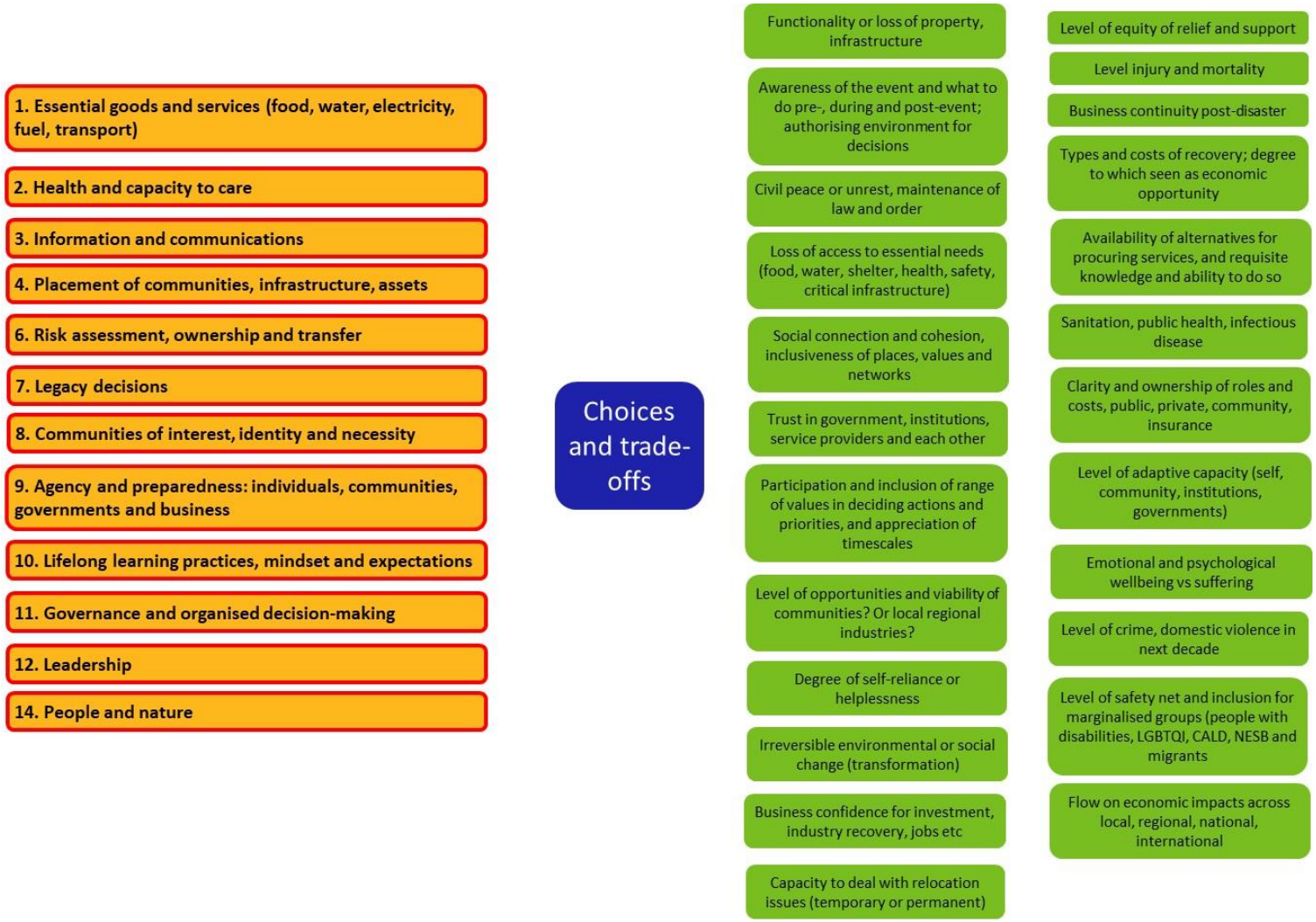


Figure 24 Aggregate view of all typical systems patterns and consequences.
Some of the things that make Australia vulnerable to disaster are captured on the left-hand side – in the typical system patterns – depending on whether these are in 'vicious' or 'virtuous' cycles, they could be vulnerable or generate vulnerability, or resilience. The effects or impacts are on the right, stated as neutral variables. These could be lost, preserved or gained depending on the state and dynamics of the system

5.4 Discussion and conclusions

5.4.1 Utility and unique contribution of typical system patterns

The discrete set of typical system patterns provides generalisable, transferrable learnings about system dynamics and root causes of vulnerability at a level of resolution which can reveal tangible issues for various sectors, or people to work with.

The analysis in this report did not go beyond this, but the approach forms a solid basis for moving towards a more sophisticated and evidence-based design of systemic interventions that can address some of the root causes.

These typical system patterns are an initial set, derived from the Project workshops, and they are not intended to be complete, comprehensive nor uncontested system representations. Where there are uncertainties or contested points of view, the diagrams provide a useful vehicle for drawing attention to these and for identifying the evidence required for resolving uncertainties or for making decisions that are robust to differing system conceptualisations or interpretations that exist.

5.4.2 From vulnerability to resilience – designing systemic interventions

A simple example using community preparedness

As outlined in Chapter 3, there was limited time in the Deconstructing Disaster workshops to comprehensively work through planning interventions. There are excellent participatory approaches to doing so, based on work such as (Wise et al., 2014, O'Connell et al., 2016).

We use an example from one of the workshops to point to workable next steps that could build upon our approach.

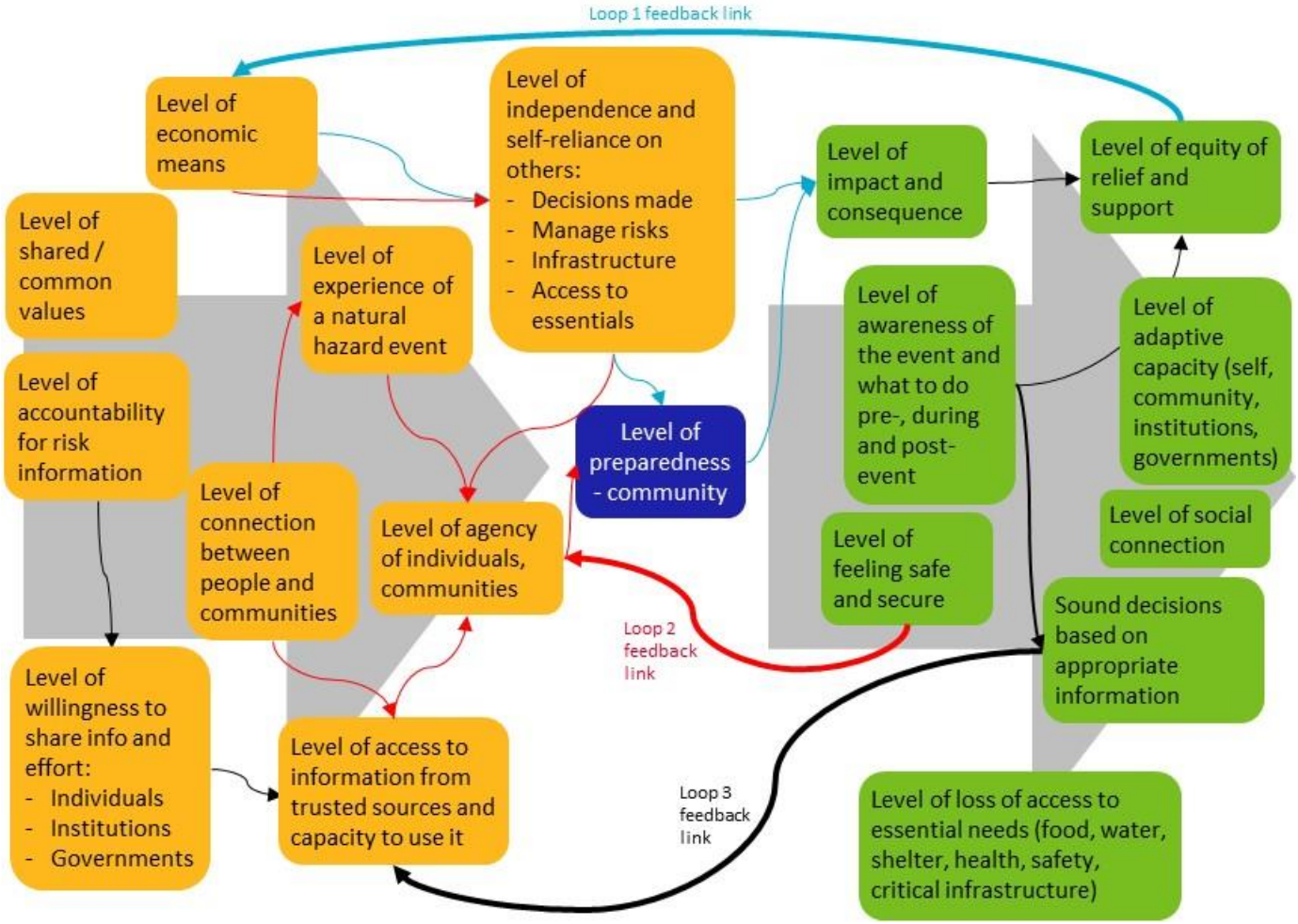


Figure 25 Cause-effect diagram for the typical system pattern 'Community preparedness' (semi-processed data from a table group at a Deconstructing Disaster workshop). All of the boxes have multiple connections generally from left to right (as signified by the grey arrows in the background). Three specific feedback loops are illustrated, with the feedback links shown with a thicker line

Preparedness is not just about an immediate emergency response – when disaster strikes, the amount of harm felt across individuals and the community is, in part, determined by the level of community preparedness. The level of preparedness is affected by various things that can either help or hinder the level including, and not limited to, the agency individuals and communities have to access information and maintain awareness, their level of self-sufficiency, the level of connection between people, experience of prior events and, dependence on others. Feedbacks include:

- Level of equity in relief and support AND level of economic means (Loop 1). Virtuous loop: the opportunity to fund equitable levels of support and relief in times of disaster relies on a high level of economic means, which in turn allows a higher level of independence and self-reliance with respect to making decisions, managing risks, and ongoing access to infrastructure and essentials. This reduces the level of impact and consequence, and reinforces the level of equity of relieve and support, reduces the risk of lost livelihoods for the most vulnerable (who can in turn contribute to the nation's prosperity), so supporting conditions needed for high economic means in the long-term future. Vicious loop: if low economic performance reduces the capacity to provide adequate relief and support to the most vulnerable in times of disaster, the cascading impacts beyond the disaster will jeopardise livelihoods, and so income earning potential and reinforce future economic challenges.

- Level of feeling safe and secure AND level of agency and self-sufficiency: individuals, communities, decisions (Loop 2). Virtuous loop: Feeling safe and secure relies is influenced by having a high degree of agency in communities and individuals. This is increased by having experience with a natural hazard event, a high level of connection between people and communities, a high level of independence and self-reliance, and a high level of access to information from trusted sources and the capacity to use it. This creates more options for ensuring one's own safety, security and capacity to help others, so creating the conditions needed to maintain skills and capacity for agency and self-sufficiency (for self and others). Vicious loop: low levels of agency and self-sufficiency mean that one's personal safety and security are more dependent on others who may not be there in times of disaster (and there is less personal capacity to help others in such times), so increasing feelings of insecurity and helplessness that further erode any capacity to build and maintain individual and collective agency and self-sufficiency.
- Level of awareness of the event and what to do pre-, during and post-event, based on sound decisions based on appropriate information are both connected to d Level of access to information from trusted sources and capacity to use it (Loop 3). Virtuous loop: being well informed with good awareness of and access to relevant information leading into a disaster not only makes for better preparedness, but the skills and connections required to be so well informed are also helpful for maintaining situational awareness as the disaster unfolds, which in turn builds experience in how to be informed and prepared for any future disasters. This applies to both individuals and groups or institutions. Vicious loop: if trusted information sources are absent or inaccessible it amplifies both pre- and post- disaster vulnerabilities, leading to poor decisions based on unreliable information or poor ability to interpret and implement it, which lead to worse consequences that make it even harder to build functional, trusted information-sharing networks, and make sound decisions.

Diagnosing virtuous and vicious cycles and the values, rules and knowledge underpinning them

The system and feedbacks can be in a state which is either a high, or a low level of preparedness, often depending on the set of values, rules and knowledge which prevails. The system can be in a 'vicious' state with a low level of preparedness, or a 'virtuous' state with high preparedness, underpinned by different values, rules and knowledge. This is illustrated by the 'vicious' and 'virtuous' states of the system shown in Table 17 .

Table 17 The system can be in a 'vicious' state with a low level of preparedness, or a 'virtuous' state with high preparedness, underpinned by different values, rules and knowledge

<table>
<tr><td rowspan="2">Low level preparedness

('vicious cycle')</td><td colspan="3">When disaster strikes, low preparedness affects the ability of individuals and communities to gain access to information and maintain awareness, which in turn impact on the ability of individuals and communities to contribute to their own wellbeing through adaptation, ensuring equity of relief and support, and maintaining social connections and feelings of safety and security. These in turn contribute to further eroding preparedness for the next event by contributing to more systemic loss of social cohesion, agency and self-sufficiency, connection to trusted information, and equitable distribution of economic means to be prepared and self-reliant.</td></tr>
<tr><td>Values
'She'll be right'
Paid work prioritised over community participation</td><td>Rules
Reliance on centralised systems which are organised into silos</td><td>Knowledge
Education primarily desk-top based in formal institutions
Popular news or social media content</td></tr>
</table>

	• Individual consumption	• Top-down decision making	• Knowledge organised and taught in silos
High-level preparedness ('virtuous cycle')	When disaster strikes, high levels of preparedness reduce the overall impacts on individuals and communities. Attributes include that access to information that supports maintaining awareness and supporting people to maintain high levels of wellbeing through ongoing adaptation, equity of relief and support. High levels of social connection promote feelings of safety and security, enhance preparedness for future shocks in building even greater social cohesion, agency and self-sufficiency, connection to trusted information, and equitable distribution of economic means to be prepared and self-reliant.		
	Values • Primacy of life • Do no harm • Care for others • Community participation • Live and adapt with nature • Learning • Open information sharing • Others' perspectives	Rules • Rules for fair group decision making • Social norms around conducting preparedness activities • Groups routinely self-organise around a common cause	Knowledge • Survival knowledge • How to work in groups to solve problems • How to imagine anticipate and prepare for extremes • Local knowledge and networks • Cross-sectoral and cross-scale connections • How to cope with extreme emotions

Designing interventions to turn vulnerabilities into strengths

Interventions can focus on how the vicious cycles in the system may be interrupted and turned into virtuous cycles. For example, some proposed interventions to disrupt the feedback loops, and the changes in values, rules and knowledge that might drive the system into a more virtuous state, are shown in Table 18. These have been put forward as an example by the authors – not derived from workshop material.

Table 18 Interventions to target feedback loops, and the changes in values, rules and knowledge to underpin them (illustrative suggestions from authors, not from workshop material)

Feedback loop	**Proposed intervention**
Level of equity in relief and support AND level of economic means	Target preparation and relief programs to disadvantaged people so they have greater ability to prepare, manage risks, actively make decisions about disasters, and contribute to the community.
Level of feeling safe and secure AND level of agency and self-sufficiency: individuals, communities, decisions	Prioritise security and assurance of individuals and whole community in relief to give them agency, help them maintain/regain control, learn from the experience and translate that into preparedness and community contribution.

Level of access to information from trusted sources (POST-DISASTER) and level of access to information from trusted sources (PRE-DISASTER)	Review the information provided during/after the event, assess how it was used and its effectiveness. Ensure information provided pre-disaster and post-disaster is integrated and consistent and actually effective at reinforcing community agency and ability to prepare.
Changes in values, rules and knowledge Based on expectation (k) that increasing support for disadvantaged people will increase their agency and participation, and hence wider community-level preparation (as opposed to increasing reliance on support). Requires preference (V) for building community capacity and reducing social disparities in preparations (as opposed to uniform distribution of effort which others might see as more equitable). Implemented as a change in priorities in programs (R). Requires information (K) about who to target and how to effectively help them for greater individual and community benefit. Monitor: reaction (Δv) of other people affected and broader community to using these priorities, ability to target disadvantaged segments (Δr), effectiveness at increasing agency of disadvantaged (Δk); effectiveness at building community preparedness (Δk).	

This simple example shows the potential utility in continuing to develop, test and refine the typical system patterns to help grapple with the complex issue of cross-scale, cross-sector, cross-disciplinary, cross-jurisdictional, systemic changes that are needed to take the opportunity to turn vulnerabilities into strengths.

These sorts of approaches have been used in the CSIRO team's work in international development in resilience, adaptation, transformation, food security and livelihoods (e.g. (Maru et al., 2017)Maru et al. 2018, (Butler et al., 2016a, Butler et al., 2017, Trimble and Plummer, 2018)

The types of approaches used in co-production as shown here mean that understanding of problems becomes enmeshed in humans' interpretations, and is thus context-specific and dependent upon who as well as what is involved in knowledge production processes. Therefore, what is known about the system to be managed is no longer outside the human experience, but is reflected in the subjective representation and understanding of a situation (Brugnach and Ingram, 2012).

The potential impacts of a catastrophic natural hazard event were briefly shown in section 5.3.4. Identifying these vulnerabilities and using the understanding of system dynamics gained through the use of system tools such as these could help to avert such consequences if the necessary interventions were made in advance of a catastrophic natural hazard event.

5.4.3 The 'space' within which decisions about trade-offs are made

The use of environment, society and economy as a triple bottom line has been used to support decision making over the past two to three decades. The concept relies on maintaining the bottom line, which is portrayed as three separate pillars, each of which must be balanced with others (implying substitutable trade-offs within and between the pillars). The triple bottom line approach has been subject to a great deal of analysis and critique (O'Connell et al., 2013). It has become clear that while the environment can tolerate some level of degradation in order to continue to deliver social or economic values now and into the future, there is increasing attention paid to potential multiple and interacting critical 'thresholds' which, if crossed, will change the state of the environmental systems upon which the social and economic 'pillars' depend. 'Planetary boundaries' is a concept to define the limits within which humanity can 'operate safely' (Rockström, 2009). Raworth (2017) built upon the concept of planetary boundaries and proposed that a

'safe and just space for humanity' is based on a social foundation (e.g. as articulated in the Sustainable Development Goals) as well as these planetary boundaries (Figure 26). The nine dimensions of the environmental ceiling are the planetary boundaries proposed by (Rockström, 2009), which have since been revised and updated in (Steffen, 2015).

This concept could be used to help guide any reconfigurations of the level of typical system patterns. Interventions can be made to ensure that the trade-offs within and between typical system patterns are within the 'safe and just space for humanity'. This is easier to conceptualise than to realise – the 'thresholds' of the ecological ceiling and the social foundation are not easy to determine and many of the thresholds on social foundation are very based on depend on values, expectations on standards of living, etc. The thresholds also depend on the physical process in question as well as the scale of assessment and operation – for example ecological thresholds on biodiversity may be breached at a very local scale without ecological collapse, but when they are breached at regional or continental scales, the consequences can be dramatic. There is a plethora of literature on the topic of thresholds, scales, indicators etc. which is too complex to cover here, but provides useful directions for further work.

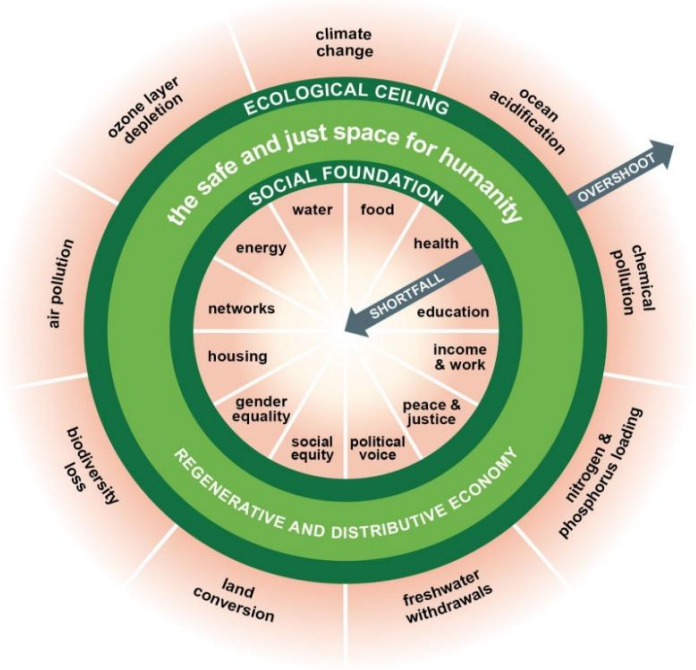


Figure 26 Raworth (2018) conceptualisation of a safe and just space for humanity.

A powerful simple representation of the dependency has been created by Bjordam (2017) (see a description of the installation by Rowling (2017)). She created a sculpture installation consisting of a large disc with a forest floor on top, representing nature. The second disc, suspended beneath, consisted of an agricultural landscape with a river across on the upper face of the plate and a city with glowing lights on the lower face of the plate, symbolising society. The third disc suspended below that, was a sphere-shaped ball of international coins, representing economy. If the wires suspending of each layer of the sculpture are cut, they fall down. Photographs of the installation from the Resilience 2017 conference in Stockholm are shown in Figure 27.

Figure 27 Photographs of Tone Bjordam's installation at the Resilience 2017 conference in Stockholm (Photo: Deborah O'Connell)

The decisions and trade-offs that have been made in the past, and are still being made, are usually based on the triple bottom line framing where the different capitals are substitutable and therefore can be traded off.

Designing interventions to do things differently for the future would be more robust if they are framed within the decision space as outlined by Raworth (2018, see Figure 26).

5.4.4 Further work: designing sets of intervention options and adaptation pathways

This Project was clearly bounded to include diagnosing vulnerabilities, and exclude developing solutions or intervention. The Deconstructing Disasters workshops (Chapter 3) did include a short session on interventions, to help frame the forward thinking of participants and demonstrate the utility of a systems approach to help break the cycle of partial solutions and the widely recognised barriers in 'siloed' approaches. There is a rich body of work in the fields of resilience, adaptation and transformation which could be drawn upon to take next steps. Specific steps that could be developed consistent with the methods used for the co-produced understanding of values, typical systems patterns, and systems narratives, are briefly described in this section.

Wise et al. (2014) critiqued the recent approaches of responding to vulnerability by taking actions addressing only the proximate causes of vulnerability, and proposed adaptation pathways as a way to frame approaches to designing systemic interventions addressing root causes. They conceptualised making 'adaptive' decisions (as expressed in values-rules-knowledge combinations) (Gorddard et al., 2016)to keep the system in a space where options for the future are kept open. In this way it is somewhat analogous to the 'just and safe' space conceptualised by Raworth (2017), but with an explicit time component of prioritising and sequencing actions on a timeline to the future, with clear triggers identified on where certain actions need to be taken in order to remain in the adaptive space. The concepts of resilience and adaptation pathways to transform systems where there is not a single entity with agency to make decisions were further explored and demonstrated by Enfors (2013) and Abel (2016).

Maru et al. (2014) provide a relevant Australian example of how a linked vulnerability and resilience approach could be extended into adaptation pathways (prioritised and sequenced actions addressing root causes) could be developed for remote disadvantaged communities in Australia, based on similar system analyses and identification of vulnerabilities and potential interventions as has been developed in this Project. The systems view build on two common and seemingly paradoxical narratives about people in remote areas (Figure 28):

1. People in remote areas demonstrate significant resilience to climate and resource variability and may be among the best equipped to deal with climate change
2. Many people in remote areas are chronically disadvantaged and therefore among the most vulnerable to climate change impacts.

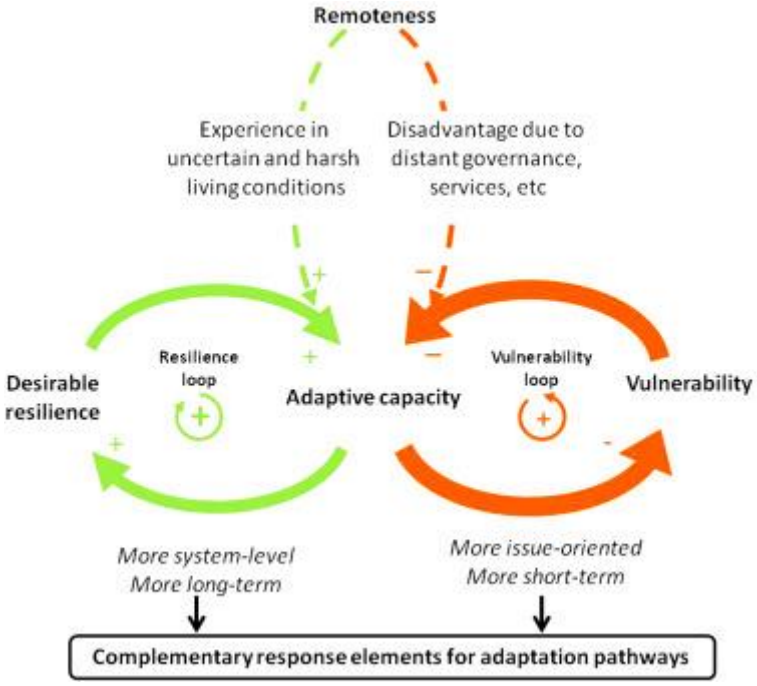
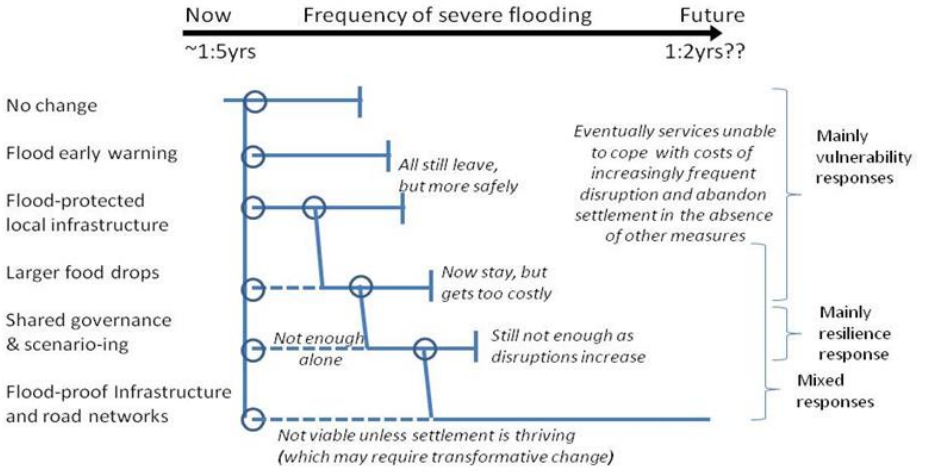
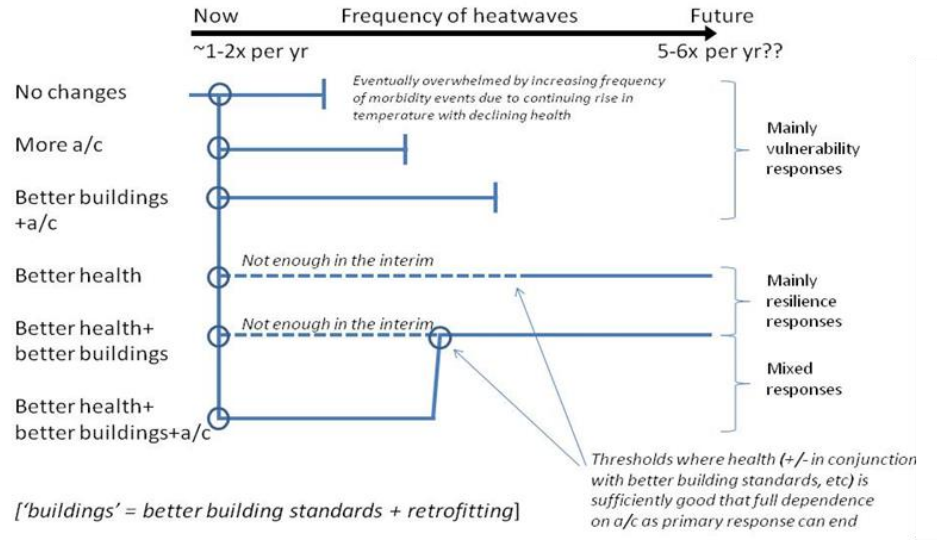


Figure 28 A systems diagram showing the feedback loops between resilience and vulnerability of remote disadvantaged communities. Thickness of the arrow shows current dominance. From Maru et al. (2014)

The analysis enabled a distillation of adaptation pathways to shift the dominant vulnerability feedbacks into those supporting resilience. Adaptation pathways with sequenced actions and trigger points for decisions were developed for dealing with increased frequency of severe flooding, heatwaves and drought (Figure 29).

O'Connell et al. (2016) distilled the methods to develop many of the approaches used in this project (imagining change, appropriate co-design and stakeholder engagement approaches, systems description and assessment, design of options and pathways, and structured learning approaches) into a clear set of guidelines for the Resilience, Adaptation Pathways and Transformation (RAPT) Approach, and Maru et al. (2017) showed their utility for design of investment programs for international development.





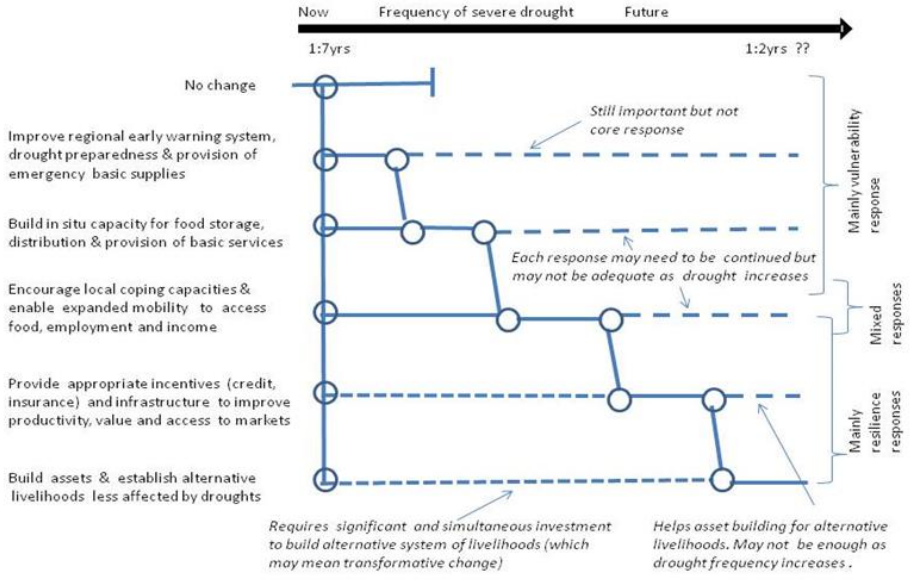


Figure 29 Potential adaptation pathways for increasing threats of major flooding, heatwaves and droughts in remote communities. Lines show potential adaptation options, dashed lines show that an option is inadequate by

itself, circles show decision points with possible switches to other options, bars show where an option becomes non-viable. From Maru et al., 2014

The approach is also helpful for working constructively with the uncertainty inherent in these system representations. Decisions need to be made based on current understanding of the system, which is always partial and heavily shaped by current context, and so laying out assumptions explicitly, and mapping out interventions and their anticipated effects, is also a way of identifying the key working assumptions that warrant testing and trial interventions can be implemented to test assumptions and revise evidence.

5.5 Key messages

Key message 1: The cause-effect diagrams from the Deconstructing Disaster workshops iteratively distilled to a set of typical system patterns of cause, effect, feedbacks and dynamics which may be in play regardless of type, location or timing of a disaster. These typical system patterns highlight systemic structures that lead to common, highly likely or inevitable outcomes and are aimed at generalising so that the ideas are transferrable.

The systems thinking and outputs from the Deconstructing Disaster workshops were reviewed and refined by the Co-Design Team, the Partnership Team and the National Advisory Panel before being distilled by the authors into a discrete set of 12 typical system patterns. These typical system patterns remain as partial system analyses which do not yet fully reflect systems-level thinking. Nevertheless, they capture the progression in workshop participants from event-driven thinking to pattern-driven thinking, which is a step change for many.

The typical system patterns have been used to diagnose system vulnerabilities at a level where learnings are generalisable enough to be transferable to other places or contexts. This apparent generalisability warrants testing, and in their current level of maturity it is most appropriate for the diagrams to be offered as hypotheses worth further exploration. A common pitfall of taking a 'systems' view is to confuse this with undertaking a comprehensive analysis of everything. Instead, the diagrams offer a way to take a whole of system perspective that informs some identification and prioritisation of particular system properties that stand out as important to pay attention to.

Key message 2: The typical system patterns were of two types: provisioning systems (e.g. food, water, energy, ecosystems, health), or behaviours, social capacities and social processes (e.g. capacity to care, land-use planning processes).

As shown in Chapter 4, people value physical 'things' and they also value processes that keep them safe. The typical system patterns reflect both of these categories as they emerged from the analysis of values and the diagrams from workshops. As well as showing the critical issues (or variables) which need to be considered and the broad patterns of dynamics in these systems, they have been used to diagnose quite specific vulnerabilities at a level or granularity which is helpful for individual sectors or decision makers to appreciate critical connections between biophysical and social processes, as well as across sectors and scales.

Key message 3: The typical systems patterns can be built on to inform interventions that build resilience and mitigate risk.

Further steps are required to check and test the typical system patterns out with a wider range of literature, experts and a broader range of stakeholders, and they could then be used (in combination with other tools such as Theory of Change) to help identify potential interventions to address the vulnerabilities by addressing systemic risk and root causes. The diagrams are not yet at the stage of fully developed

system diagrams. They have utility in moving the conceptualisation of disasters, risk and planning from an 'event' based construct, to one where patterns can be seen.

Disaster risk reduction and mitigation across sectors and scales is a very complex and interconnected space. Government departments and private industries alike tend to have areas of specific focus, and/or responsibilities and approaches tend to be constrained or 'siloed', which makes it difficult to gain insights across the system and the dynamics. The typical system patterns could help greatly in helping people to understand the complexity, and the interaction between issues, sectors and scales.

Key message 4: The typical system patterns reflect multiple perspectives and types of knowledge and can be used in an ongoing way to complement existing tools such as risk assessment approaches. They can help frame discussions on complex interactions between sectors, scales, and tensions in values and help people to understand the conflicting system representations and systemic points and types of intervention.

Although not illustrated in this report, we anticipate that further efforts to develop the system diagrams would reveal competing and conflicting system conceptualisations. This is not something to avoid, and indeed these diagrams are a vehicle for making these different perspectives explicit in a constructive way that supports evidence-based reflection. In other words, the diagrams are best recognised as socially constructed living documents, rather than attempts to distil a single, 'correct' system conceptualisation. They can be used along with other methods such as the values, rules and knowledge tool to help address conflicting perspectives, contested values, and understanding how different sets of rules can work together or against each other. These knowledge co-production processes are relational and dynamic – knowledge is constructed through interaction between people and practice and is constantly being created and recreated (and hopefully progressed) through ongoing interactions, learning and iterations.

6 An emergent evidence-based logic to underpin new narratives about disaster, vulnerability and resilience

Authorship: Deborah O'Connell, Russell Wise, Nicky Grigg, Michael Dunlop, Rachel Williams, Jacqui Meyers, Veronica Doerr, Seona Meharg, Jill Edwards, Monica Osuchowski, Mark Crosweller.

6.1 Introduction

The purpose of this chapter is to synthesise the results and conclusions across all of the chapters. The detailed discussion and cross-referencing with relevant literature is provided in the individual chapters, and in this chapter the synthesis is kept simple, provides no examples, and focuses on the flow of logic and major conclusions.

A key aim of the Australian Vulnerability Profile is to generate a new national narrative(s) about disaster preparedness in Australia. In this chapter, the output of the Project is provided – a generic, evidence-based logic to underpin narratives. This can be used to support various narratives in a range of styles (for example policy, anecdotal, biographic, fictional genres) by a range of others – the Australian Vulnerability Profile and, as was intended by the co-design model underpinning this Project, also by all of the partners and stakeholders to help shape their policy, illustrative or other narratives in ways that speak to their own various constituencies.

Chapters 1 and 2 showed the overarching structure of the project, the co-design approach to designing for impact, and how the various components of the project were linked.

Chapter 3 presented the Deconstructing Disaster workshops. The literature review and methods used in workshop design were covered in this chapter, and were set up to flow through all the subsequent analysis. Some semi-processed examples of results pertaining to the overarching Australian Vulnerability Profile research questions were provided, and more conclusive responses to the research questions pertaining to the utility of the workshops themselves were covered.

Chapter 4 presented the values framework. This values framework was developed based on previous work (Gorddard et al., 2017), and was used in this project to both elicit and analyse some of the values at play in the choices that people and organisations make about what to prioritise and how to use limited resources to deliver and sustain the priority things they care about. The application of the framework to the information from the workshops highlighted that trade-offs and contestations are unavoidable between: the priorities of different stakeholders (in terms of what they care about); what is valued and prioritised during periods of relative stability compared with during disaster; short-term and long-term levels of prosperity; and economic/financial outcomes compared with incommensurable or intangible social and environmental outcomes.

Chapter 5 showed how the data and diagrams representing workshop participants' understandings of the main causes and effects of vulnerability could be generalised into 'typical system patterns' so that the learnings are transferrable across disaster types or locations. The typical system patterns were used to diagnose specific causes of vulnerabilities and their consequences and can be further interrogated to identify points of intervention to ameliorate these causes and effects. An example was provided of how

they could be used to diagnose vicious and virtuous cycles (i.e. patterns of reinforcing feedbacks for either negative or positive outcomes) and design interventions to address the systemic vulnerabilities.

In each of the chapters, a gradual picture has been built up to address the overarching research questions:

> *Research Question 1: What do we value, and what do we stand to lose in disaster?*
>
> *Research Question 2: What makes Australia vulnerable to catastrophic disaster?*
>
> *Research Question 3: Has the Project been an effective intervention in helping to shift the narrative, build capacity and networks, change practice and institutions?*

This final chapter is a synthesis and comprises discussions and conclusions; there are no methods or results. All of the elements from the previous chapters are brought together to present a synthesised view and more complete response to the three research questions.

Some next steps are also proposed. These are not next steps for the Australian Vulnerability Profile (which are beyond the remit of this Project and report), but rather those which would help to take the science forward.

6.2 Building a simple logic for a system archetype and narrative

The synthesised results and discussion in this section provide the building blocks for an evidence-based, co-produced narrative logic emerging from this research project. It can be used in various ways, by a range of users, to help support the various stories and narratives that they might choose to communicate to their stakeholders and other audiences.

The whole system can be represented by the diagram in Figure 37.

6.2.1 Reframing the problem

Any change in a narrative needs to be supported by reframing the problem. Some of this was presented in Chapter 1 (see key messages section 1.7).

Natural hazards only lead to disasters if they intersect with a society which is exposed and vulnerable.

Disasters emerge at the intersection of complex, dynamic biophysical and social systems. Although this has been recognised as a gap in understanding by many in the literature (reviewed in section 1.2) and by Emergency Management Australia in proposing the Australian Vulnerability Profile, the current paradigm in operationalising 'disaster risk and mitigation' is framed around a more standard approach to risk with most effort placed on quantifying the characteristics of the hazard, exposure and potential impacts. Deconstructing vulnerability and using the systems understanding to chart ways forward represents a step change in the problem framing. The initial premise of the Project was to focus on deconstructing vulnerability.

Existing risk assessment and management approaches are useful for some sorts of natural hazards and categories of risk, but are inadequate with dealing with cumulative and cross-scale issues, or situations where the likelihood is low but the consequences are catastrophic.

The uses and limitations of existing risk approaches were discussed in section 1.2 as a rationale for developing the Australian Vulnerability Profile. This Project introduces a set of methods and tools to deal with the more complex categories of risk, and the ways of using these tools to move beyond current risk assessment approaches are further explored in sections 6.3, 6.4 and 6.5.

Accepting inevitability of worst case scenarios is hopeful, not hopeless.

Operational environments that resist any talk of the inevitability of worst case scenarios hinder action on obligations to protect in all circumstances. It is a form of vulnerability to be unwilling to contemplate and see things that are confronting. Worst case scenarios include situations where the capacity for emergency services to respond will be exceeded (Crosweller, 2015). These scenarios have rapidly cascading impacts on every typical system pattern, and a host of catastrophic consequences (Chapter 3 and section 5.3.4).

Therefore, a better understanding of complex cross-scale risk, vulnerability and how to address these is needed. A robust and ethical process for including the range of knowledge and stakeholders is essential to address these issues.

The problem reframing by Emergency Management Australia (2017) in setting up the initiative of the Australian Vulnerability Profile, and this Project to help support the development thereof, created the space and the opportunity for the dialogue that took place during the Project. The effective problem framing encouraged a broad range of key stakeholders to participate, actively and generously contributing their knowledge and experience and enabling everyone to learn. Other success factors are discussed in sections 3.7.7, 3.9, 4.5 and 5.5.

6.2.2 The logic for a systems approach to understanding vulnerability and key points of intervention

People hold different values and prioritise different things in different contexts and at different times. People value physical things (such as houses, mementos, people and services) as well as non-physical things such as a sense of security, harmony, or self-efficacy. They also value processes in society that keep them safe, resilient, and prospering.

People value a vast array of things including physical things, other people and experiences. The value of these things is realised through the diversity of relationships people, individually and collectively, have with them. The relationships often depend on specific attributes of the things, and the relationships satisfy a diversity of motivations or held values within people. The relationships people have with different things are dependent on context; in different situations different things or attributes are important, and different motivations come into play. While many of the things people value are important both in times of relative stability and in the face of disaster, there are a range of things that are possibly taken for granted most of the time but whose value is revealed in times of disaster. These include things that are directly damaged or lost during disaster such as houses, mementos, capital, people and services, and amenity associated with these things, but also sense of security, safety, harmony (lack of trauma), normalcy and self-efficacy. There is another class of things whose value is revealed during disaster: those processes and capacities that have the ability to reduce vulnerability during stable times and to enable coping and recovery during and after disaster. An example is the diffuse system of processes that govern the location and construction of housing and infrastructure, and specifically the ability of that system to reduce known vulnerabilities. Another example is the ability of service providers, public, community and private, to deliver tailored responses that address the specific needs of affected people, as opposed to focusing on aggregated economic costs. More fundamental examples include societal norms, business practices and economic policies that could reduce the extent to which the burden of vulnerability is borne by individuals and communities separate from those who profit economically or politically through the processes that create and transfer risk. Recognition that these systems have failed to reduce vulnerability leads to loss of trust and confidence in governments, businesses and even society.

The way systems operate, resources are allocated, where people live, individual and societal expectations, how building and infrastructure are constructed, the activities that drive the economy, and the social

services provided, are all outcomes and consequences of choices, decisions and trade-offs that have been made based on what is known and valued at particular points in time. Decisions can only be made within the set of 'allowed' choices, i.e. they are with system rules and other constraints. Therefore, understanding what people value and why, in different contexts, is a core aspect to understanding why and how the things that are valued also make us vulnerable to catastrophic disasters.

Some values are complementary and others are in conflict. Where values are in conflict, they cannot be held or realised simultaneously without creating tensions between (or within) the individuals or groups involved. In such situations decisions, choices and trade-offs are unavoidable.

The conclusions of Chapter 3 showed that people and organisations value different things, and prioritise the things of value very differently in the context of stability and prosperity compared to when uncertainty, instability or disaster strikes. In exploring the consequences of catastrophic disaster through narrative, and employing tools for system analysis, the indirect causes and tacit underlying values became more explicit.

In Chapter 4, a deeper analysis revealed tensions between the aspirational principles for living with disaster and current behaviours and stated 'things of value', as illustrated in Figure 30. The tensions and trade-offs are symbolised by [A] in Figure 31 and Figure 37.

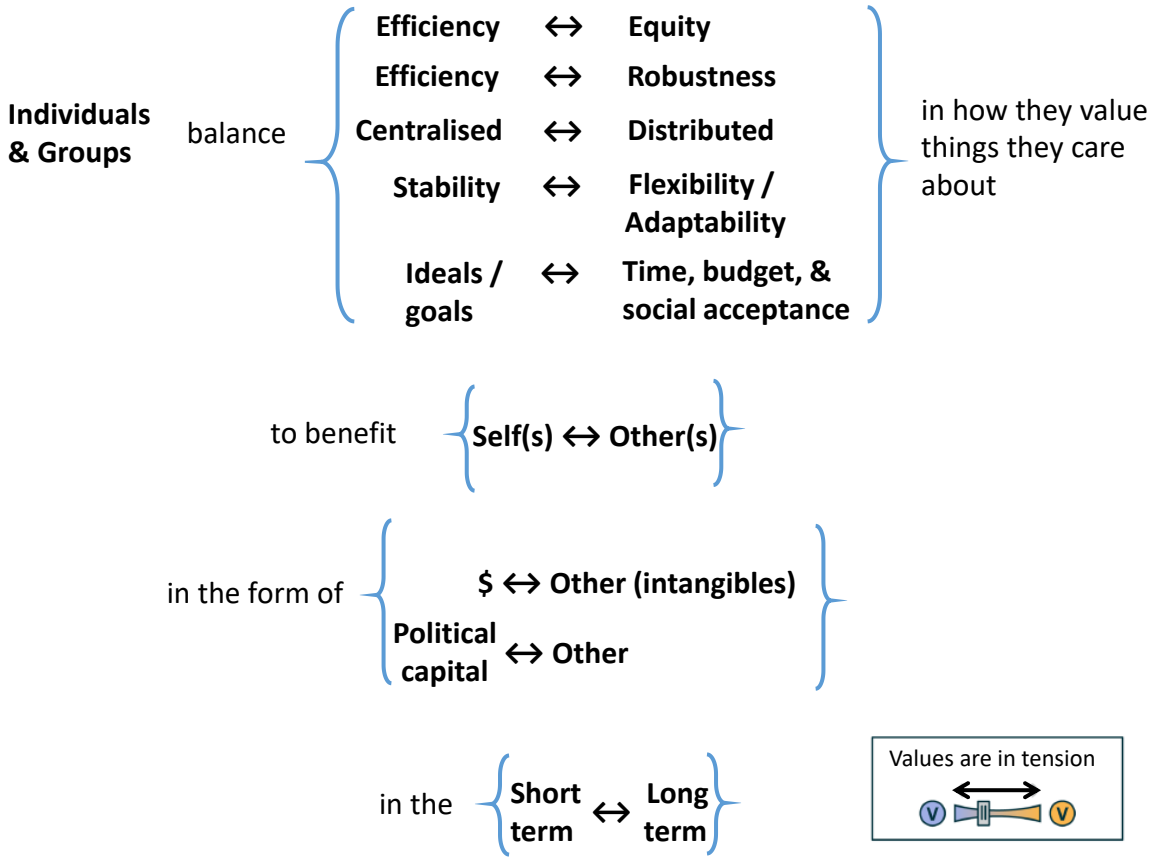


Figure 30 Value tensions that exist within and between individuals and groups that need to be continually revisited and rebalanced in dynamic situations, particularly before, during and after disasters

The results from Chapters 3, 4 and 5 clearly illustrate a set of consistent characteristics present in most, if not all, disaster situations. Individuals, groups, organisations are shown in Figure 31 element [B], including:

- the diversity of values at play in any location or situation
- differences in the value priorities of individuals and groups

- the dependence of values and value priorities on the context. The context is influenced by state of the system (stable vs disrupted), the knowledge about the system, and the rules that give credibility and legitimacy to different values
- the diversity of value priorities leads to many perspectives on the same situation.

The different numbers and sizes of human shapes in Figure 31 symbolises different individuals and groups having different levels of influence in the system. This is an important consideration, particularly when considering social justice values of equity, fairness and voice.

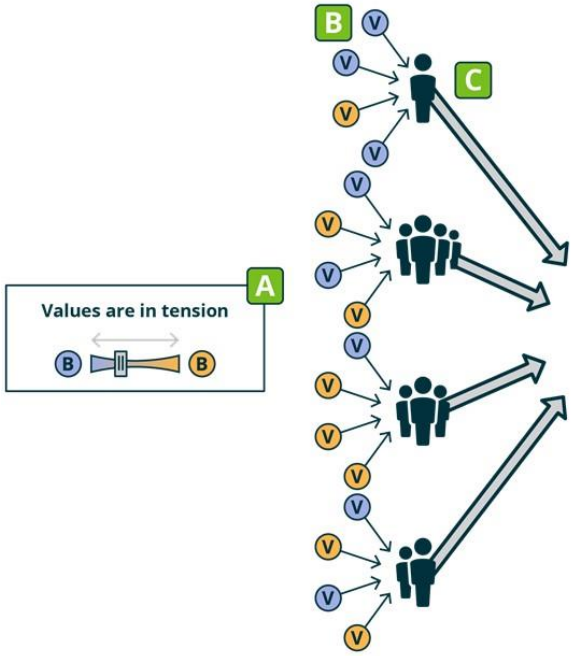


Figure 31 Individuals and groups hold different values and prioritise them differently

The values of individuals are reflected in 'rules' at a societal level that codify, simplify, or provide common 'guidelines' for society at large. For decisions to be credible, legitimate and legal, decision makers need: knowledge of the nature of change, response options and the implications of both; values to assess the options in terms of their legitimacy and feasibility; and rules that enable implementation.

The trade-offs in values and choices are made partly by individuals, families, communities and other informal groups; and partly through the actions of formal groups such as all three levels of government, businesses and other organisations. All sorts of institutions, or 'rules' exist to codify, simplify, or provide common 'guidelines' for society at large. These 'rules' can take many forms – from informal cultural 'norms' (e.g. washing hands before eating) through to formal laws and policies and regulations from government, incentives, consultation processes, business plans, codes of conduct, building and planning codes and processes. They are informed by knowledge, which then intersects with the values and the rules as shown in Figure 32 as element [D]. This concept was introduced in section 3.2.3.

Figure 32 The societal systems of values, rules and knowledge interact and co-evolve to enable and constrain the decisions of individuals and groups (Gorddard et al., 2016)

Societal decisions affecting vulnerability are the result of multiple, cumulative, non-linear processes by which tensions and trade-offs in different values, rules and knowledge types are managed. Some groups in society have disproportionate power to increase or reduce vulnerability to disaster, while others are disproportionately vulnerable.

Figure 32 is a simplified representation of how the societal systems of values, rules and knowledge interact to enable or constrain the decisions that can be legally and legitimately made. These interactions become complex and extremely messy beyond the individuals and group levels when looking at the societal scale (Figure 33). While many of the voluntary choices and trade-offs at an individual level are reasonably understandable and align with the individuals' best interests, many individuals' 'choices' and actions are influenced, constrained, or even entirely directed by the prevailing, predominant societal rules, values and knowledge. So although most people would like to make decisions that are aligned with their personal values, they are constrained in the choices and trade-offs they can make by formal and informal rules, societal preferences, expectations and values, and the knowledge considered credible. In this way, the scope of legal and legitimate choices individuals can make is dramatically shaped by the current and historical influences that businesses and governments, communities or societies have on the rules, available knowledge, and societal priorities and expectations (values).

Some people and groups have more opportunity than others to make choices of all sorts in their lives, and this variation affects the impacts and consequences experienced during hazardous incidents and the capacity to respond and recover. People and organisations differ in their ability to access and make use of information about hazards, risks and avoiding them. They also differ in their own exposure, their preferences, and their circumstances. Individuals, business and governments constantly adjust how they make their choices. When individual choices are adjusted, individuals are responding to different values and incentives. Ultimately no single entity is responsible for or in control of the societal-level trade-offs that emerge as a result of the cumulative effect of numerous individual choices, but they are strongly determined by the distribution of power and wealth, and access to information and resources, and the dominant narratives at play.

In summary, there are many layers and mechanisms for different rules, values and knowledge to constrain or enable decisions, and therefore many unintended consequences in terms of the choices and actions that are ultimately made by people. These are complex to understand and resolve.

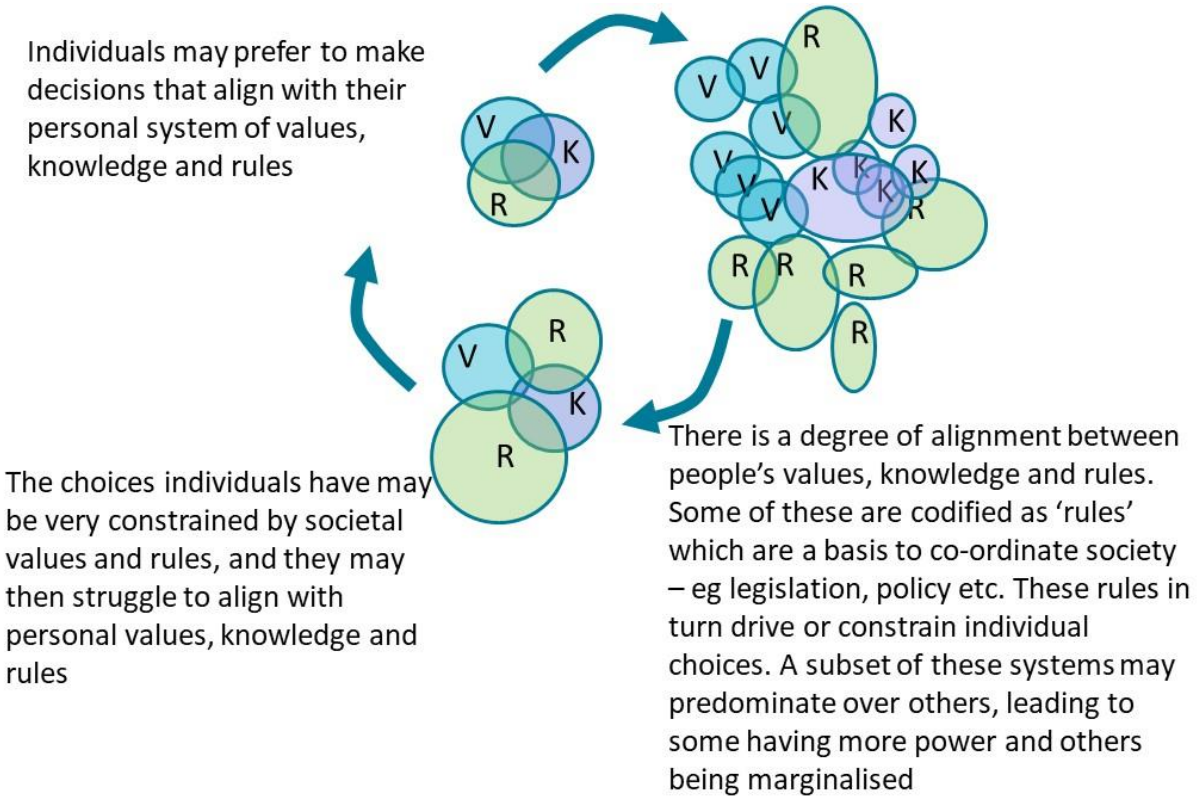


Figure 33 Conceptualisation of how the systems of values rules and knowledge enable or constrain decisions at the individual, group and societal levels

The cumulative choices and trade-offs are manifest in a number of typical system patterns, which serve society well when times are stable and relatively prosperous.

During times of relative stability and prosperity (marked as [1] in Figure 35 and Figure 37), the cumulative system of values and choices (marked as [E]) is built upon the dependency of society and economy on the environment (Figure 34).

The use of environment, society and economy as triple bottom line has been used to support decision making in the last two or three decades. As described in more detail in section 5.4.3, various authors (Rockström, 2009, Wise et al., 2014, Steffen, 2015, Raworth, 2017) have shown different conceptualisations of how, if options for the future are to remain, decisions need to be framed within the space bounded by thresholds which may be environmental, social or 'adaptive space'. This is symbolised using the Bjordam (2017) representation in Figure 34.

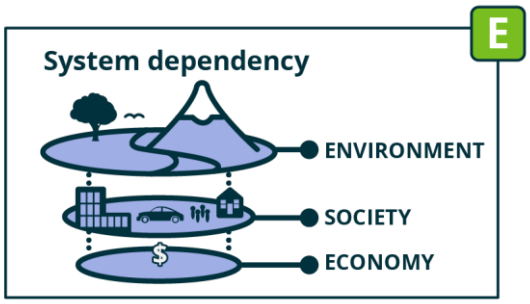


Figure 34 Symbolising dependency of economy on society, and environment (based on suspended sculpture by Bjordam 2017)

The cumulative choices made in times of stability and prosperity lead to outcomes which in general have served society well (marked as [F] in Figure 35 and Figure 37). Particularly well served have been those individuals and groups who hold the power, have the knowledge, whose values predominate and who have stronger influence on the rules. The systems of governance and market forces that usually flourish under a stable and prosperous system tend to hold a 'Business as Usual' pattern of reinforcing the prevailing systems (marked as [2] in Figure 35 and Figure 37).

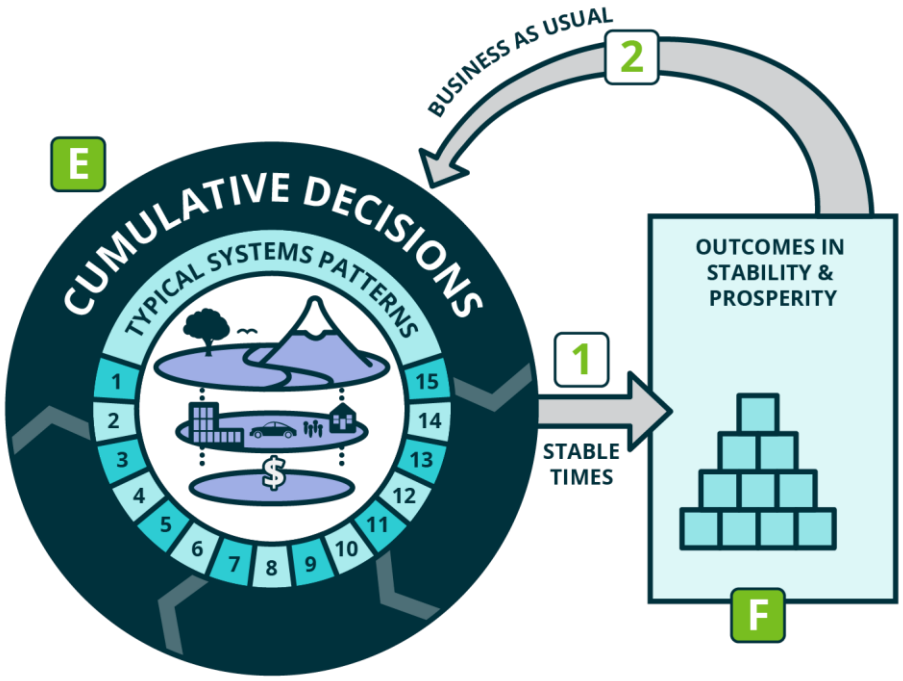


Figure 35 In stable times [1] cumulative choices (reflected in typical system patterns) [E] lead to outcomes of stability and prosperity [F] with reinforcing feedbacks [2]

The participatory systems analyses that emerged from the stakeholder workshops (Chapter 3) were synthesised into typical system patterns (Chapter 5 and Appendix Typical System Patterns, see Table 16 for summaries). These were used to understand and explore system connections and feedback loops, and diagnose vulnerabilities in, or caused by, the identifiable system patterns. Twelve 'typical system patterns' were identified through the processes described in the methods. These fall into two broad categories:

- Provisioning systems (e.g. food, water, energy, ecosystems, health)
- Behaviours, social capacities and social processes (e.g. capacity to care, land-use planning processes).

Simple descriptions of the typical systems patterns are:

- **Essential goods and services (#1):** The drive for efficiency in highly interconnected supply chains can see low levels of diversity and redundancy, and a severe disruption can trigger cascading and amplifying failures, with consequences worsened if people's expectations of uninterrupted services have left them unprepared and inexperienced in coping with the loss of essential goods and services.
- **Health and capacity to care (#2):** An emergency incident with high levels of injury and mortality risks overwhelming a system already stretched to provide routine services, with cascading public health consequences that further erode the capacity for emergency response and recovery.
- **Information and communications (#3):** In times of disaster the pressure to make and share complex, difficult decisions with speed and accuracy drives imperatives for fail-safe, interoperable and broad-reaching communication infrastructure, and trusted, respectful communication practices that foster civil peace and support those who are suffering, however these all need to be established well before incidents occur, when there is less imperative to do so.
- **Placement of communities, infrastructure and assets (#4):** The location and quality of housing and other infrastructure is shaped by innumerable considerations and there can be resistance to the increased costs and complexity of planning and building practices that better account for risks from natural hazards, even though failure to do so locks in unwanted cascading consequences during emergency incidents.
- **Risk assessment, ownership and transfer (#6):** When there are different owners, managers and insurers at different stages in an asset's life cycle, short term financial interests of transient owners and stakeholders can see a lower emphasis on long term risk awareness and associated anticipatory actions, resulting in impacts of future hazards being borne by those who have not been party to or beneficiaries of past decisions.
- **Legacy decisions (#7):** The cumulative decisions and actions made by individuals, organisations and governments in the past constrains the options available to current and future decision-makers, creating path-dependencies that risk locking in unwanted consequences, however there many barriers to acknowledging and acting upon the deficiencies of legacy decisions.
- **Communities of place, interest, identity and necessity (#8):** In daily life most people have considerable freedom to engage with various networks of people as, when and how they wish, however during emergency events communities of necessity are thrown together and may need to work together to secure essentials of life, care for the injured and share information and decision-making, with varying degrees of preparedness to do so.
- **Agency and preparedness (#9):** The means and motivation to prepare and plan for hazardous events is readily displaced by other pressing demands and expectations of daily life, so eroding awareness, preparedness and agency when faced with emergency incidents.
- **Lifelong learning practices, mindset and expectations (#10):** Formal learning in educational institutions equip students for everyday life, which in itself reflects assumptions and expectations about the future. These formal learning approaches are only a small subset of the lifelong learning practices that would more effectively support preparation for, response to and recovery from hazardous incidents.
- **Governance and organised decision-making (#11):** Governance and decision-making can be a highly formal and structured process, or highly agile, flexible and adaptive with 'rules' that emerge from a given context (protocols developed by a community or business in response to a rapidly

changing situation). Both are needed in stable times, and higher agility (or the capacity for it) is even more important in a disaster.

- **Leadership (#12):** In times of stability, leadership structures and models in many domains have been characterised by hierarchical use of power and authority, command and control approaches to decision making and implementation, investment in positional leadership and a stronger focus on 'leading from the top'. In situations where rapid change and innovation are required, different leadership structures, styles, skills and cultures may be more useful, and informal, emergent and diverse leadership may be a more useful approach.
- **Nature and people (#14):** Every person's wellbeing is dependent upon natural systems for the provision of goods, services and income, however nature is also a source of dangerous hazards that put lives at risk, and effective balancing of benefits and risks of our interactions with nature depends on the level of understanding of natural systems and governance processes that use that knowledge, and knowledge of the values at stake, to guide decisions.

The full set of typical system patterns developed are provided in Table 16 and are fully described in Appendix Typical System Patterns.

The world now faces rapid, unprecedented change. Extreme natural hazard events are inevitable, and there is an increasing chance of multiple events at once or in close succession. The balance of choices and trade-offs made in stable times can create vulnerability to these events, with potentially disastrous consequences.

The world is going through a period of rapid, novel change and potential shocks [3] which could readily translate into disastrous outcomes [G]. The choices and trade-offs made in times of relative stability and prosperity [E, 1] can create vulnerabilities to major disruptions that amplify disastrous outcomes [G] (Figure 36). The focus of this report is shocks from natural hazards, but this holds true for a variety of different socio-economic shocks too.

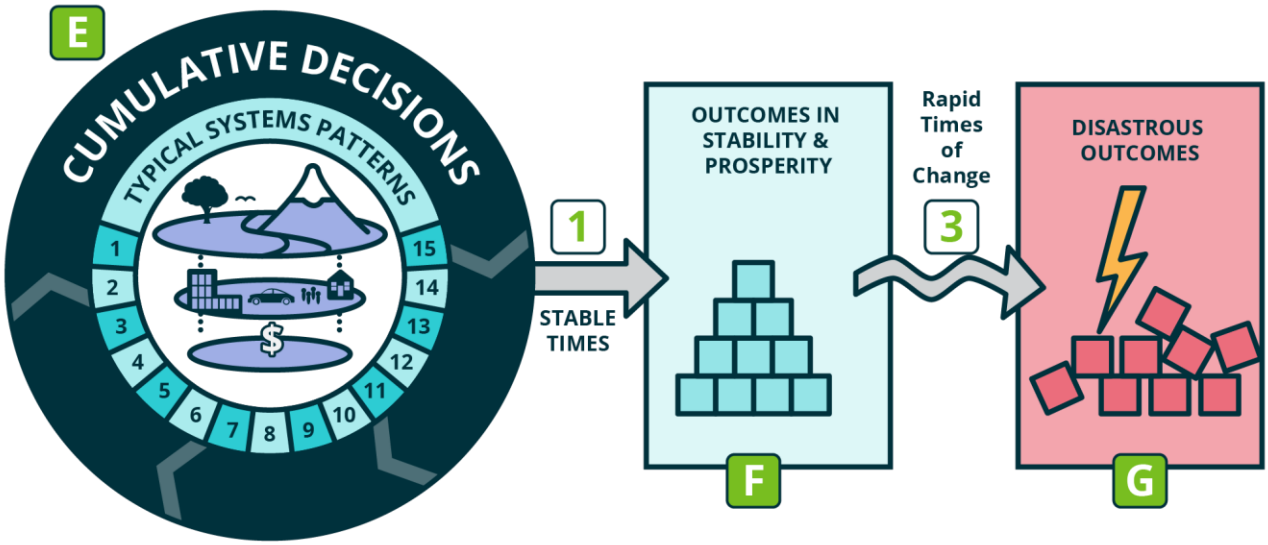


Figure 36 Major shocks [3] can trigger disastrous outcomes [G]

After a disaster happens, there are decision points, with choices to reinforce the current state of existing typical system patterns, or to address root causes of vulnerability.

When a disaster happens, there are decision points for choices [H] to go in one of two ways as shown in Figure 37:

- to reinforce existing patterns and join the Business as Usual trajectory (marked as [4] joining [2] in Figure 37). This could be described as 'Reinforcing Vulnerability'
- or to design 'Interventions addressing root causes' [5] by rebuilding a different system after a disaster (transforming the system), thereby ensuring that the vulnerabilities are not perpetuated in whatever is rebuilt during recovery. This may be, for example relocating settlements, changing laws or other changes to the system structure.

Interventions can be made prior to a natural hazard event, to mitigate the risk of disaster, by making choices to alter the system to reduce vulnerability and increase resilience to extreme natural hazard events.

The most important opportunity for decision makers in all sectors, at all levels, in government, industry and civil society, is shown by decision point [[I] leading to arrow [6] in Figure 37.

These are the decisions that can be made now, while the warning signs of an increasingly unstable system and higher risks of catastrophic disaster are clear, to prevent or reduce the harm and suffering that would eventuate if such a disaster occurred.

This has been the major focus of this Project, and of the Australian Vulnerability Profile more broadly. This is the point at which choices, decisions, actions, interventions can be made to recognise the identified vulnerabilities, and take action to address them.

The challenge, and hope, is to find effective ways to shift the thinking of our political leaders, government agencies, industries and businesses, investors, communities and individuals to start creating the adaptive and transformative changes that go beyond mitigations of individual risks and instead tackle systemic drivers so that the pathways represented by arrow [6] are made effective before catastrophic disaster arrives. As well as reducing vulnerability to catastrophic disaster, these actions also hold the possibility and

promise of redesigning systems that can stay within Raworth's (2017) 'safe and just space for humanity', within the ecological ceiling and based on a strong social foundation (Figure 26).

The way that the approaches developed and tested in this Project can help to do this will be discussed in the following sections.

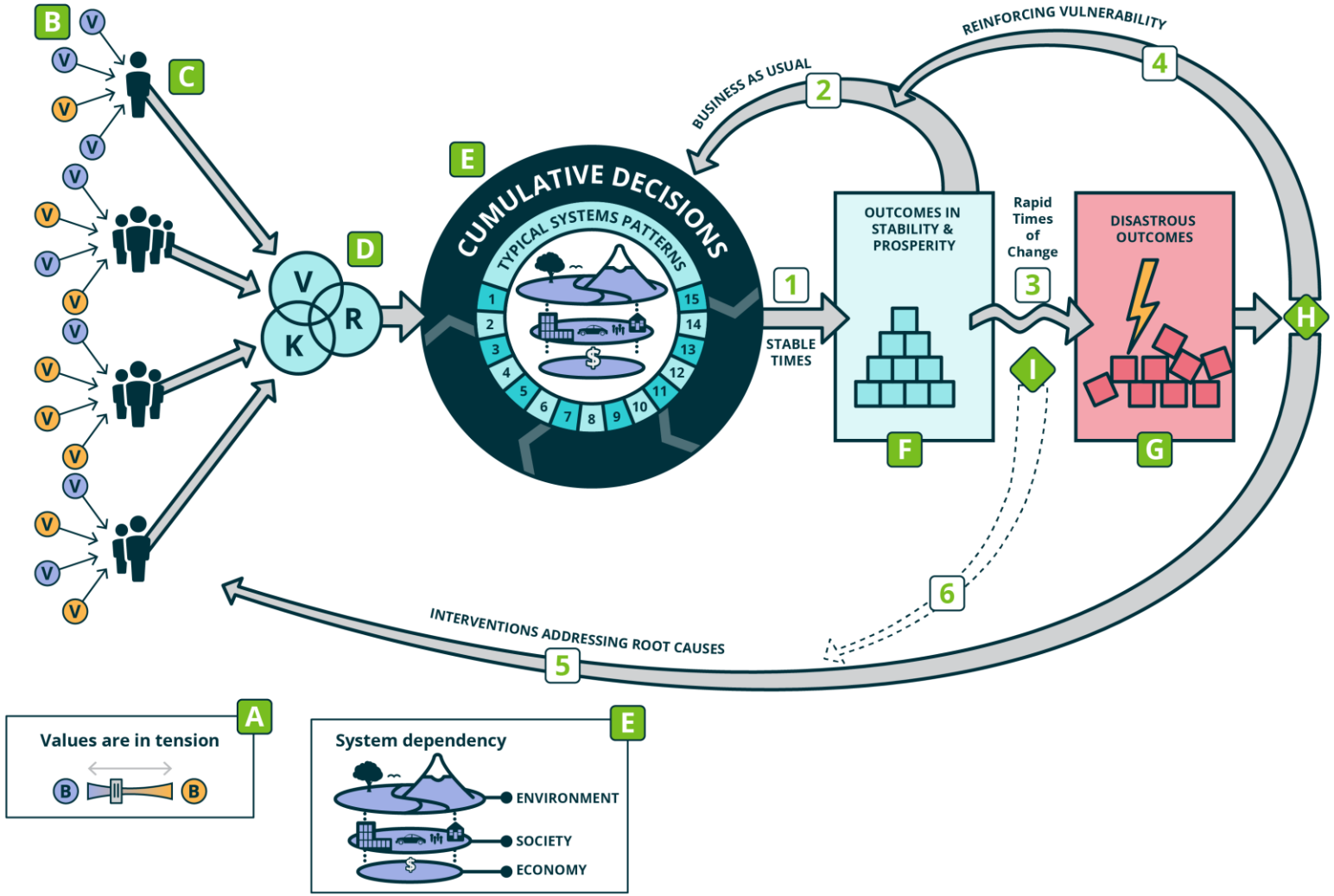


Figure 37 A system view of understanding vulnerability, and intervening to create a system where people can live successfully with natural hazards

6.3 The multiple modes of risk assessment

The organisations that implement risk assessment and management are scattered along a maturity pathway in terms of their appetite, resources and capability for it. It can be somewhat overwhelming to work out how to deal with the myriad risks that have to be managed, particularly those which involve multiple sectors, scales, and stakeholders and higher levels of ambiguity and uncertainty.

Snowden and Boone (2007) proposed an approach to categorising problems and solutions as simple, complicated, complex, chaotic, or disorder. Jones et al. (2014) built on this to describe a hierarchy of simple, complicated and complex risks, and link these to the different characteristics of decision-making (Figure 38).

Characteristics of decision making	Simple risk	Complicated risk	Complex risk
Methodology	Linear, cause and effect	Top down and/or bottom up, iterative	Iterative and/or adaptive, ongoing and systemic
Approach	Analytic and technical	Collaborative process with technical input	Process driven. Frame and model multiple drivers and valued outcomes
Stakeholder strategy	Communication	Collaboration	Deliberation, creating shared understanding and ownership
Mental models	Common model	Negotiated and shared	Contested initially and negotiated over project
Values and outcomes	Widely accepted	Negotiated over project by user perspectives and calculated risk	Contested initially and negotiated over project
Monitoring	Straightforward	With review and trigger points	As real-time as possible, adaptive with management feedback and trigger points

Figure 38 Hierarchy of risks and characteristics of decision-making (from Jones et al. 2014)

Parts of the overall risk in dealing with disaster risk reduction can be dealt with in a 'simple' modality. This does not necessarily mean that they are simply, easily or cheaply solved, or that deep scientific expertise is not required. Rather, it means that the problems can be clearly formulated by experts/researchers, are technically resolvable by a scientific approach, using deductive logic and testing of hypotheses to develop predictive knowledge – for example, reducing risks by testing and designing improvements in building standards (by experts) which are then adopted or implemented by industry. These simple approaches to risk are necessary and appropriate to solving the overall problem.

The 'complicated' mode of risk assessment and management may include methods to better quantify and characterise hazards (e.g. climate change modelling and projections, exposure and impact assessments) or deal with emergency response (e.g. the communications and logistics planning). These can require high levels of expertise across multiple disciplines, and they do lend themselves to developing some level of predictive knowledge which is important to assessing and managing risk.

The global risks and types of changes potentially leading to catastrophic disasters are rapid, novel, interacting and cumulative – these are the characteristics of 'complex' risk. Core characteristics include: many disciplines may be required, the problem is not necessarily resolvable by experts because gaining predictive knowledge may not be possible, and stakeholders with diverse forms of knowledge and roles in the system are an integral part framing the problem and implementing the risk management strategies. Therefore, working in this space requires a fundamental shift in the modality of the approach, and the expectation that simple, knowable 'solutions' are possible – rather, it is about understanding, designing and

implementing actions which show and effectively 'steer' social and ecological systems towards the desired outcomes of reduced harm from disasters in the future. The magnitude of changes needed to steer towards more sustainable futures will range from minor incremental change of parts of systems, through to major structural change of large systems. It is essential that a structured process of monitoring, evaluation and learning underpins the implementation of any changes, so that people know whether the desired changes are happening, as well as how, and why.

This Project uses the approaches relevant to the complex category of risk, and should build on and complement the 'simple' and 'complicated' approaches to risk assessment and management that are already in various states of play in different organisations in Australia.

6.4 Ways to use the approaches and tools used in this Project to conduct vulnerability assessment

The interpretation and implementation of the outputs of this Project for use in the Australian Vulnerability Profile are within the remit of the Australian Government, and beyond the scope of this Project and report.

In this section, suggestions are provided on how existing disaster risk assessment approaches can be readily broadened or complemented with the approaches and tools deployed in this Project.

The key elements for doing this would involve some or all of the following:

- Problem framing: a clear argument about the need to move beyond existing approaches such as risk assessment (e.g. section 1.2 and section 6.2.1)
- Have the agreement, support or approval of those with the mandate, funds, responsibility or agency to participate in the process, and act upon the findings (section 3.8.6).
- With key relevant stakeholders adopt or adapt the Deconstructing Disaster workshop approach, encompassing any one or more of its concepts, tools or processes (Chapter 3), particularly those discussed below.
    - Appropriate participatory and engagement processes where the design includes explicit consideration of who is involved, how diverse types and sources of knowledge are co-produced and managed, ethics protocols, a balance of logic and emotions, experience of designers and facilitators (Chapter 2, section 3.2).
    - The use of narrative (Chapter 3) to engage heart, mind and imagination, encourage anticipatory learning, and to shift participants to the thinking needed for pathway 6 (Figure 37), and communicate effectively. Many of the stories created through the workshops have the potential to be turned into powerful communication products to a range of audiences
    - Tools to encourage systems thinking. These may include (but are not limited to) those used in this Project:
        - the values framework (Chapter 4) to elicit and understand how people have different held values, value different things, and prioritise them differently depending on the context
        - the values-knowledge-rules tool (Chapter 3) to understand barriers and enablers, and use all three lenses for problem framing and solutions
        - the cause-effect diagrams to gain insight into multiple perspectives on a system, and its dynamics (Chapter 2 and Chapter 5). Typical system patterns were used as a tool to explore how cumulative choices about values, rules and knowledge affect

vulnerability by identifying the causes and effects, reinforcing and dampening feedbacks, and diagnose vulnerabilities. They can also be used to identify potential intervention points, and options and pathways for shifting the patterns (simple example in section 5.4.2, further discussed in section 6.5). These diagrams represent a step change from the event-based thinking of many participants, to pattern-based thinking – but they are still only partial system analyses that would benefit from further refining

  - synthesis processes to simplify and build explicit systems logic (section 6.2.2)
  - the tools to explicitly think through the intended impacts sought by proponents of an initiative (e.g. using Theory of Change), and a monitoring, evaluation and learning approach to assess whether these changes were realised (Chapter 2). Although a full analysis has not been completed, the early results from the post-workshop surveys from participants indicate that there was useful learning, elevation of systems understanding, new networks and capability built (section 3.7.7). It is important to acknowledge that more outputs and outcomes from the Project are possible than are visible as tools or results in this report

- The vulnerabilities identified at overarching systems level, and at sub-system level with each of the typical system patterns (listed in detail in Appendix Typical system patterns) could be further developed. The diagrams are not at the stage of being fully developed system diagrams. They had high utility in moving participants from an 'event' based construct, to one where patterns could be seen. With further work, these could be used to construct a hierarchical taxonomic 'profile' of vulnerability *per se*, if this was deemed useful. The tabulated causes and effects for each of the typical system patterns could be used in other policy development processes as important variables or factors to consider – even if the system framing *per se* was not used, the derivation of these variables from using a systems perspective will be useful to feed into other sorts of considerations
- Alternatively, many of the diagrams could be web-enabled as an exploratory tool.

6.5 Moving beyond vulnerability – resilience, adaptation pathways, transformation and a structured approach to enhancing anticipatory learning

This Project provided support to the development of the Australian Vulnerability Profile by providing some clarity and evidence around what makes Australia vulnerable to disaster, and what values are at stake. The process has stimulated dialogue around imagining extremes and taking a systems view. Using a vulnerability assessment lens has provided a step change in thinking beyond more standard risk assessment methods. But what lies beyond vulnerability assessment and how can the links be made to resilience, and sustainability development goals (Kelman et al., 2015, Kelman et al., 2016, O'Connell et al., 2016, Kelman, 2017)?

6.5.1 Designing intervention options and pathways

Proactive and strategic interventions to shift or rebalance the knowledge, values or rules can create a greater range of options to reduce vulnerability (examples were provided using outputs from this project in sections 5.4.2 and from another Australian project in section 5.4.4), and this approach could be expanded or modified.

There are many approaches and tools in the areas of resilience thinking (Walker et al., 2006, Walker and Salt, 2012), and for combining resilience assessment with planning options and pathways for designing interventions (Haasnoot et al., 2013, Wise et al., 2014, Butler et al., 2016a, Butler et al., 2016b, O'Connell et al., 2016, Maru et al., 2017, Lyne, 2018).

These approaches could be explored and adapted to be appropriate for a more thorough focus on designing interventions than was possible in the Deconstructing Disaster workshops. A process of more rigorously identifying, prioritising and sequencing the interventions could be helpful in working out pathway 6 (Figure 37).

6.5.2 Co-production of ways forward

A person-centred pathways-based approach would help to ensure the intervention strategies are actionable and sufficiently adaptable to accommodate pervasive uncertainties (Werners et al., 2013, Butler et al., 2016c) https://coastadapt.com.au/pathways-approach. Decision making can, through an effective process of co-creation, become a process in which a group defines a problem and then develops knowledge to solve it (Brugman and Ingram 2012). Decision choices are the result of an interactional process of knowledge development in a group rather than the rational choice of a decision maker. This way of making decisions presents the advantage that solutions can be better tailored to jointly defined objectives, since what a problem is, and how it is approached and solved, is determined cooperatively among participants and benefit from the diversity of problem solvers (Brugman and Ingram 2012).

6.6 Conclusions

The short responses to the research questions framing this Project are summarised in this conclusion.

Research Question 1: What do we value, and what do we stand to lose in disaster?

What people value, and might lose, can be understood by systematically analysing the relationships that people have with things of value. People value a vast array of things including physical things, other people and experiences. The value of these things is realised through the diversity of relationships people, individually and collectively, have with them. The relationships often depend on specific attributes of the things, and the relationships satisfy a diversity of motivations or held values within people. The relationships people have with different things are dependent on context; in different situations different things or attributes are important, and different motivations come into play.

People value things differently in stable times and in the face of disaster. The workshops identified that, while many of the things people value are important both in times of relative stability and in the face of disaster, there are a range of things that are possibly taken for granted most of the time but whose value is revealed in times of disaster. These include things that are directly damaged or lost during disaster such as houses, mementos, capital, people and services, and amenity associated with these things, but also sense of security, safety, harmony (lack of trauma), normalcy and self-efficacy. Losses may be to the individual or shared through personal or community connections. Understanding how the relative importance of things of value changes can help inform preparation and response actions to more effectively reduce losses and suffering.

People value the processes in society that keep them safe, and prospering. There is another class of things whose value is revealed during disaster: those processes and capacities that have the ability to reduce vulnerability during stable times and to enable coping and recovery during and after disaster. For example, the diffuse system of processes that govern the location and construction of housing and infrastructure, and specifically the ability of that system to reduce known vulnerabilities. Or the ability of service providers,

public, community and private, to deliver tailored responses that address the specific needs of affected people, as opposed to focusing on aggregated economic costs. Or more fundamentally, societal norms, business practices and economic policies that could reduce the extent to which the burden of vulnerability is borne by individuals and communities separate from those who profit economically or politically through the processes that create and transfer risk. Recognition that these systems have failed to reduce vulnerability leads to loss of trust and confidence in governments, businesses and even society.

People value resilience, and believe that it has been declining. Resilience in the face of floods, fire or cyclones is often held as a defining Australian characteristic. However, the workshops clearly revealed it is not a given, especially in a rapidly changing Australia. It can readily be eroded by greater focus on cost reduction, near-term outcomes, and increased mobility placing people in unfamiliar situations and communities.

Exploration of catastrophic disaster revealed a range of differences between the ideal (vision for successfully living with disasters) and the actual (current state and dynamics of the things of value). This provided evidence of the tensions in values and priorities, and the difficulties faced in evaluating trade-offs and making choices between people, generations, geographical locations, and jurisdictions. Section 4.5 and Figure 30 provide concise summaries.

Research Question 2: What makes Australia vulnerable to catastrophic disaster?

There is a nested set of answers to this question.

At the highest level, lack of awareness and acknowledgement of vulnerability is itself a vulnerability. Exploration of the potential impacts of catastrophic disaster on the current system showed that everyone, and everything is vulnerable. A catastrophic disaster would be indiscriminate in the immediate impacts, depending on location and type of hazard, it could cut across all socio-economic groups, locations, ecosystems, supply chains and industries. Different people and groups of society may have varying capacities to reduce their exposure, or recover more quickly – but everyone would be affected through the rapidly cascading impacts.

The overarching systems diagram (Figure 37) shows that there is a reinforcing 'trap' of vulnerability if the upper feedback loops are used – i.e. continuing with Business as Usual institutions, decisions, and expectations. There is a pattern of increasing disaster costs in Australia, and there are some signs of changing from the upper loops to the lower ones – for example some institutional changes are being made to 'build back better' rather than build the same vulnerable infrastructure.

The real vulnerability is, however, whether society can find ways to shift to loop 6 – building resilience of communities by transforming systems – without having to encounter disaster as the trigger for doing so. The inertia, status quo, vested interests, legacy decisions and other forms of 'lock-in' mean that it takes concerted effort and a very different set of expectations, framings, leadership from all sectors of society to do so. It goes against the typical story arcs (such as the 'hero's journey') to which humans are so attuned – i.e. 'life goes along as usual, a crisis happens, a dilemma is exposed, a hero survives and resolves, and may if needed find redemption'. In this case, the multiple emergent distributed citizens, the 'post heroic' leadership (Fletcher, 2004), foresees and averts a crisis, spends effort and money on avoided costs which are not visible or measurable, creates systems and institutions which address values tensions driving the system in ways that are creating vulnerability, and redistribute benefits. In this Project a powerful experiential disaster narrative was used as a 'nudge' towards thinking about moving towards loop 6, but a much greater and more widespread shift would be needed than what can be stimulated in this manner. As a prerequisite to such a shift, acknowledging, understanding and materially addressing the root causes of vulnerability could be a great benefit and strength.

At the sub-system level, typical system patterns were used to understand dynamics for 'vicious' and 'virtuous' cycles, and diagnose specific vulnerabilities (Appendix Typical System Patterns). The exploration

of catastrophic disaster showed that, unlike previous disasters in Australia where several typical systems patterns may be disrupted, if a catastrophic disaster occurred, all of the typical system patterns would be affected. This degree of interdependency between systems is perhaps one of the greatest vulnerabilities.

The utility of typical systems patterns can be built on to inform interventions that build resilience and mitigate risk. Further steps are required to check and test the typical system patterns out with a wider range of literature, experts and a broader range of stakeholders, and they could then be used (in combination with other tools such as Theory of Change) to help identify potential interventions to address the vulnerabilities by addressing systemic risk and root causes.

Although not illustrated in our report, we anticipate that further efforts to develop the system diagrams would reveal competing and conflicting system conceptualisations. This is not something to avoid, and indeed these diagrams are a vehicle for making these different perspectives explicit in a constructive way that supports evidence-based reflection.

> *Research Question 3: Has the Project been an effective intervention in helping to shift the narrative, build capacity and networks, change practice and institutions?*

A full analysis of the Project is yet to be completed, however the early results from the post-workshop participant surveys indicate that there was useful learning, elevation of systems understanding, new networks and capability built (section 3.7.7).

The workshops were clearly successful as standalone activities in terms of:

- providing a forum for dialogue between levels of government, sectors, organisations, scales of operation, different disciplines and perspectives
- introducing stakeholders to a different set of ideas and approaches
- helping to build capacity, trust and networks which will hopefully persist beyond the workshop
- raising 'expert' awareness of the importance of involving and working with communities (this came out strongly in Adelaide and Brisbane workshops, while the message from the Perth workshop was less clear)
- contributing to a step change in the way many participants frame the challenge, and potential ways forward in addressing systemic cross-scale issues. There is clear evidence that the nature and depth of conversations, analysis of the problem, types of interventions suggested, changed over the course of the two days.

The convening power of the Commonwealth and States; the participation of senior and executive leadership; and the science and facilitation expertise underpinning workshop design and delivery methods were a large contributor to successful outcomes.

There is a real opportunity to use the successful elements of the learning design and find ways to amplify the experiential learning process in other ways beyond this project.

Glossary

Term	Definition
Adaptive capacity (Adaptability)	The capacity of actors in a system to respond to shocks and to trends and (if known) the proximity of the state of the system to a threshold, and so to influence resilience. See General resilience.
Adaptation	This contested term has many variants (see Resilience, Adaptation and Transformation – terms used differently by different communities of practice). In this report we use it in a way consistent with the social-ecological literature, to refer to the process change that enables a system to maintain its identity, so that it is better able to cope with trends and shocks, or to reduce vulnerability to disturbance. We apply the term in this report to intentional actions by people, making the most of windows of opportunity.
Adaptive governance	Institutional and political frameworks designed to adapt to changing relationships in society and between society and ecosystems.
Adaptation pathways	Implementation pathways are sequences of alternative sets of prioritized decisions and actions to achieve desired impacts. Adaptive pathways are informed by learning, and continually updated with improved understanding of interactions between scenarios of change, decision lifetimes, and social and ecological thresholds.
Agency	Agency is the capacity to intentionally act and shape events. Agency can be individual, collective, or proxy, whereby individuals can influence through others. Agency requires forethought, self-reflectiveness, and an ability to regulate motivation and performance (Bandura, 2018). Underpinning agency, is *efficacy* which can also be can be individual, collective or proxy. Efficacy is concerned with perceived capability, "an individual or collectives' belief that addressing an issue is within their individual or collective abilities" (Heald, 2017).
Controlling variable	A variable that is underlying or shaping change in the system. For example, CO_2 concentration is a controlling variable for climate and ocean acidification. A controlling variable may not be of interest or concern in its own right, but because other variables of concern are affected by it. A controlling variable may change in a slow, predictable way (e.g. rising groundwater table), but the impacts of that change may not be smooth and can exhibit threshold effects. For example, once saline groundwater rises to within a certain distance of the soil surface, capillary action draws it to the surface creating saline topsoil that can prevail even if the water table falls again. In this case the controlling variable (groundwater level) changes smoothly, but the rapid response in soil fertility amounts to a rapid, effectively irreversible, shock in land use options.
Disaster	Severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery (IPCC, 2014).
Discounting	A mathematical operation making monetary (or other) amounts received or expended at different times (years) comparable across time. The discounter uses a fixed or possibly

	time-varying discount rate (>0) from year to year that makes future value worth less today (IPCC, 2014).
Exposure	The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected (IPCC, 2014).
Feedback loop	A chain of cause and effect forms a loop that can either amplify or dampen the effects of change. For example, poverty can be reinforced by feedback loops (e.g. poverty leads to poor health which leads to unemployment which leads to greater poverty).
General resilience	Capacity of the system to cope with a diverse range of shocks and disturbances. There are some system properties, like high levels of health and education in a population, that confer a good ability to adapt and respond to a wide range of unexpected changes. It is sometimes referred to as "coping capacity" or "adaptive capacity". Further discussion in Walker et al. (2014).
Governance	Governance is the way people, organisations and society more generally arrange themselves to make decisions (after LVK), including the information used, the values that are prioritised, who is involved, the rules applied, and levels of oversight. Governance emerges from the interactions of many actors including government, the private sector, and not-for profit organizations at levels ranging from international to local. It includes not only laws and regulations but also negotiation, mediation, conflict resolution, elections, public consultations, protests, markets, online platforms for peer-to-peer exchange (e.g. Airbnb) and other decision-making processes. Governance can be formally institutionalized or, equally important, "expressed through subtle norms of interaction or even more indirectly by influencing the agendas and shaping the contexts in which actors contest decisions and determine access to resources" (Krievens et al., 2015)
Hazard	The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources. In this report, the term hazard usually refers to climate-related physical events or trends or their physical impacts (IPCC, 2014).
Impact Pathways	Is the explicit articulation of the mechanisms by which an intervention will bring or contribute to desired changes and desired impact.
Institution	A set of rules and norms that guide how people within societies live, work, and interact. Formal institutions consist of codified rules such as constitutions, organized markets, and property rights. Informal institutions consist of the rules which express social and behavioural norms of an individual, family, community, or society.
Intentional transformation	The deliberate transformation of a system to one with different defining variables and therefore a different identity (e.g. a new way of making a living), initiated and guided by the actors. See also transformation.
Intervention	Is the term used to describe any action that is planned or made in the system. It is used specifically in a sequence of other actions such that a pathway is formed. In addition there are times where one such action is so important that no other changes in the system can occur without this specific action, these are termed fundamental interventions. Interventions can be at any part of the social ecological system e.g. governance, changes in rules, laws, etc.; changes in recommended or required management practices; capacity-

	building, including – education, information flows; development of social networks, institutions, support groups; economic/ financial – financial aid; incentives and disincentives
Learning	Learning is the explicit process of challenging stakeholders' accepted wisdom and understanding through new information or knowledge. This is a fundamental objective of building human capital, but there may be different approaches to achieving it. A favoured method is "social learning", defined as "*knowledge-sharing, joint learning and knowledge co-creation between diverse stakeholders around a shared purpose, taking learning and behavioural change beyond the individual to networks and systems*." It includes opportunities to acquire and practise non-academic capabilities, such as physical skills in preparing a property for bushfire and interpersonal skills in coping with conflict or difficult emotions.
Lock-in	Lock-in occurs when a market is stuck with a standard even though participants would be better off with an alternative. In this report, lock-in is used more broadly as path dependence, which is the generic situation where decisions, events or outcomes at one point in time constrain adaptation, mitigation or other actions or options at a later point in time (IPCC, 2014).
Multi-stakeholder Engagement	Multi-stakeholder engagement refers to (structured) processes that are used to ensure participation on a specific issue and are based on a set of principles, sometimes inspired by the rights-based approach to development (i.e. freedom of association, the right to participate in political processes and freedom of opinion, speech and expression). The process aims to ensure participatory equity, accountability and transparency, and to develop partnerships and networks among different stakeholders. Specific tools and approaches can be found in UNDP (2006) and DiFD (2002)
Natural hazard	See Hazard
RAPT Approach	The Resilience, Adaptation Pathways and Transformation Assessment (RAPT) Approach is an integrated assessment process to guide management and monitoring of complex social–ecological systems. It has broad application in supporting project planning and implementation for sustainable land management, and to management of other social–ecological systems (O'Connell et al 2016).
Resilience	Resilience is a property of a social–ecological system. It refers the ability of a system to maintain system identity i.e. absorb shocks, such as drought, by reorganising so as to retain the same functions, structure, and feedbacks. It is neither good nor bad – a system could be in an undesirable state but still be resilient to shocks, e.g. a grassland that has been invaded by unpalatable shrubs. This contested terms has many other definitions discussed in other places (e.g. (Adger, 2000, McCann, 2000, Manyena, 2006, Barrett and Constas, 2014).
Risk	The potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as probability or likelihood of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. In this report, the term risk is often used to refer to the potential, when the outcome is uncertain, for adverse consequences on lives, livelihoods, health, ecosystems and species, economic, social and cultural assets, services (including environmental services) and infrastructure (IPCC, 2014).
Risk Management	The plans, actions or policies to reduce the likelihood and/or consequences of risks or to respond to consequences (IPCC, 2014).

Robustness	Robustness refers to the ability of a thing to be effective in the face of multiple different types of challenge. It can refer to a decision, process, community, infrastructure or supply chain. If a system is optimised for one particular situation, it can often be more efficient than if it is designed to perform under multiple situations. Hence, robustness may come at a perceived cost, either being less effective in a given (e.g. the most anticipated) situation or more expensive.
Social–ecological system	Interacting system of ecosystems and human society with reciprocal feedback and interdependence. The concept emphasizes the humans-in-nature perspective. It includes both physical entities (e.g. water, people) and non-physical influences (e.g. worldviews, knowledge).
Stakeholders	A stakeholder is any entity with a declared or conceivable interest or stake in a policy concern. The range of stakeholders relevant to consider for analysis varies according to the complexity, issue, area and the type of intervention proposed. Stakeholders can be of any form, size and capacity. They can be individuals, organizations, or unorganized groups.
Structural change	Changes, for example, in the relative share of gross domestic product (GDP) produced by the industrial, agricultural, or services sectors of an economy, or more generally, systems transformations whereby some components are either replaced or potentially substituted by other components (IPCC, 2014).
Sustainability and Sustainable Development	This contested term is used in a "universalist sense" to mean the central notions of the planet and its people enduring in perpetuity, while maintaining health, prosperity and well-being. This is commonly translated into a concept of three interdependent "pillars" of sustainability, i.e. maintaining environmental, social and economic health. Sustainable development is "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987). There is increasing recognition that in order for human related goals to be met, there are prerequisite ecosystem functions that need to be maintained.
System	See social-ecological system.
System Identity	System identity is characterised by the system structure, feedbacks and function. For a system to retain its identity in the face of disturbance it means that the system reorganises to keep performing in the same way (Walker and Salt 2012).
Scenarios or Futures	Stories that describes a possible future, by identifying significant events, actors and mechanisms. A set of scenarios that bracket the range of possible futures is a useful tool for examining the kinds of processes and dynamics that could lead to a SES developing along particular trajectories.
Threshold (aka critical transition)	A level or amount of a controlling, often slowly changing variable that if crossed triggers a larger or more significant set of system responses. Some transitions can be difficult, slow or impossible to reverse (e.g. slow progression of diabetes can trigger irreversible damage to eyesight or amputation) – see tipping point.
Tipping point	A level of change in system properties beyond which a system reorganizes, often abruptly, and may not return to the initial state even if the drivers of the change are abated. For the climate system, it refers to a critical threshold when global or regional climate changes from one stable state to another stable state. The tipping point event may be irreversible (IPCC, 2014).

Transformability	Transformability is the capacity for a system to be transformed to a different system. See Transformation.
Transformation	A system change to a new identity
Transition	The course of the trajectory from one domain of a system to another, or from one kind of system to another (i.e. a transformational change).
Values, rules and knowledge tool	Decisions are always made within a particular context, and one way to help understand this is to use a Values-Knowledge-Rules "lens" To make a decision, the following are needed: • enough people must want the outcome (Values) • the decision must be allowable (Rules) • some knowledge that informs the rationale for decisions and interventions (Knowledge) The prevailing set of Values, Rules and Knowledge defines the context in which decisions are made. This space in the middle metaphorically holds the options are that are available to a decision maker. It is relatively easy to make an intervention that falls within this space. When decisions are needed that are not consistent with the current decision context, interventions are needed to change the context.
Vicious and virtuous cycles	Vicious and virtuous cycles are both feedback loops where causes lead to effects that reinforce causes. In a vicious cycle, the feedback loop reinforces unwanted outcomes, whereas in a virtuous cycle the feedback loop reinforces desirable outcomes. Where a vicious cycle is in operation, it can be possible to turn it into a virtuous cycle because both can be represented by a neutrally-expressed reinforcing cycle. For example, the virtuous cycle "improved communication practices build trust that leads to more information sharing that fosters improved communication practices" can be expressed as a vicious cycle "worsening communication practices erode trust that lead to less information sharing that fuels poorer communication practices", or as a neutrally-expressed reinforcing cycle "the quality of communication practices affects levels of trust that in turn influence the quality of communication practices".
Vulnerability	The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt (IPCC, 2014). In this Project, vulnerability is used in order to highlight the plurality of values being affected and at stake in disasters, and to shift away from the currently narrow technocratic approach to risk assessment and emphasis on economic values.

Acronyms

AI	Artificial intelligence
ANZEMC	Australia-New Zealand Emergency Management Committee
AVP	Australian Vulnerability Profile
BoM	Bureau of Meteorology
EMA	Emergency Management Australia
GA	Geoscience Australia
GDP	Gross Domestic Product
GST	General Sales Tax
LNG	Liquefied Natural Gas
NDSR	National Strategy for Disaster Resilience
NESP	National Environmental Science Program
PESTLE	Political Economic Social Technological Legal and Environmental
PPR	Prevention, Preparedness, Response
RAPTA	Resilience Adaptation Pathways and Transformation Assessment
TOR	Terms of Reference

Appendices

A.1 Ethics Protocols

The following information was provided to participants in the Project.

Research Ethics Information Sheet for Contributors

The Attorney-General's Department (AGD), through Emergency Management Australia (EMA), is leading the development of the *Australian Vulnerability Profile* (The Profile). Developed with and endorsed by stakeholders, the result will be a national narrative; a documented account of the connection between hazard, exposure and vulnerability, with a specific focus on why and how Australia is vulnerable to severe to catastrophic disasters. It will lead to a better appreciation of how the nation's underlying stresses drive disaster risk and present resilience challenges, as well as improve our understanding of the consequences and cascading impacts of severe to catastrophic disasters.

The purpose of developing the Profile is to enhance Australia's preparedness for severe to catastrophic disasters, in order to reduce their impact and improve economic and social sustainability into the future.

CSIRO is collaborating with EMA to work with states and territories, the community and private sectors and other key stakeholders, to construct the first iteration of the Profile.

We work within a set of ethical protocols which are intended to keep all participants within a safe and respectful process for sharing knowledge, to acknowledge the intellectual contribution that you will make to the project, and seek your informed consent for using it in the range of ways that we envisage taking the work forward.

What is involved in contributing to the project?

You are invited to participate in workshops, surveys and/ or interviews.

- Workshops will last between 1 – 2 days, depending on the nature of the workshop. Workshops will not be audio recorded.
- A series of surveys and interviews will be undertaken throughout the project to enable data gathering for development of the Profile and to gauge the effectiveness of the process itself.

These activities will help create the building blocks used to develop the Profile and associated evaluation and learning, with the longer term goal of enhancing Australia's preparedness for severe to catastrophic disasters.

We are also seeking your consent to take photographs of the workshop, which may include pictures of you participating in focus group activities.

How will the information you provide be handled?

The information you provide during this activity will be synthesised into a visual and written report, which will be used by the project team from CSIRO and EMA to design the ongoing activities of the project, including the first Australian Vulnerability Profile.

In some instances the facilitator or interviewer will request audio recording the interview to aid with transcription of the interview. If you agree to be recorded, the file will be securely stored on the CSIRO staff member's computer. All data be stored securely by CSIRO and retained for a period of five years after which it will be destroyed.

CSIRO and EMA will use photographs from the workshops (which may contain your image) in any of their publications and materials (including written, electronic or multimedia materials) for distribution anywhere in the world, on CSIRO and EMA's websites, for promotional or reporting purposes.

When giving your permission you should be aware that any information published on the internet is accessible to millions of users from all over the world, that it will be indexed by search engines and that it may be copied and used by any web user. This means that once the photograph is published on the Internet we will have no control over its subsequent use and disclosure.

CSIRO anticipates keeping photographs on a secure filing system in perpetuity. Other material including audio files, workshop notes and the interview transcriptions will be stored on a secure CSIRO project electronic filing system and retained for a period of five years after which it will be destroyed.

The information you provide to us will be used to write reports; manuscripts for academic publication; website context, and promotional material for research activities. Unless requested separately you will not be personally (or individually) identifiable at any stage of the synthesis writing process. It is possible that comments or ideas that you will provide will be referenced as a 'stakeholder', 'interviewee' or 'participant'. If we wish to ascribe a quote we will contact you separately and specifically request permission. De-identified, non-sensitive data collected by the project may also be shared with other researchers for the purposes of verifying published results or advancing other research on this topic.

Participation, withdrawal, and confidentiality

Aside from giving up your time, there are no foreseeable risks associated for participating in this project. Participation in all activities is completely voluntary and you are free to withdraw from specific project activities or involvement in the Australian Vulnerability Profile project at any time without explanation, prejudice, or penalty, by notifying one of the project team. If you decide to withdraw, simply notify a researcher either at the workshop or on the contact details below. The information collected during workshops, surveys and interviews will be treated sensitively and individual contributions will not be reported to others external to the group. We will only use information that you give us permission to include, however once your responses have been combined with others' for analysis, it may not be possible to remove your contribution.

We are mindful that the information and feedback that you provide to us is sensitive. All information collected will be treated confidentially and any journal papers or reports will focus on describing the system rather than an individual perspective.

How to find out more about the project?

This project is being funded by EMA as one of their priority projects and by the CSIRO Land and Water. If you would like to receive a copy of the final report, please tick the box on the consent section of the survey. In addition, please feel free to contact us at any time during the project.

Thank you for your participation in this research.

AGD
Monica Osuchowski
Email: Monica.Osuchowski@ag.gov.au
Address: 3-5 National Circuit, Barton ACT 2600
Tel: 02 6141 3619

CSIRO
Dr Deb O'Connell
Email: deborah.o'connell@csiro.au
Address: CSIRO Ecosystem Sciences; Clunies Ross Street; Black Mountain; ACT; 2605
Tel.: 02 6246 4548

Ethical clearance and contacts

This study has been cleared in accordance with the ethical review processes of CSIRO, within the guidelines of the National Statement on Ethical Conduct in Human Research. If you have any questions concerning your participation please contact the CSIRO research lead (contact details are provided below). Alternatively, any concerns or complaints about the conduct of the research can be raised with CSIRO's Social Science Human Research Ethics Committee by email at csshrec@csiro.au or by contacting the Manager of Social Responsibility & Ethics on +61 7 3833 5693.

Dr Deb O'Connell
Email: deborah.o'connell@csiro.au
Address: CSIRO Ecosystem Sciences; Clunies Ross Street; Black Mountain; ACT; 2605
Tel.: 02 6246 4548

A.2 Hazard scenario brief to guide development of hazard scenarios

Background

Emergency Management Australia (EMA) is leading, in collaboration with ANZEMC, a project that explores the question of '*what makes Australia vulnerable to disaster when severe to catastrophic events impact what people value*'. This project is known as the 'Australian Vulnerability Profile (AVP)'.

EMA has partnered with CSIRO to provide the underpinning science and techniques to engage and collaborate with stakeholders to answer this question. Initially, workshops were held in Adelaide and Brisbane in November 2017 to explore this question, with additional stakeholder engagement proposed in Perth, Melbourne and Sydney in 2018.

Hazard scenarios developed for EMA by the Bureau of Meteorology (BoM) and Geoscience Australia (GA) are being used in workshops to support data capture for the Australian Vulnerability Profile (see Attachment A). This document provides details about the hazard scenarios and confirms agreement in how they will be used.

Overview

The scenarios presented by BoM and GA are done so as a plausible but extreme sequence of weather, climate and natural hazard events.

BoM has been guided by EMA and GA's knowledge of relevant settings for the exploration of Australia's vulnerability to extreme weather and natural hazards in setting the scenarios. The scenarios explicitly include plausible near-future extremes under projected climate change. The geological hazard scenarios presented by GA are credible scenarios selected from national scale hazard assessments GA releases for earthquake and tsunami. GA also developed plausible impacts from the hazard scenario for EMA.

The purpose of the scenario

The scenarios are to be used in a workshop setting only, to help participants imagine severe to catastrophic events, allow participants to explore future vulnerabilities, and walk-through likely consequences. The scenario is not to be used as part of a formal contribution to any publication or public presentation.

What the scenarios are

The scenario is based on the likely impact of a plausible 'perfect storm' of weather and climate events in the near future (next decade) and a plausible geological hazard independent of the climate setting and climate driven event. The events are based on historical extreme events and likely global warming trends combined with naturally-occurring climate variability as currently observed in the real world.

These events are placed in a combination and sequence that is physically plausible for the climate of Australia, and specific to the region that the workshop is held in. This scenario is not overly dependent on further warming of the climate system, but rather a confluence of already observed trends and extremes of natural variability. Nevertheless, continued warming is expected to occur – in part because of greenhouse gases already released into the atmosphere — which underscores the salience of the scenarios and the overall exercise in the context of understanding vulnerability and disaster risk reduction.

The scientific basis of the scenarios is informed by and outlined in:

- the Joint BoM/CSIRO State of the Climate Report and Climate Change in Australia publications that detail changes in extreme events under climate change
- GA's National Seismic Hazard Assessment and National Offshore Probabilistic Tsunami Hazard Assessment (updates scheduled for released by June 2018), and their supporting publications.

What the scenarios are not

The scenario is *not a forecast.* The scenario is *not a prediction*.

Attachment A: EMA Brief

Purpose

For EMA/CSIRO to provide guidance to inform the assistance provided from technical partners to develop hazard scenarios specifically for AVP stakeholder workshops

The role hazard scenarios play in the workshop

Hazard scenarios are sought to spark conversation about 'what makes Australia vulnerable to disaster' among workshop participants. The scenarios will be used to guide discussions among workshop participants specifically in Session 1 and 3 of the AVP Workshop process. The hazard scenarios will not be replicated or described in the AVP itself.

CSIRO have considered severe to catastrophic events emerge from a confluence of trends and extremes in planning the approach to the AVP workshop and engaging participants. The broader context surrounding the hazard scenario will be carefully staged as well as careful presentation of the scenario itself.

Specific requirements for the 'hazard scenario set':

Hazard scenarios provided by technical hazard agencies such as BoM and GA are preferred for credibility. However, the discussion the hazard scenario generates among participants is more important than technical accuracies of the hazard scenario itself. Appropriate caveats and disclaimers will be used to treat any identified risks.

Hazard scenarios will be at the level of severe to catastrophic, and have national implications. Scenarios will be such that the impacts could be looked at through the lenses of: government, institutions, communities and individuals, households and families. Vulnerabilities that can be tested or exposed through the scenarios include loss of access to (or stress on) food, water, sanitation, shelter, health, communications, energy and transport for example. These could be exposed through impacts of the scenario on people, property, critical infrastructure and environment.

Hazard scenario products expected

- A joint BoM/GA proposal very briefly outlining the range of possible hazard scenarios that could be considered for WA and NT (together or separately), and the central issues or implications that could arise from the impacts (leveraging existing material and resources where possible) for EMA/CSIRO consideration.
- One hazard scenario set for WA and NT with elements grounded in lived experience of workshop participants if feasible (e.g. Boxing Day tsunami, Yarloop & Harvey bushfires, tropical cyclones, severe storm and flooding, fuel shortage) with a broad wide-spread regional impact and an additional stress in a populated area of WA and NT (such as Perth or SW WA and Darwin).
- The scenario, and events within the scenario, could unfold in different locations over a period of weeks or months. Services should be impacted and unavailable for at least a three week period.
- The scenario will provide a description of the broader context and list up to six things (system vulnerabilities) that will either break or be exposed from the scenario event chosen and list options to further stress the system pushing it to a breaking point (these can be considered context variables).
- Materials or resources appropriate to help people visualise the scenario (maps, photos, stories, posters etc.) with necessary agency disclaimers (and an indication of any uncertainties if agencies desire) etc.
- An accompanying narrative using novel and non-technical communication methods (no scientific language).
- A joint GA/BOM presentation for Session 1 and 3 at the AVP workshop, within allocated time.

Risk Management:

There is a risk that participants may talk about the hazard scenarios presented by BOM/GA outside the workshop context and may misconstrue these scenarios as forecasts or worse case. Risk treatment options include:

- Label all products: 'Not an official model of scenario. For workshop discussion only'
- Communicate the scenarios are not predictions, not forecasts, not worst case, not an 'official modelling' of a scenario; and are intended to support workshop discussion purposes only.
- Ground the scenario in a lived experience and reinforce the broader context for the scenarios. For example, that record breaking conditions are already being observed, or that infrastructure continues to age.

A.3 Summary of Session 2 vision stories and values

Vision stories and values

Story Name	Summary	Values
Social values as a rudder	•Working together in complementary ways so no element is precluded or disadvantaged •Social values are about having a sense of community, this will be the rudder that helps the community make the right decisions •Institutions are based on principles of accountability and transparency guided by core values of justice, equity and sustainability (between people and people and nature).	Working together to achieve holistic view while minimising exclusion. Sense of community involvement for better decision making. Institutions are transparent and accountable, are just, equal, sustainable.
Adaptive Butterflies	Image of moths adapting to a changing environment while retaining their unique identities. They are smiling about it too! The inspiration comes from the evolution of peppered moths, https://theconversation.com/natural-selection-in-black-and-white-how-industrial-pollution-changed-moths-43061 LEGAC (Learn, Evolve, Grow, Accept, Connect) Learn: learn from the past and past emergencies, learn about the hazards we live with, learn from each other and from within, lifelong experiential learning. Evolve: In recovery things will not be the way they used to be and this is not a bad thing, adapt to conditions, always changing as our environment changes. Grow: Grow our awareness, grow together as a community, grow from past experience, grow our shared stories and confidence. Accept: Accept when the current situation is not working (go past denial), accept challenges and be ready to act if needed, live with nature instead of fighting it. Connect: Connect people to services and services to services, 'we're all in this together', support and respect community members, help each other through.	Adapting while retaining identity, happiness with self and situation. Learn from past, evolve, grow awareness, self-confidence, grow as a community. Accept situation, connect with services and within communities, help each other.
Anticipate PPRR	The vision used disaster preparedness framing and emphasised values in the phases of: Anticipation: knowledge to forecast; community being informed and acceptance of diversity Prevention: Insurance, mitigation and education/knowledge Prepare: practice and exercise, agreed clean-up strategy Response: understand shared responsibility	Information helps community anticipate and prevent/prepare/ mitigate disaster. Sense of shared costs and responsibility. Community-led recovery.

Story Name	Summary	Values
	Recovery: cost sharing f/work, accepted strategies to move forward, and for recovery to be community-led Do what we do … but adapt and improve.	
SHACK	'SHACK' (Shared Responsibilities, H[ole], Accountable, Connected, Knowledgeable). Everyone in the community has responsibility for themselves, but also to share their knowledge. Different touch points that you have in the community will make a difference.	Shared responsibility and accountability, connection, knowledge. Individuals hold responsibility for self and to share their knowledge. Different touch points in community.
CCBY	Everyone has education and knows what hazards could occur and the potential consequences so they can help themselves and others who can't, before during and after an incident Shaking/holding hands, promoting community from within. Not just focus on local community, but social communities (e.g. religious, school, sport). Promote sharing of information Through education giving hazard preparedness. All comes about through rules and regulations. All learnings publicly available and promoted, not hiding info from previous incidents (and regulations require that disclosure).	Education to pre-empt disaster, help self and others. Sense of community (local and social communities e.g. religious, school, sport). Information sharing, learning about disasters. Removing regulations that require disclosure about previous incidents.
Chameleon	People have access to knowledge and awareness of hazards and risks around them. Tools to be better prepared (e.g. survival kit) Innovation: ideas that include a community perspective, including grants and access to funding, blue sky, cut red tape Build back better and safer Connectedness, networks and inclusive society Accepting vulnerability is part of people's resilience not an obstacle to it. Crystal ball: strategic foresight, long-term planning for unexpected events and future-proofing. Mascot: chameleon blends into its environment. All about adapting to our environment. We need to adapt to environment – can't stop fires, storms, floods but we can adapt and use knowledge tools and connections to be better prepared and more resilient.	Knowledge/awareness of risk. Tools for preparing. Community innovation, funding access, cut red tape. Build back better. Community networks, inclusivity. Accepting that vulnerability is a part of resilience, not an obstacle to it. Long-term planning, acceptance that can't stop disaster but can adapt.
Community with artificial intelligence (AI)	Currently all is tailored to individuals. In the future would like more of a community focus. Everyone together, diversity of old/young, elders sharing knowledge with other generations, people with disabilities etc. They are still individuals, but also part of a community. Good infrastructure, access to water etc.	Community focus and integration, inclusive of young, old, people with disabilities. Infrastructure, water access, diverse food sources, renewable energy sources for community self-sufficiency. Green

Story Name	Summary	Values
	Diversity of sustainable food. Locavores. Renewables, Tesla battery, energy sources geographically dispersed so not all in the one place. Green space where people connect with one another. Artificial intelligence – e-connected governance and knowledge systems Integrated (e.g. child care and aged care working together). Communities being integrated and connected in a sustainable way.	spaces for people to connect. AI knowledge/modelling systems.
Surviving and Thriving in a Community	Economically viable at the centre, preferably prosperous Want people to be happy, cohesive, inclusive, healthy, sustainable, prepared, supportive and caring, informed, resourceful. Thriving and surviving in a supportive community. Community has wonderful attributes and they can survive thunder storms, heat waves, drenching rain and fire.	Prosperous communities; quality of life, economic productivity, inclusive/ supportive, prepared, informed, resourceful. Survive disaster better together.
Values, Knowledge, Rules	Values: Safety and security (particularly financial security), happiness, community connectedness, identity (e.g. culture + religion), wellbeing, health, shared responsibilities. Knowledge: informed and educated people, with data and evidence to support and access to it (telecommunications), actively seeking knowledge to make decisions Rules: governance, laws, systems, standards	Values: personal/financial security, community connection/wellbeing, identity/culture. Knowledge: seek science-based knowledge to be informed/make decisions. Rules: governance, laws, systems.
Community Preparedness	Knowledge, values, rules work together for people to be happy. ASC: A Safer Community. Knowledge: ensure people understand their risks, historical and future; know your neighbours, community, leaders etc. Clarity of roles. Values: safety of people first, then property, economy, environment, effective communication and consultation, long-term values. Rules: Build back better. Learn from experience. Do no harm. Accountability, responsibility and liability.	Values: prioritisation – people first, property, economy, environment. Knowledge: understand risk, know neighbours. Clarity of community roles. Rules: Build back better, learn from past, accountability. Values, knowledge, rules working together create happy community.
Telescope Microscope	A future in which we transcend our drivers to always want stability and make short-term decisions, and instead recognise that transformation itself, and persistence and planning for the long term, are deeply valued A future in which we recognise the inherent tension of looking long and broad (like through a telescope) and	Plan for long term instead of short. Tension between long and broad vs narrow and focused views; requires balance in decision-making. Community focus on people and their connection, working together in harmony. Laws/ rules should suit

Story Name	Summary	Values
	focused (like through a magnifying glass) and actively work for balance A future in which we focus on people, connectedness, working together as one society, and celebrate our transformation and persistence. Thus, rules, codes, law, and gathering of new information are deliberately designed to support those values – well-designed systems that support people and transformation	these values to support people in their transformation.
Disaster Chef	The picture is of a pie with the following ingredients: People know how to and do help themselves 'Shared vision', supported by honesty, transparency, commitment, accountability, vigilance; Sustainable buildings and infrastructure; Interdependencies and cross-sectoral impacts considered in everything we do Policy/planning (e.g. education, health, building etc.) considers effects of natural hazards. People know how to and do help themselves: they know what to expect, they can imagine it and they have the tools to find and implement solutions. 'Shared vision', everyone on the same page, whole of society focus on coping with natural hazards: supported by honesty, transparency, commitment, accountability, vigilance. Sustainable buildings and infrastructure, using natural resources 'off the grid'. Interdependencies and cross-sectoral impacts considered in everything we do (e.g. health, education), and disaster resilience considered in all decisions. Policy/planning (e.g. education, health, building etc.) considers effects of natural hazards, and is dedicated to practising for incidents. Be aware when decisions in a sector have repercussions for emergency management.	People knowing how to help selves and society having 'shared vision' – including honesty, transparency, commitment, accountability (beneficial when applied to disaster situations). Interdependencies considered in our actions. Disaster impacts and regional differences considered in policy/ planning.
Utopia Magnified	Connected community – shown in a magnifying glass (or bubble). Disaster happens but doesn't affect the community because they are good at adapting. Values: Being connected, cohesive, equitable, adaptable, networked, High standard of living Environmental sustainability (e.g. urban agriculture, shady trees, biodiversity) Love Adaptable design of urban environment (how people work and play) Cultural norms and rules:	Community buffered from disaster by: interconnection, cohesion, equality, adaptation, networking, quality of life, sustainable/disaster resistant infrastructure, decentralised control, accountability. Future cultural norms: implant in humans providing tracking, medical records etc; beneficial in emergencies. Tech cloud for information distribution.

Story Name	Summary	Values
	Decentralised control, Accountable at all levels, New cultural norms (e.g. 'cyborg culture' or 'the Jetsons') – being tracked with all info implanted – could help with not being lost, having all medical records etc. Or getting what you need instantly like food delivered. But not everyone liked the idea of this system and didn't like not being able to 'opt out' if this was the cultural norm. A 'Tech cloud' so information is distributed and not held centrally	
Girl Learning (Woman's Life Journey)	Image of educated girl growing up, learning about her community and how to live successfully with natural hazards through each stage of her life. Sharing her knowledge with her family and community.	Education and empowerment of girls/ women (including about disaster), sharing new knowledge with family/ community. Women in leadership roles.
Ripple of Resilience	Like a stone thrown into a pond the 'Ripple of Resilience' is a concept that catalyses the building of resilience by putting individuals and communities at the centre, and building layers of resilience in depth around them. The layers of resilience in depth could include: Information layer Individual preparations layer Community network layer Community monument layer Community leadership layer Individual financial layer Emergency Services layer Resilient critical infrastructure layer Macroeconomic layer International assistance and readiness layer Each layer could be assessed individually, and the resilience in depth of a community or individual could be assessed holistically.	Individuals and communities protected by layers/elements contributing to resilience; information, community networks, leadership, financial freedom, emergency services, resilient infrastructure, macroeconomics, international assistance
The Big Umbrella	The vision is about shared positive values based on a collective understanding. Our understanding of risk, hazard, vulnerability and exposure drives our options and choices which enables our way of life to continue with minimal disruption. We acknowledge the change of demographic of the society and on the ground – we are being realistic – acknowledge conflicting values (people are often found to disagree rather than mediate or nut out). There is a connection between thought and action and policy vs pragmatic. The umbrella symbolises a shared responsibility to live successfully with disaster, people working together	Shared positive values, decision making driven by understanding of risk/ vulnerability. Acknowledge diversity and conflicting values. Thought vs action and policy vs pragmatism are linked. Need shared responsibility, different groups and rural/urban differences represented as well in policy making to protect from disaster.

Story Name	Summary	Values
	across all sectors and levels to develop policy and actions to deflect/protect Queenslanders from harm.	
Australia in Harmony	It's going to take all ways of thinking, all ways of knowing – all contributed, what are we all willing to have in our society. Strong theme – for 80,000 years lived on land in harmony with natural hazards – a lot to learn from Aboriginal and Torres Strait Islander people about this – sometimes communities might need to move at different times – might mean there are lessons around sharing infrastructure, values of reciprocity, wisdom, eldership. Becoming resilient will need to incorporate all ways of thinking, knowing and all manner of contributions and require compromises to determine what elements are valued. This involves recognising the important knowledge indigenous peoples have about living in harmony with natural hazards and the values of reciprocity, wisdom and eldership they can teach us. Australia's resilience will be oriented by continually asking what is in the best interests of our children, not just now but in hundreds of years' time and reflecting on what intergenerational justice means. Resilience also means turning our minds to the finite nature of our planet's resources and how we can restore and regrow resources and communities. Australia's resilience features informed, inclusive, adaptive, responsive, connected and enduring communities and the awareness, integrity and honesty are integral elements	Importance of living in harmony with the natural world. Much to be learned from indigenous people. Awareness, integrity and honesty. Values of informed, inclusive, adaptive, responsive, connected, enduring communities. Fairness and equity – not just now but for future generations.
Bouncing Back Better Communities	Bouncing Back Better Communities BBB-rated community learning together through our great ideas and innovations through a community working hand-in-hand, well connected and co-created this vision for itself. Infrastructure that is adaptive and resilient Synthesised: A community that is prepared to bounce back better from disasters is one which values strength, economic and social capital and is self-reliant and self-organising. It learns together through the sharing of great ideas and innovations, working hand-in-hand it is well connected and co-creates a vision for itself. A community prepared to bounce back better has infrastructure which is adaptive and resilient.	Strong economic and social capital, self-reliant and self-organising, plan for community. Bulletin boards for information, information highway via satellite.
Connectedness 4 Arms	The links within a community are what makes it strong. The walls protecting a community from	Links in a community (connectivity, support and inclusivity) hold it

Story Name	Summary	Values
	disaster are its connectivity, its support networks, inclusivity and its ability to hold together in the face of adversity. Urban planning for disaster resilience requires looking at how natural and built environments relate to one another; the level of disaster impact is dependent on their interaction, which in turn is dependent on the level of harmony between the two. Education and knowledge sharing about past events gives people agency and fosters individual responsibility.	together in a disaster. Urban planning for harmony between built and natural environments. Education and individual responsibility.
Growing the Forest of Resilience	Tree of wisdom underpinned by roots of resilience: education, local knowledge, leadership, engagement and community. Grow values through trunk: freedom, diversity, rule of law, wisdom, opportunity. Winds of change blow us to the future Human innovation: ideas and science Young saplings grow off sun which comes from this hope and aspiration: economy, built environment, people and natural environment: need to exist in complex ecosystem of the future. Foundations build future: global competitiveness, sustainable, future-proofed environment, fit for purpose, diversification, healthy local businesses, people who are caring, proactive, tolerant and an engaged community – engaged with the natural environment which we value. These foundations help to grow the saplings. The forest survives the storms, storms which will always come.	Education, local knowledge, leadership, engagement and community are necessary agents for freedom, diversity, rule of law, wisdom and opportunity. Innovation fuels their growth.
Learning Interconnected Environment	Neighbourhoods are not just about living around the block or in next street, could be pastoral station 80 km away – neighbourhoods quite dynamic. Prepared community with knowledge and resources, decisions and plan made in advance. Individuals connected, there to help and spontaneously respond if required. Good communication and good action plans. Everyone supporting idea that communities should be better prepared – government takes responsibility but can't do it all, private, non-government orgs. Need more involvement. Always changing and updating plans as needed.	'Neighbourhood' not just about geographic proximity. Have knowledge, resources and plan beforehand. Everyone communicating and contributing. Responsibility of the government to arrange but they don't successfully. Private, non-gov. organisations need a larger part in this – question of who should take responsibility (shared?)
The Pomegranate	Australia is a pomegranate; the analogy of many seeds interconnected with other seeds make up a greater whole. Australia's resilience is related to individuals connecting within communities which connect to	Interconnection within and between communities. Common goals and strong/resilient infrastructure, volunteers. Healthy communities are

Story Name	Summary	Values
	other communities. Intra-web: adversity within one community can go towards being solved when reaching out to other interconnected communities for support. Inter-web: the community itself is helped by individuals reaching out to others who supply care and promote inclusivity. Common goals and strong infrastructure mean when disasters happen, connected communities bounce back quicker. Spontaneous volunteering and the generosity of others helps quicken recovery. Active communities and physically, mentally, confident communities are strong communities, creating the foundation of resilience. Ensuring they are informed, have good governance, common goals and a bottom-up approach rather than top-down go towards building that resilience.	strong communities. Being informed, good governance, bottom-up approach build resilience.
The Road to Resilience	Started with discussion about local government trying to educate the community in south-west what do you need if you lose power, water, food – could a community live without these things for 72 hours – but then changed this to weeks What do you need to survive for more than 3 days? Food, water and shelter communities find ways to find this – need ways to glue it all together. Need strong leadership to give guidance and direction – people to raise their voices and come together. Need community to take care of each other. Need form of government to come and help (or maybe not) Prior conversation about how natural hazard could affect them – long before incident – losing power, water etc. Knowledge sharing – education for people not exposed to emergencies Until people have become exposed to serious event Rules, value and knowledge want to share – metropolitan vs rural community. All in this together.	Strong leadership: guidance and direction, dialogue between individuals. Community helped by self and government. Discussion and plan for disaster beforehand. Knowledge sharing, education. Differences between rural and urban communities need to be acknowledged (particularly in policy making).
Slacklines and Ladders	Community on the slackline, community is the artist, in order to get up onto slackline need to be empowered by the ladder of capability. Once up there need to be assured by the safety net of systems, train them up and empower them to stay up there as long as needed but also provide safety nets. Amplifier of knowledge: ideas comes from academia and government but two ways street and come back again. But can't yell too	Understanding and acceptance of natural hazard risks and impacts. Prepared for them and able to recover when they occur through knowledge, empowerment, self-reliance and resilience. Partnerships and teamwork with as many stakeholders as possible.

Story Name	Summary	Values
	loud or else community will fall off! Everything needs to be done through collaboration – teamwork makes dream work.	
Solid Ground and Pillowcases	Living in context of hazards forces you to think about what matters in life and what you really value. Teenage – adult life corrupted by power, fame and material objects need to step outside that and see the world anew. Imagine you are a 4-year-old whose house has just been flooded, really see what matters to people. 4-year-old has a pillow case to fill with things to take with them – things they would want to take are their family, mum and dad and community through this even when land been taken from you – will always be living on solid ground.	Experience of natural hazards reveal what matters in life. What mattered before but no longer matters in a disaster situation is something that is worth examining, and depending on age, background, ethnicity etc. it will be different for everyone.
The Resilience Tree	Idea of diversity and networks of connectedness – networks (community, social, essential services) diversity (local community members, government, types of community members) best reflected in the roots as a foundation for resilience (along with a healthy environment, some degree of redundancy, etc.). These provide the necessary principles/values for resilience to play out/be achieved in the branches – the maintenance of a sustainable quality of life, an adaptable economy, effective planning processes, innovation and effective shared learning, etc. The different colours of leaves reflect the diversity of people and institutions that both enable these domains to draw on the principles/values of the roots as well as the diversity that in turn is supported and continually sustained through innovation, effective planning, shared learning, etc.	Respect for diverse views, equity, self-reliance, learning and adapting/ adaptability, being collaborative/ progressing collectively.

A.4 Reactions to the catastrophic disaster scenario

Table of disaster reactions from sticky notes from Perth workshop:

Credibility	• Scenario not unrealistic • Bad but not worst case • Even though tsunami less likely, the impact pattern is similar to what storm surge might be in a big low pressure/TC system. I think something like this will happen within 20 years • More of the same – history (Alby and 2004), current event + 1 – what next • Not without precedent (Katrina) • Cyclone: I am aware of TC Alby moving all the way down SW

Immediate logic and logistics responses	• Would anticipate emergency services and health service and other support agencies would be overwhelmed
	• Most likely require interstate assistance – state emergency, national disaster
	• Military support needed for tsunami response
	• Essential service providers will not have sufficient resourcing as operate from Cockburn
	• Loss of: [secondary services]:
	• Fuel terminals, natural gas
	• Perth: constrained generation
	• Pilbara: intermittent power outages
	• Had enough PPR been done? Who has survived?
	• Response: How? Where? What with? From where?
	• Resilience of me, family, agency?
	• Location
	• Responses/actions for plans
	• Services affected
	• Casualties
	• Family/friends
	• Multiple locations, impacted by flooding and tsunami
	• Capability and capacity exhausted quickly
	• Large number of people displaced/injured/killed
	• Hope effort required to provide even the most basic level of support
	• The scale of the impact
	• How do you prioritise a response? (viewed from a central response location)
	• How do you access affected communities with one way in and out (where that one way is impacted)?
	  ○ Inundation to lots of communities
	  ○ Lives? Injuries?
	  ○ Infrastructure
	  ○ Oil and gas
	  ○ Rail
	  ○ Ports
	  ○ Airports
	• Briefings: [listed specific agencies, redacted]
	• Test support: rest of country, aviation
	• Where to put response efforts
	• Confidence in moving people
	• Still early in the season
	• Power? Water? Return or not?
	• Resources stretched, communities largely unaware
	• Public warnings, RAOS

	• Up north resilience but tsunami creates uncertainty
	• Down south fires, temps, devastating, heatwave, fire, deaths, loss of homes
	• Emergency services stretched beyond capability/fatigue. Social welfare systems can't cope
	  ○ Health
	  ○ Police
	  ○ DFES
	  ○ Power utilities
	  ○ Water
	  ○ Other essential services
	  ○ Displacement
	  ○ Relocation
	  ○ Repair/restoration
	• Public comms – restoration
	• Statewide – stretched emergency services. Centralised command and localised impact
	• National assistance? What would that look like?
	• Extent of death
	• Extent of serious injury – how will this be dealt with?
	• How do we limit any other injuries/deaths?
	• Property damage
	• No of residences destroyed or unliveable – how will this be dealt with?
	• How do we limit further destruction?
	• Business premises destroyed – economic impact
	• How do we limit further destruction?
	• Reassurance/command/leadership
	• Self-reliance, protect-in-place, survival kit
	• Check on neighbours, vulnerable people
	• Prioritising
	• Safe refuge high ground/inland
	• Flooded at home – personal impact
	• State response – all affected
	• 90% population live within 50 km of coast
	• Limit of capability (personal, services, personal impacts)
	• Depressing
	• Loss of life – casualties and injuries
	• Hoping that BoM could provide enough warning for agencies, community and volunteers to be prepared
	• There will not be sufficient resources to respond
	• Major support will be required from Federal government and neighbouring states – International as well
	• Significant bushfire (CAT D)
	• Major recovery (DACC)
	• Tsunami:
	  ○ Widespread deaths
	  ○ Damage to coastal (CAT D)
	  ○ International assistance (DACC)
	  ○ Long-term recovery

Comments on longer-term impacts	• Recovery processes significant, extended duration • Significant social, economic impact as well as state and national economy • Self-organise • Self help • Reality check • Regroup (fatigue) • Authentic leadership and communication

	• Priority actions • Critical activities • Bring about significant policy shifts • Strengths approach • Celebrate success (all spheres) • Bring people along the process/journey/adventure • Huge disruption – loss of faith in the world • 'At risk' communities • Australia is not prepared for an event of this scale – particularly over such a large geographic area • Institutional response: '2nd wave of disaster', response at odds with community expectations • Recovery – widespread affect means resources are stretched – longer time to recover/repatriate • How well will community recover? • Shock sets in, feelings of despair and loss
Immediate response and reflection and reprioritisation process from one participant	• My family, their potential risk, location (2) • Our team at work or at SLSG, what is our weakest link to resilience and our ability to engage effectively (3) • My plan, to survive (1) • On reflection…..a reordering to enable me to get a sequence for survival that maximises my chances.

Emotional responses	• Fearful – losses of life
	• Determined – to start getting into it
	• Overwhelmed by back-to-back events
	• Uncomfortable being pushed beyond the imaginable
	• Worried about short time frame to act and avoid harm
	• Feeling of inadequacy to deal with despair
	• Have we done enough to prepare the country?
	• Is our potential lack of action increasing their vulnerability?
	• Really angry, having spent the weekend in [redacted named coastal towns], that they continue to develop their foreshore areas with dwellings that put more people in harm's way. Irresponsible
	• Anxious, worried for those that are so unaware and will suffer
	• Hopeful (but cautious) that the process of imagining these things will translate into action to avoid such impacts
	• Feel lucky it's a scenario
	• Concerned
	• In awe of nature
	• Disbelief
	• Glad that I live on a hill – concerned because I live in an area with bush
	• Reflective – heard the tales of TC Alby from locals and know what the impact was on my community
	• Questioning the level of resilience within my community – feel like we need to educate more
	• Frustrated because it's hard to get people to think about the 'what ifs' surrounding severe/catastrophic disasters
	• During:
	  ○ Overwhelmed/what the fuck?
	  ○ Confused; uncertain
	  ○ Fear – terror
	  ○ Trapped – every option is bad or entails significant trade-off

	○ Dread • After: ○ Insecurity and vulnerability ○ Confused, irritable, sad, overwhelmed ○ Order in the world – gone ○ Faith in the world ○ Loss, grief, awe, surrender ○ Alarmed by the scale of impact from two large but increasingly plausible events • Anxious about the mass human impact • Frustrated that these scenarios aren't being properly considered and planned for • Hopeful that we do actually already know and have a lot in place • Sobering: • Who will not hear of the imminent danger? • Who will hear but not believe they are in danger themselves? • Who will hear of the danger in their area and act for themselves alone? • Who will hear, warn others and help vulnerable people as well as themselves? • Who will spend time warning others without leaving time to get themselves to safer ground? • What it made me feel: The veneer of civilisation is very thin in the face of these events We are in so many ways both fragile and capable at the same time. But ultimately we are all vulnerable. • Feel: ○ Overwhelmed ○ Response would be patchy/delayed ○ Lots of community members would be needing urgent assistance ○ How utterly unprepared we are ○ The importance of satellite phones and relationships (?) ○ The importance of living on high ……(?) ○ …. Survival ○ This is nothing compared to Syria, India and Bangladesh • Feelings of: ○ vulnerability ○ helplessness ○ extent of effect ○ whole/incredible stretch of country affected: scale of event ○ one calamity after another ○ how does community cope during/after the event?
Use to plan ahead	• Community information: ○ Are impacted locations marked with advisory signs? ○ Do emergency responders test and exercise these scenarios? • Planning regulations: do our building standards and planning laws reflect the models? • Local risk and arrangements: do local risk assessment and arrangements cater for these events? ○ Plans for coordinated response ○ Alternative comms ○ Public informed ○ Interstate/international assistance ○ Pre-positioning resources ○ Pre-impact evacuation • Hurricane Katrina lessons

	• Decades of recovery
	• Whole of state economic impact
	• Insurance may not be possible in the future
	• Will the LNG infrastructure need to be rebuilt?
	• What will the support from Eastern Australia be?
	• Will international help come? (Indonesia)
	• Will the disaster change attitudes?
	• We do our best!!!
	• Can we change and adapt our emergency management on the fly?
	• Emergency services – outside capability – think differently
	• Lack of communication key issue
	• Would coastal communities understand enough about tsunami to move to higher ground? After cyclone may think these are connected?
	• Extreme temps in SW – Fires!
	• Change of thought processes – move communities to safety rather than combat hazard
	• State and district coordination will be nearly impossible due to lack of comms
	• May need to be organised from local level
	• Outside understanding/imagination – people will be terrified
	• Lower socio-economic – vulnerability
	• Cyclone – heatwave – fire – tsunami
	• No power – no money/fuel/food/cooling
	• Change the fabric of the state – policy? Religion? Insurance!
	• Lower socio-economic – put yourself in their shoes
	• Volunteers – work force?
	• Economic issues
	• Inadequacy to deal with despair
	• We are not prepared for large-scale events
	• The geographical spread of impact exceeds the capacity of response services
	• Australia is predominantly coastal living exposed to catastrophic risk – the catastrophe is the pre-existing risk
	• Significant time to recover
	• Agencies not equipped for concurrent impacts
	• Need international assistance
	• Need to learn lessons when reconverging. Rebuild in better locations – use opportunity
	• Thinking: How do we get community to visualise these plausible scenarios without being alarmist?
	• We need a national approach
	• We need to build better infrastructure and make better planning decisions
	• Bought to light just how WA could be impacted and probability it could happen. Brought back memories of disasters that have happened elsewhere. Just how prepared are we to handle such an event. Personally – building near Busselton raised question of what impact event may have. How would I deal with such an event – professionally and or personally
	• I need to focus on local
	  ○ Wondered what is available to help – how to prioritise
	  ○ What advice do we need to give residents?
	  ○ How should we communicate and rally the public/residents?
	  ○ When you are aware of the unfolding disaster and there is no more you can do until it is over
	• What it made me think about:
	  ○ The Australian identity
	  ○ The need for a ‘plan B’
	• It made me think of my friend who was on the beach when the tsunami hit in Asia and his story of survival and also identity (?)
	• It made me think about who would really be affected by this

	• Current response not suitable for future requirements
	• Modelling is helpful
	  ○ Timings and warnings very short
	  ○ Combinations heat/tc/heatwave/earthquake/tsunami
	  ○ Aceh and other places

A.5 Summary of Session 6 stories

Story Name	Summary
Example Energy Impact on Vulnerable People	This story is about the impact of a widespread disruption in energy supply on disabled people. It was told in a fictional sense during Session 6 of the Adelaide workshop, drawing heavily on the participant's experience.
Cinderella	Disaster preparation allegory told through 'Cinderella' story. The evil stepmother [org name provided and redacted] and ugly stepsisters hold power while refusing to information or resource share with Cinderella (agency doing all the hard work). A great event (disaster) is planned and Cinderella can't afford to attend while her stepsisters dance with the Prince ([org name provided and redacted]). The Fairy Godmother ([real life analogue provided and redacted]) waves her policy wand and endows Cinderella with funding and resources, allowing her to meet the Prince who instantly sees Cinderella is what he and the community need. Approaching midnight she loses her slipper of community trust and support, which finally is returned to her by Prince Charming.
Kids at School	Role play set in 2100 community living well with disaster; elder telling 7-year-olds stories about the 2017 disasters. Began with cyclone, then earthquake, then a tsunami – back then many were hurt or lost. Kids ask how it could have happened, having only ever known 100% effective disaster management. They learn in 2017, people didn't look after their health and when their medications were lost in the disasters, they got sick and when they went to hospital, those were destroyed or washed away too. Well why didn't they know how to help themselves? They believed the government were coming to help them and when no-one came – they didn't know what to do! So what do we teach you in schools because of what happened? Kids tell him about first aid, community connection and how they are microchipped with tracking devices and personal medical information.
Once Upon A Time Family	One day, a family got an [organisation name redacted] tweet about an incoming disaster. Dad started calling SES, disaster services and other emergency numbers on the fridge which he'd never read, while Mum sat around and panicked. Their kids told them to stop what they were doing and follow the evacuation route and seek out key connections in the neighbourhood to tell them the family was safe and if others needed help. The kids told their parents they had been playing a fun virtual reality Playstation game and app at school, and after the disaster the parents began playing the games with their kids whenever they could.

Story Name	Summary
Pub Flood Lines	In a low-lying coastal town, local pub-owner Phillipa is the anchor of the community. Her pub's wall has flood lines drawn from historical high tides, and with a predicted storm surge on the way she runs a sweepstakes for the town to guess where the waters will reach for the new line this year. Everyone places their bet and raises money for the pub. The flood is catastrophic, causing loss of life, houses and property. Phillipa helps with recovery and puts people who've lost everything up in her house, elevated on the hill. With no power at night, people stay up and tell stories. One old man tells of selling the farm he owned to the government when it was flooded in the 1930s. While he assumed it would become parkland, they instead built houses on what he knew was dangerous flood-prone land. He confronted the council at the time but nothing became of it, and after learning this decision had destroyed her community, Phillipa has to do something. She contacts Erin Brockovich and after researching the shady dealings between the local government and developers, they put together a case against those responsible for placing unsuspecting residents in a dangerous flood zone, ultimately killing the residents. After winning the case in supreme court, Australian laws were changed disallowing developers to build anywhere where they would transfer risk to people living there.
The Scene	Scene 1: [location redacted] is paradise no more. Beach scattered with the remains of buildings, hundreds of bodies lay like broken dolls. Scene 2: Meanwhile further north, [location redacted] is full of debris and broken trees but no bodies. How did this happen? Scene 3: Five years earlier, development office [location redacted] regional council approves building in a 1 in 20-year flood zone. Approver thinks – what could go wrong? Won't happen in my lifetime. Scene 4: Slightly north, a developer is declined by a council who defend their case for respecting environmental risk plans. Scene 5: Big wind, rain and one monster wave. Where would you rather live? Lesson: let's have the courage to let our councils know that to survive in the future; we need sustainable and ethical planning for our towns and communities.
Red Riding Hood	'Little Red Riding Hood' allegory set in [location redacted] Forests of Resilience. Little Red hears the Big Bad Wolf has started a fire in the Forests of Resilience and tells Grandma. Little Red sets off to help her but finds the bridge crossing is burnt down. A nearby Woodchopper helps Red by felling a tree to make a new bridge. They both journey on to find Grandma, only to realise the wolf traps and wolf-proof fence have failed from lack of funds – resulting from failed GST distribution system and centralisation of services. Finding the Big Bad Wolf at the door, Woodchopper chainsaws his head off and Red rushes in to save Grandma. They discuss moving Grandma closer to town so she may access services and wolf-proof her house more effectively.
Insurance Ad	Short trailer for insurance movie: '[location redacted]: The Safe State Summer Skies'. Eric worked in insurance. He found it interesting, but no-one else did. How will he change this? Trailer poses a large-scale re-branding of insurance as optimistic, involving a shift to a blue-sky-thinking approach and winning the public over with a cute new mascot: the bilby. By engaging the public to think twice about insurance (obviously cute animals will do the trick) and reducing its cost, increased the membership bases of all types of insurance is better for everyone in the face of disaster.

Story Name	Summary
3 Little Pigs	Once there lived three isolated villages. The first, Strawsville was shabby and forgotten and one day, a Big Bad cyclone came to blow Strawsville away. Its residents packed up and left for Sticksville, where they were welcomed by the Sticksville Mayor who promised their houses were strong, and the village invincible. They had strong community groups but no-one between them communicated, so there was little trust. Then one day a Big Bad bushfire came and burnt Sticksville to the ground, so everyone moved to Bricksville. The Bricksville Mayor welcomed the Strawsville and Sticksville residents, telling them they couldn't ensure they would resist anything that was thrown at them, but that the community would stick together. Sticksville and Strawsville saw the village's trust, respect and care for one another and were impressed. Then, one day a Big Bad earthquake came ad shook Bricksville to its roots. The village houses stayed strong because the community was the mortar that held the bricks together.
SBS Insight Post catastrophic disaster in Western Australia	One of the table groups acted out a skit of an SBS Insight program, set six months after Tropical Cyclone Bad and a tsunami. The panel comprised the state premier, commissioner of [org name redacted] and an industry leader, 'Mr Neoliberal Moneybags' (representing the [org name redacted]). There is one token marginalised person on the panel, however she is seated on the floor while others have a seat. The panel members use the opportunity to advocate their own interests and pat themselves on the back, while casting blame and aspersion on others to score political points and seek more resources for their own activities. Mr Moneybags is celebrated for resuming gas exports to [location redacted] within seven days of the disaster, and he is heckled by disaffected rural shire presidents in the audience who ask why gas exports to [location redacted] were prioritised over meeting the needs of the local community post-disaster. The shire presidents also squabble among themselves, and complain about the Lord Mayor who has recently returned from a 'fact finding mission' in the exotic locations around the world where he learned about SPF 50 sun screen. Every time the token vulnerable person tries to talk, she is told to wait until she is asked and given space to speak – which never happens. At some point, other disenfranchised and marginalised people/protestors try to enter the studio where there is a live audience – hands are visible, trying to push the door to the workshop room open and security is called to move them out of the building. This piece was performed as a chaotic comedy skit, and caused hilarity while mimicking and exaggerating familiar political dynamics. It was a powerful piece of satire even as a quickly scripted spontaneous performance, and had the effect of being able to use humour and fiction to draw attention to societal tensions and vulnerabilities in times of crisis.
Top Springs	In [location redacted] lives a happy town called Top Springs, but friends Tyrone and Miranda are upset after the flooding has washed away their homes. Miranda misses her caravan, and now Tyrone can't go to Scots College because his dad didn't have home insurance. He feels terrible that his dad was the one who built the Caravan Park where Miranda lived so close to the river, but now she has a house from the insurance which his dad didn't have. In the post-flood town meeting, Tyrone's dad – the Mayor – spin the disaster as a community bonding exercise, which not everyone agrees with as they shout about how the council has failed them, and about missing out on insurance because of living in a flood zone. Eventually the town is rebuilt further up the hill and parkland is secured where the houses and caravans once were.

Story Name	Summary
Who Would've Thought Chapter Book	A new children's hospital has just been built. There was community engagement, committees established, a news story published; everything was going to plan. The local government would deliver a shiny new hospital in exchange for another term in parliament. The day before the sick children are moved to the hospital it is discovered that there may have been hitches in the plan. The sheets plastered to the ceiling thought to have no asbestos in fact, did. Who would've thought to check compliance with Australian standards? The water could not be used, in fact it contained lead. But who would've thought to have checked? Now the children must stay in the old hospitals, while it is all costing us millions of dollars, daily. We've envisioned a state where social improvements aren't politicised and safety is prioritised over efficiency. Thankfully there was a royal commission into the matter, and surely now there will be more checks in place. Chapter two. One day, there was a government with good intentions who decided to build a children's hospital. Hold on, this sounds familiar. Continue Chapter 3, Chapter 4, etc.

A.6 Typical Systems Patterns

In a separate document for ease of working across multiple authors. Will fold into here before we submit

References

ABEL, N., GORDDARD, R., HARMAN, B., LEITCH, A., LANGRIDGE, J., RYAN, A. & HEYENGA, S. 2011. Sea level rise, coastal development and planned retreat: analytical framework, governance principles and an Australian case study. *Environmental Science & Policy,* 14**,** 279-288.

ABEL, N., WISE, R. M., COLLOFF, M. J., WALKER, B. H., BUTLER, J. R. A., RYAN, P., NORMAN, C. LANGSTON, A., ANDERIES, J. M., GORDDARD, R., DUNLOP, M., O'CONNELL, D. 2016. Building resilient pathways to transformation when "no one is in charge": insights from Australia's Murray-Darling Basin. *Ecology and Society* 21.

ADGER, W. N. 2000. Social and ecological resilience: are they related? *Progress in Human Geography,* 24**,** 347-364.

AIHW 2016. Australia's health 2016: Burden of disease and injury in Australia. *Australia's health series no. 15.* Canberra: Australian Institute of Health and Welfare,.

AIHW 2017. Elective surgery waiting times 2016–17: Australian hospital statistics. Canberra: Australian Institute of Health and Welfare,.

AIHW. 2018a. *Deaths in Australia: Life expectancy* [Online]. Australian Institute of Health and Welfare, Australian Government. Available: https://www.aihw.gov.au/reports/life-expectancy-death/deaths-in-australia/contents/life-expectancy [Accessed 24 July 2018].

AIHW. 2018b. *Deaths in Australia: Trends in deaths* [Online]. Australian Institute of Health and Welfare, Australian Government. Available: https://www.aihw.gov.au/reports/life-expectancy-death/deaths-in-australia/contents/trends-in-deaths [Accessed 24 July 2018].

BANDURA, A. 2018. Toward a psychology of human agency: Pathways and reflections. *Perspectives on Psychological Science,* 13**,** 130-136.

BARNETT, J., EVANS, L. S., GROSS, C., KIEM, A. S., KINGSFORD, R. T., PALUTIKOF, J. P., PICKERING, C. M. & SMITHERS, S. G. 2015. From barriers to limits to climate change adaptation: path dependency and the speed of change. *Ecology and Society,* 20.

BARRETT, C. B. & CONSTAS, M. A. 2014. Toward a theory of resilience for international development applications. *Proceedings of the National Academy of Sciences,* 111**,** 14625.

BECK, U. 1992. *Risk society: Towards and new modernity*, London, Sage.

BERNS, G. S., BLAINE, K., PRIETULA, M. J. & PYE, B. E. 2013. Short- and Long-Term Effects of a Novel on Connectivity in the Brain. *Brain Connectivity,* 3**,** 590-600.

BINDOFF, N. L., STOTT, P. A., ACHUTARAO, K.M., ALLEN, M.R., GILLETT, N., GUTZLER, D., HANSINGO, K., HEGERL, G., HU, Y., JAIN, S., MOKHOV, I.I., OVERLAND, J., PERLWITZ, J., SEBBARI, R. & ZHANG, X. 2013. Detection and Attribution of Climate Change: from Global to Regional. In: Climate Change 2013: The Physical Science Basis. Cambridge, UK and New York, NY, USA.

BJORDAM, T. 2017. *Tone Bjordam* [Online]. Norway. Available: http://www.tonebjordam.com/ [Accessed].

BROWN, G. 2006. Mapping landscape values and development preferences: a method for tourism and residential development planning. *International Journal of Tourism Research,* 8**,** 101-113.

BROWN, K. & WESTAWAY, E. 2011. Agency, capacity, and resilience to environmental change: lessons from human development, well-being, and disasters. *Annual review of environment and resources,* 36**,** 321.

BROWN, T. C. 1984. The concept of value in resource allocation. *Land Economics,* 60**,** 231 - 246.

BROWN, V. 2008. *Leonardo's Vision: A Guide to Collective Thinking and Action*, Sense Publishers.

BRUGNACH, M. & INGRAM, H. 2012. Ambiguity: The challenge of knowing and deciding together. *Environmental Science & Policy,* 15**,** 60-71.
BRUNDTLAND, G. H. 1987. *Report of the World Commission on environment and development: our common future*, United Nations.
BUTLER, J., BOHENSKY, E., DARBAS, T., KIRONO, D., WISE, R. & SUTARYONO, Y. 2016a. Building capacity for adaptation pathways in eastern Indonesian islands: synthesis and lessons learned. *Climate Risk Management,* 12**,** A1-A10.
BUTLER, J., SUADNYA, I., YANUARTATI, Y., MEHARG, S., WISE, R., SUTARYONO, Y. & DUGGAN, K. 2016b. Designing and evaluating the priming of adaptation pathways in developing countries. *Climate Risk Management,* 12.
BUTLER, J. R., DARBAS, T., ADDISON, J., BOHENSKY, E. L., CARTER, L., COSIJN, M., MARU, Y. T., STONE-JOVICICH, S., WILLIAMS, L. J. & RODRIGUEZ, L. C. 2017. A hierarchy of needs for achieving impact in international Research for Development. *Social Science and Sustainability***,** 109-129.
BUTLER, J. R. A. 2017. Applying RAPTA to Indigenous People's Green Climate Fund Concept Notes. Brisbane: UNDP.
BUTLER, J. R. A., BOHENSKY, E. L., SUADNYA, W., YANUARTATI, Y., HANDAYANI, T., HABIBI, P., PUSPADI, K., SKEWES, T. D., WISE, R. M., SUHARTO, I., PARK, S. E. & SUTARYONO, Y. 2016c. Scenario planning to leap-frog the Sustainable Development Goals: An adaptation pathways approach. *Climate Risk Management,* 12**,** 83-99.
CARPENTER, S. R. & COTTINGHAM, K. L. 1997. Resilience and restoration of lakes. *Conservation Ecology (online),* 1.
CHAN, K. M. A., BALVANERA, P., BENESSAIAH, K., CHAPMAN, M., DÍAZ, S., GÓMEZ-BAGGETHUN, E., GOULD, R., HANNAHS, N., JAX, K., KLAIN, S., LUCK, G. W., MARTÍN-LÓPEZ, B., MURACA, B., NORTON, B., OTT, K., PASCUAL, U., SATTERFIELD, T., TADAKI, M., TAGGART, J. & TURNER, N. 2016. Opinion: Why protect nature? Rethinking values and the environment. *Proceedings of the National Academy of Sciences,* 113**,** 1462-1465.
CLARK, W. C., VAN KERKHOFF, L., LEBEL, L. & GALLOPIN, G. C. 2016. Crafting usable knowledge for sustainable development. *Proceedings of the National Academy of Sciences,* 113**,** 4570-4578.
CLEMENS, A. 2018. Writing a page-turner: how to tell a story in your scientific paper. *LSE Impact Blog* [Online]. Available from: http://blogs.lse.ac.uk/impactofsocialsciences/2018/05/21/writing-a-page-turner-how-to-tell-a-story-in-your-scientific-paper/.
CONINX, I., BENTZ, J., MICHALEK, G. & DE ROOIJ, B. 2018. Using strategic narratives to help integrate CCA & DRR. Available: https://www.placard-network.eu/using-narratives-to-help-integrate-cca-drr/.
CROSWELLER, M. 2015. How a change in thinking might change the inevitability in disasters. *Australian Journal of Emergency Management,* 30**,** 48-55.
CSIRO AND BUREAU OF METEOROLOGY 2015. Climate Change in Australia Information for Australia's Natural Resource Management Regions: Technical Report. Australia: CSIRO and Bureau of Meteorology.
DAHLSTROM, M. F. 2014. Using narratives and storytelling to communicate science with nonexpert audiences. *Proc Natl Acad Sci U S A,* 111 Suppl 4**,** 13614-20.
DELOITTE ACCESS ECONOMICS 2015. The economic value of informal care in Australia in 2015. Barton, Australia.
EDER, M. 2017. *Leading the Narrative: The Case for Strategic Communicaton*, Naval Institute Press.
ELLERTON, P. & BROWN, D. 2018. Sorry Mr Spock: science and emotion are not only compatible, they're inseparable. *The Conversation.*

ELY, A. S., ANDY; MARSHALL, FIONA. 2018. How is transformative knowledge 'co-produced'? *Integration and Implementation Insights* [Online]. Available from: https://i2insights.org/2018/04/03/co-producing-transformative-knowledge/ [Accessed 3 April 2018 2018].

EMERGENCY MANAGEMENT AUSTRALIA 2017. Understanding the Drivers of Disaster: the case for developing an Australian Vulnerability Profile.

ENFORS, E. 2013. Social–ecological traps and transformations in dryland agro-ecosystems: Using water system innovations to change the trajectory of development. *Global Environmental Change,* 23**,** 51-60.

FOLKE, C., CARPENTER, S., WALKER, B., SCHEFFER, M., CHAPIN, T. & ROCKSTROM, J. 2010. Resilience Thinking: Integrating Resilience, Adaptability and Transformability. *Ecology and Society,* 15.

GORDDARD, R., COLLOFF, M. J., WISE, R. M., WARE, D. & DUNLOP, M. 2016. Values, rules and knowledge: Adaptation as change in the decision context. *Environmental Science & Policy,* 57**,** 60-69.

GORDDARD, R., DUNLOP, M., WISE, R. M. & DUNSTAN, P. 2017. Rethinking Approaches to Valuation in Marine Systems. CSIRO Report to the Pressures on the Marine Environment Theme of the Marine Biodiversity NESP Hub.

GRAHAM, S., BARNETT, J., FINCHER, R., HURLIMANN, A., MORTREUX, C. & WATERS, E. 2013. The social values at risk from sea-level rise. *Environmental Impact Review,* 41**,** 45-52.

HAASNOOT, M., KWAKKEL, J., WALKER, W. & TER MAAT, J. 2013. Dynamic adaptive policy pathways: A method for crafting robust decisions for a deeply uncertain world. *Global Environmental Change-Human and Policy Dimensions,* 23**,** 485-498.

HEALD, S. 2017. Climate Silence, Moral Disengagement, and Self-Efficacy: How Albert Bandura's Theories Inform Our Climate-Change Predicament. *Environment: Science and Policy for Sustainable Development,* 59**,** 4-15.

IPCC 2014. Climate Change 2014, Annex II: Glossary. *In:* MACH, K. J., PLANTON, S., VON STECHOW, C. (ed.). Geneva, Switzerland.

ISO 2009. ISO 31000:2009 Risk Management – Principles and Guidelines. Geneva: International Organization for Standardization (ISO).

JONES, M. & CROW, D. A. 2017. How can we use the 'science of stories' to produce persuasive scientific stories? *Palgrave Communications,* 3**,** 53.

JONES, N. A., ROSS, H., LYNAM, T., PEREZ, P. & LEITCH, A. 2011. Mental models: an interdisciplinary synthesis of theory and methods. *Ecology and Society,* 16**,** 46. [online] URL: http://www.ecologyandsociety.org/vol16/iss1/art46/.

JONES, R. N., PATWARDHAN, A., COHEN, J. S., DESSAI, S., LAMMEL, A., LEMPERT, R. J., MIRZA, M. M. Q. & VON STORCH, H. 2014. Foundations for decision making. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Cambridge University Press, Cambridge, UK and New York, NY, USA.

JONES, R. N. & PRESTON, B. L. 2011. Adaptation and risk management. *Wiley Interdisciplinary Reviews: Climate Change,* 2**,** 296-308.

KELMAN, I. 2017. Linking disaster risk reduction, climate change, and the sustainable development goals. *Disaster Prevention and Management: An International Journal,* 26**,** 254-258.

KELMAN, I., GAILLARD, J. & MERCER, J. 2015. Climate Change's Role in Disaster Risk Reduction's Future: Beyond Vulnerability and resilience. *Int J Disaster Risk Sci,* 6**,** 21-27.

KELMAN, I., GAILLARD, J. C., LEWIS, J. & MERCER, J. 2016. Learning from the history of disaster vulnerability and resilience research and practice for climate change. *Natural Hazards,* 82**,** 129-143.

KENTER, J. O., O'BRIEN, L., HOCKLEY, N. & ET. AL. 2015. What are shared and social values of ecosystems? *Ecological Economics,* 111**,** 86-99.
KERN, F. 2011. Ideas, Institutions, and Interests: Explaining Policy Divergence in Fostering 'System Innovations' towards Sustainability. *Environment and Planning C: Government and Policy,* 29**,** 1116-1134.
KIM, D. 1992. *Systems archetypes I: Diagnosing systemic issues and designing interventions*, Pegasus Communications, Inc. .
KOLB, D. A. 1984. *Experiential learning: experience as the source of learning and development,* New Jersey, US, Prentice-Hall.
KRUTILLA, J. V. 1967. Conservation Reconsidered. *American Economic Review,* 57**,** 777-786.
LEACH, M., MEARNS, R. & SCOONES, I. 1997. *Environmental entitlements : a framework for understanding the institutional dynamics of environmental change / Melissa Leach, Robin Mearns and Ian Scoones,* Brighton, Eng, Institute of Development Studies, University of Sussex.
LEACH, M., SCOONES, I. & STIRLING, A. 2010. Governing epidemics in an age of complexity: Narratives, politics and pathways to sustainability. *Global Environmental Change,* 20**,** 369-377.
LONSDALE, K., PRINGLE, P., TURNER, B. 2015. Transformative adaptation: what it is, why it matters and what is needed. University of Oxford, Oxford, UK: UK Climate Impacts Programme.
LUKASIEWICZ, A., DOVERS, S. & EBURN, M. 2017. Shared responsibility: the who, what and how. *Environmental Hazards,* 16**,** 291-313.
LYNE, M. 2018. Island nation leads the way in climate resilience. *ECOS* [Online]. Available from: https://blogs.csiro.au/ecos/tonga-leads-the-way-in-climate-resilience/.
MANUEL-NAVARRETE, D. & PELLING, M. 2015. Subjectivity and the politics of transformation in response to development and environmental change. *Global Environmental Change*.
MANYENA, S. B. 2006. The concept of resilience revisited. *Disasters,* 30**,** 434-450.
MARSHALL, G. 2015. *Don't Even Think About It: Why Our Brains Are Wired to Ignore Climate Change*, Bloomsbury USA.
MARU, Y., O'CONNELL, D., GRIGG, N., N., A., COWIE, A., STONE-JOVICICH, S., BUTLER, J., WISE, R., WALKER, B., MILLION, A. B., FLEMING, A., MEHARG, S. & MEYERS, J. 2017. Making 'resilience', 'adaptation' and 'transformation' real for the design of sustainable development projects: piloting the Resilience, Adaptation Pathways and Transformation Assessment (RAPTA) framework in Ethiopia. Canberra, Australia: CSIRO.
MARU, Y. T., STAFFORD SMITH, M., SPARROW, A., PINHO, P. F. & DUBE, O. P. 2014. A linked vulnerability and resilience framework for adaptation pathways in remote disadvantaged communities. *Global Environmental Change,* 28**,** 337-350.
MCCANN, K. 2000. The diversity-stability debate. . *Nature,* 405**,** 228-33.
MCCARTHY, B. 1981. *4Mat System: Teaching to Learning Styles With Right-Left Mode Techniques,* Barrington, Excel, Inc.
MCCARTHY, B. 1996. *About Learning,* Barrington, Excel, Inc.
MILLENNIUM ECOSYSTEM ASSESSMENT 2006. Ecosystems and Human Well-being: A Framework for Assessment. Island Press, Washington, DC. Washington D.C.
MOEZZI, M., JANDA, K. B. & ROTMANN, S. 2017. Using stories, narratives, and storytelling in energy and climate change research. *Energy Research & Social Science,* 31**,** 1-10.
MONBIOT, G. 2017a. George Monbiot: how do we get out of this mess? . *The Guardian*, 9th September.
MONBIOT, G. 2017b. *The Power of Stories: Why We Need More Than Facts to Win* Verso Books.
NATIONAL RURAL HEALTH ALLIANCE 2016. The health of people living in remote Australia. Deakin West, ACT.

NGOZI ADICHIE, C. 2009. The danger of a single story. TEDGlobal.
NORRIS, F. H. 2016. *Disasters and Domestic Violence* [Online]. National Center for PTSD, U.S. Department of Veterans Affairs. Available: https://www.ptsd.va.gov/professional/trauma/disaster-terrorism/disasters-domestic-violence.asp [Accessed 24 July 2018].
O'CONNELL, D., ABEL, N., GRIGG, N., MARU, Y., BUTLER, J., COWIE, A., STONE-JOVICICH, S., WALKER, B., WISE, R., RUHWEZA, A., PEARSON, L., RYAN, P. & STAFFORD-SMITH, M. 2016. Designing projects in a rapidly changing world: Guidelines for embedding resilience, adaptation and transformation into sustainable development projects. Washington, D.C.
O'CONNELL, D., BRAID, A., RAISON, J., HATFIELD-DODDS, S., WIEDMANN, T., COWIE, A., LITTLEBOY, A. & CLARK, M. 2013. Navigating sustainability: measurement, evaluation and action. Australia: CSIRO.
O'CONNELL, D., LIN, B., CAPON, T. & STAFFORD SMITH, M. 2015. Disaster resilience and mitigation. Technical report on current and future capacity to deliver on risk assessment and mitigation needs. Australia.: CSIRO, Australia.
O'HARE, P., WHITE, I. & CONNELLY, A. 2016. Insurance as maladaptation: Resilience and the 'business as usual' paradox. *Environment and Planning C: Government and Policy,* 34**,** 1175-1193.
OSTROM, E. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*, New York: Cambridge University Press.
OSTROM, E., GARDNER, R. & WALKER, J. 1994. *Rules, games, and common-pool resources*, The University of Michigan Press, Ann Arbor.
PELLING, M. 2014. Transformation: a renewed window on development responsibility for risk management. *J Extreme Events,* 1**,** 1 - 5.
PERSSON, J., SAHLIN, N.-E. & WALLIN, A. 2015. Climate change, values, and the cultural cognition thesis. *Environmental Science & Policy,* 52**,** 1-5.
POULIOS, I. 2010. Moving Beyond a Values-Based Approach to Heritage Conservation. *Conservation and Management of Archaeological Sites,* 12**,** 170-185.
PROUST, K. & NEWELL, B. 2012. Introduction to Collaborative Conceptual Modelling. ANU Research Publications.
PUCHNER, M. 2018. How stories have shaped the world. Britain Broadcasting Company.
RAMM, T. D., GRAHAM, S., WHITE, C. J. & WATSON, C. S. 2017. Advancing values-based approaches to climate change adaptation: A case study from Australia. *Environmental Science & Policy,* 76**,** 113-123.
RAWORTH, K. 2017. *Doughnut economics : seven ways to think like a 21st century economist*, Random House Business.
ROCKSTRÖM, J., W. STEFFEN, K. NOONE, Å. PERSSON, F. S. CHAPIN, III, E. LAMBIN, T. M. LENTON, M. SCHEFFER, C. FOLKE, H. SCHELLNHUBER, B. NYKVIST, C. A. DE WIT, T. HUGHES, S. VAN DER LEEUW, H. RODHE, S. SÖRLIN, P. K. SNYDER, R. COSTANZA, U. SVEDIN, M. FALKENMARK, L. KARLBERG, R. W. CORELL, V. J. FABRY, J. HANSEN, B. WALKER, D. LIVERMAN, K. RICHARDSON, P. CRUTZEN, AND J. FOLEY 2009. Planetary Boundaries: Exploring the Safe Operating Space for Humanity. *Ecology and Society,* 14.
ROTMANN, S. 2017. "Once upon a time…" Eliciting energy and behaviour change stories using a fairy tale story spine. *Energy Research & Social Science,* 31**,** 303-310.
SANDEL, M. 2012. *What Money Can't Buy: the Moral Limits of Markets*, Macmillan.
SCHARMER, O. 2007. *Theory U: Leading From the Future as it Emerges—The Social Technology of Presencing,* San Francisco, CA, Berrett-Koehler Publishers.
SCHARMER, O. 2018. *The Essentials of Theory U: Core Principles and Applications,* San Francisco, CA, Berrett-Koehler Publishers.

SCHWARTZ, S. H. 1992. Universals in the content and structure of values - theoretical examples and empirical tests from 20 Countries. *Advances in experimental social psychology,* 25**,** 1-65.
SCHWARTZ, S. H. 1994. Are there universal aspects in the structure and contents of human values? *Journal of Social Issues,* 50**,** 19-45.
SCHWARTZ, S. H. 2012. An Overview of the Schwartz Theory of Basic Values. *Online Readings in Psychology and Culture,* 2.
SERRAO-NEUMANN, S., CRICK, F., HARMAN, B., SCHUCH, G. & CHOY, D. L. 2015. Maximising synergies between disaster risk reduction and climate change adaptation: Potential enablers for improved planning outcomes. *Environmental Science & Policy,* 50**,** 46-61.
SNOWDEN, D. J. & BOONE, M. E. 2007. A leader's framework for decision making. *Harvard Business Review*.
STEFFEN, W. R., K.; ROCKSTROM, J.; CORNELL, S. E.; FETZER, I.; BENNETT, E. M.; BIGGS, R.; CARPENTER, S. R.; DE VRIES, W.; DE WIT, C. A.; FOLKE, C.; GERTEN, D.; HEINKE, J.; MACE, G. M.; PERSSON, L. M.; RAMANATHAN, V.; REYERS, B.; SORLIN, S. 2015. Planetary boundaries: Guiding human development on a changing planet. *Science* 347.
STERN, P. 2000. Toward a coherent theory of environmentally significant behavior. *Journal of Social Issues* 56**,** 407-424.
STERN, P. C., DIETZ, T., ABEL, T., GUAGNANO, G. A. & KALOF, L. 1999. A Value-Belief-Norm Theory of Support for Social Movements: The Case of Environmentalism. *Research in Human Ecology,* 6**,** 81-97.
STIRLING, A. C. & SCOONES, I. 2009. From Risk Assessment to Knowledge Mapping: Science, Precaution, and Participation in Disease Ecology *Ecology and Society,* 14.
TRIMBLE, M. & PLUMMER, R. 2018. Participatory evaluation for adaptive co-management of social–ecological systems: a transdisciplinary research approach. *Sustainability Science***,** 1-13.
TSCHAKERT, P., BARNETT, J., ELLIS, N., LAWRENCE, C., TUANA, N., NEW, M., ELRICK-BARR, C., PANDIT, R. & PANNELL, D. 2017. Climate change and loss, as if people mattered: values, places, and experiences. *Wiley Interdisciplinary Reviews: Climate Change,* 8**,** e476.
VAN KERKHOFF, L. E. & LEBEL, L. 2015. Coproductive capacities: rethinking science-governance relations in a diverse world. *Ecology and Society,* 20**,** 14.
WALKER, B., GUNDERSON, L., KINZIG, A., FOLKE, C., CARPENTER, S. & SCHULTZ, L. 2006. A handful of heuristics and some propositions for understanding resilience in social-ecological systems. *Ecology and Society,* 11**,** 15.
WALKER, B. & SALT, D. 2012. *Resilience thinking: sustaining ecosystems and people in a changing world*, Island Press.
WERNERS, S. E., PFENNINGER, S., VAN SLOBBE, E., HAASNOOT, M., KWAKKEL, J. H. & SWART, R. J. 2013. Thresholds, tipping and turning points for sustainability under climate change. *Current Opinion in Environmental Sustainability,* 5**,** 334-340.
WESTLEY, F., ZIMMERMAN, B. & PATTON, M. 2009. *Getting to maybe: How the world is changed*, Vintage Canada.
WIEK, A., WITHYCOMBE, L. & REDMAN, C. L. 2011. Key competencies in sustainability: a reference framework for academic program development. *Sustainability science,* 6**,** 203-218.
WISE, R. M., FAZEY, I., STAFFORD SMITH, M., PARK, S. E., EAKIN, H. C., ARCHER VAN GARDEREN, E. R. M. & CAMPBELL, B. 2014. Reconceptualising adaptation to climate change as part of pathways of change and response. *Global Environmental Change,* 28**,** 325 - 336.
ZAK, P. J. 2015. Why Inspiring Stories Make Us React: The Neuroscience of Narrative. *Cerebrum: the Dana Forum on Brain Science,* 2015**,** 2.
ZIMMERMAN, M. J. 2001. *The nature of intrinsic value*, Rowman & Littlefield, Lanham, Maryland.

CONTACT US

t 1300 363 400
+61 3 9545 2176
e csiroenquiries@csiro.au
w www.csiro.au

AT CSIRO, WE DO THE EXTRAORDINARY EVERY DAY

We innovate for tomorrow and help improve today – for our customers, all Australians and the world.

Our innovations contribute billions of dollars to the Australian economy every year. As the largest patent holder in the nation, our vast wealth of intellectual property has led to more than 150 spin-off companies.

With more than 5,000 experts and a burning desire to get things done, we are Australia's catalyst for innovation.

CSIRO. WE IMAGINE. WE COLLABORATE. WE INNOVATE.

FOR FURTHER INFORMATION

CSIRO Land and Water
Dr Deborah O'Connell
t +61 429 814 989
e Deborah.O'Connell@csiro.au
w www.csiro.au

CSIRO Land and Water
Dr Russ Wise
t +61 2 6246 4374
e Russell.Wise@csiro.au
w www.csiro.au

CSIRO Land and Water
Dr Veronica Doerr
t +61 2 6246 4099
e Veronica.Doerr@csiro.au
w www.csiro.au